COMPARATIVE ANALYSIS OF FACTORS ASSOCIATED WITH INSECTICIDE-TREATED NET UTILIZATION BETWEEN RURAL AND URBAN AREAS IN GHANA: IMPLICATION FOR MALARIA CONTROL AND PREVENTION

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DEDICATION

This thesis is dedicated to my family.

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ABSTRACT

Malaria is a global health and development challenge, so the World Health Organization (WHO) has recommended the use of Insecticide-Treated Nets (ITNs) for its prevention. In Ghana, despite efforts to increase ITN ownership, ITN utilization among urban residents is still low, creating a wide disparity between rural and urban residents in Ghana. Therefore, this study aimed to investigate factors that influence ITN use in rural and urban contexts in Ghana.

The study was a cross-sectional design and used data from the 2019 Ghana Malaria Indicator Survey (GMIS). A representative sample of 25,316 households across various regions of Ghana was selected using a multistage cluster sampling technique. Descriptive statistics were initially conducted to determine the characteristics of the data. Bivariate analysis, specifically a chi-square test of association, was conducted to examine the association between residence and ITN use. Separate bivariate analyses were conducted to determine factors associated with ITN use in each residence type. A hierarchical multiple binary logistic regression was further conducted to determine factors associated with ITN use.

The key findings of the study showed a significant association between residence and ITN utilization [$\chi 2$ (1, N = 25284) = 1373.78, $p < 0.001$]. Rural residents were more likely to use ITNs than urban residents. Also, the study revealed that the education level of household heads is significantly associated with ITN use in both rural and urban areas. Additionally, the study demonstrated that in both rural and urban areas, households in the second, middle, fourth and richest wealth quintiles are likely to use ITNs. Interestingly, the results of the study showed that households without a child under five were significantly more likely to use ITNs in urban areas.

Based on these findings, the study stressed the need for targeted interventions to improve ITN utilization among urban residents in Ghana and emphasized the importance of education and wealth status in shaping ITN use. Overall, these findings highlight the complex interplay of social, economic and demographic factors that influence ITN utilization in Ghana. They underscore the need for multifaceted approaches that take into account the specific needs and challenges faced by different populations in both rural and urban settings, as espoused by McLeroy et al.'s (1988) social ecological model of health promotion.

Keywords: Household ITN use, rural and urban ITN use, health promotion, Ghana

ABBREVIATIONS AND ACRONYMS

ABBREVIATION/ACRONYM	FULL MEANING
ANC	Antenatal Clinic
CAPI	Computer-Assisted Personal Interviewing
CDC	Centers for Disease Control and Prevention
CSPro	Census and Survey Processing
CWC	Child Welfare Clinic
DFID	Department for International Development
DHS	Demographic and Health Survey
EA	Enumeration Area
GBD	Global Burden of Disease
GHS	Ghana Health Service
GNI	Gross National Income
GSS	Ghana Statistical Service
IPTp	Intermittent Preventive Treatment in pregnancy
IRS	Indoor Residual Spraying
ITN	Insecticide-Treated Net
LLIN	Long-lasting insecticidal nets
NMCP	National Malaria Control Program
NMIMR	Noguchi Memorial Institute for Medical Research
NPHRL	National Public Health and Reference Laboratory
NSD	Norwegian Centre for Research Data
P	Plasmodium
PHC	Population and Housing Census
PMI	President's Malaria Initiative
SDG	Sustainable Development Goal
SMC	Seasonal Malaria Chemoprevention
SP	Sulfadoxine-pyrimethamine
SSA	Sub-Saharan Africa
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
WHO	Word Health Organization

CHAPTER ONE: INTRODUCTION

1.0 Background to the Study

Malaria is a parasitic infection that is transmitted by the Anopheles mosquito, which leads to an acute life-threatening disease and poses a significant global health challenge (Buck & Finnigan, 2022). According to the wealth Health Organization (WHO), malaria is an acute febrile illness caused by a parasite called Plasmodium (P), which is transmitted to humans through the bites of infected female Anopheles mosquito (WHO, 2020). Malaria is called a parasitic infection because it is caused by a parasite and this parasite depends on its host (humans and mosquitoes) to survive and multiply (Sato, 2021). In other words, malaria is classified as a parasitic infection because it is caused by a protozoan, a type of single-celled organism, belonging to the Plasmodium genus, which depends on a human host to survive and reproduce (Rios-Barros et al., 2022).

There are five distinct species of malaria parasite that have been identified as capable of infecting humans, which include P. falciparum, P. ovale, P. vivax, P. malariae, and P. knowlesi (Kho et al., 2022). According to the WHO, each of these species of malaria has its own unique characteristics and geographic distribution (WHO, 2020). The P. falciparum is the most deadly of the human malaria parasites due to its short replication cycle, leading to more severe symptoms (Sato, 2021). It can also adhere to and block blood vessels, leading to organ damage and cerebral malaria and has a higher risk of developing resistance to antimalarial drugs (Nishanth & Schlüter, 2019). The P. ovale is a less common species of the malaria parasite that typically causes mild symptoms but has the ability to stay inactive in the liver, which can result in recurrent malaria episodes (Bartoloni & Zammarchi, 2012). The P. vivax is generally considered less deadly than the P. falciparum, but can still cause severe symptoms, particularly in young children and pregnant women (Dayanand et al., 2018). The P. falciparum predominates sub-Saharan Africa and causes the highest morbidity and mortality (Zekar & Sharman, 2020). The P. vivax is present in Southern Asia, the Western Pacific and Central America (Battle et al., 2019) while the P. ovale and the P. malariae are present in Sub-Saharan Africa (Quaye et al., 2021). The P. knowlesi is present in South-East Asia (Zaw & Lin, 2019). Climate is a key determinant of both the geographic distribution and the seasonality of malaria. Without sufficient rainfall, mosquitoes cannot survive and if not sufficiently warm, parasites cannot survive in the mosquito (Yamana & Eltahir, 2013).

The principal mode of malaria transmission is through the bite of the female Anopheles mosquito (Lefevre et al., 2018). When the infected female Anopheles mosquito bites a person, it introduces the parasites into the person's bloodstream, which then travel to the liver (Baer et al., 2007). In the liver, the parasites mature and in turn release another form of parasites, called merozoites. The parasites enter the bloodstream and infect the red blood cells, where they multiply. The cells then break open within 48 to 72 hours and infect more red blood cells. The first symptoms usually occur 10 days to 4 weeks after infection, though they can appear as early as 8 days or as long as a year after infection (Milner, 2018). Other potential modes of malaria transmission are transfusion of blood from infected persons, the use of contaminated needles or syringes and from mother to the unborn child (Abrol & Lal, 2012). The signs and symptoms of malaria are variable but most often, patients experience fever, headache, back pain, chills, sweats, nausea, vomiting, diarrhea and cough (WHO, 2020).

Malaria is an urgent global development and public health challenge due to its negative health and economic impact on countries (Perera et al., 2022). According to the WHO, malaria is a leading cause of suffering, death, poverty and underdevelopment in the world today (WHO, 2020). Globally, 241 million cases of malaria and 627,000 deaths were reported in the year 2022 and Africa alone accounted for 95% of the cases (Lancet, 2022). Malaria is a globally prevalent disease but it is more prevalent in some parts of the world than others due to the variation in the distribution of factors that support breeding of the mosquito parasite (Short et al., 2017). While malaria is uncommon in temperate climates, it is rife in tropical and subtropical countries. Forty percent of the global population resides in or visits malaria-endemic regions annually (Buck & Finnigan, 2022). According to Choutos (2023), roughly half of the world's population lives in areas where malaria is prevalent.

Despite being a preventable and treatable disease (Vilay et al., 2019), malaria continues to have a devastating impact on the health, economies and livelihood of people across the world (Pell, 2023). Every year, about 500 million people become severely ill from malaria and more than one million people die from the disease (Fatima, 2022). The most vulnerable groups are young children, who have not developed immunity to malaria yet and pregnant women, whose immunity has been decreased by pregnancy (Perera et al., 2022). Apart from being a global health problem, malaria is also a global development challenge (Paaijmans & Lobo, 2023). The adverse impact of malaria permeates diverse aspects of the world

economy, including health, education, tourism and poverty. Malaria negatively affects individuals, households, families, communities and nations in terms of health and cost of treatment and prevention. It deprives malaria-endemic countries revenue and healthy lives needed to increase productivity (Ochi et al., 2015). The direct cost that malaria places on world economies is estimated to be at least $12 billion annually (Perin et al., 2022). On top of this, areas of the world with a high risk of malaria are estimated to receive 48% fewer tourists than those without, resulting in approximately $3.5 billion loss of revenue from tourism (Akpan, 2022).

Malaria continues to be a major health challenge in many parts of the world. As a result, it remains on the global agenda as a priority issue that requires sustained attention, resources and action from governments, organizations and individuals (De Cock et al., 2013). In other words, malaria impacts development and this explains its inclusion in the global discourse as evidenced by the Sustainable Development Goals (SDG) agenda (Bautista-Puig et al., 2021). The SDG3 (good health and wellbeing) aims to ensure healthy lives and promote well-being for all. Its targets include reducing maternal mortality, ending preventable deaths of newborns and children under 5 years of age, ending epidemics of communicable diseases, combating non-communicable diseases among others. Malaria is a major cause of mortality among children under five globally (Dasgupta et al., 2022). According to the United Nations International Children's Emergency Fund (UNICEF), nearly every minute, a child under five dies of malaria (UNICEF, 2023). Health is a key asset for sustainable development as it is reaffirmed in the cliché, “a healthy nation is a wealthy nation.” Decreasing the malaria burden will directly contribute to achieving SDG target 3.3, which specifically aims to end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases by 2030. SDG3 has a target to reduce global malaria incidence and mortality rates by 90% from 2015 to 2030 (Laporta et al., 2022).

In sub-Saharan Africa (SSA), malaria is a major public health challenge because the region bears the largest share of the world malaria burden (Oladipo et al., 2022). Africa was the continent with the highest burden of malaria cases in 2020, accounting for 95% of all cases worldwide (Baba et al., 2020). Additionally, Africa recorded 96% of global malaria deaths, indicating the gravity of malaria burden on the continent (Kolawole et al., 2023). Malaria has a significant economic impact in SSA, with estimates suggesting that the disease costs the region up to $12 billion annually in direct and indirect costs

(Nonvignon et al., 2016). Direct costs include medical expenses, while indirect costs include lost productivity and income. Malaria places a huge strain on health systems in SSA, with many countries struggling to provide adequate prevention, diagnosis and treatment services (Tyagi, 2023). This is compounded by factors such as drug resistance, inadequate funding and weak health infrastructure. Malaria is a severe public health threat in both rural urban areas of SSA (Larson et al., 2021). In most urban areas of developing countries, poor housing, lack of sanitation and drainage of surface water could increase vector breeding (File et al., 2019). For example, it has been reported that in most rapidly growing cities in sub-Saharan Africa, the combination of rapid population growth, inadequate sanitation and poor housing conditions create conditions conducive to the spread of malaria (Shadmi et al., 2020). It has also been documented that farming activities and poor housing conditions are significant risk factors for mosquito bites and malaria transmission (Mabayoje, 2019).

In Ghana, malaria is one of the main health challenges, accounting for a significant burden of disease and mortality in the country (Kawaguchi et al., 2022). According to the WHO, Ghana is among the top 10 countries in the world with the highest burden of malaria (WHO, 2020). With an increase of malaria cases by 8%, Ghana was among the two highest burden countries in Africa reporting the highest absolute increase in malaria cases in 2018 (Heinemann et al., 2020). Malaria is both endemic and perennial throughout Ghana, putting the entire population at risk. In 2021, the WHO estimated that there were an estimated 5.3 million malaria cases with 12,500 estimated deaths recorded. It is estimated that on average, 3.5 million cases of malaria are recorded each year in Ghana (Awuah et al., 2018). The high incidence of malaria in Ghana is linked to changes in climate, altitude, topography, human settlement and environmental factors (Kumi-Boateng et al., 2015). Ghana has a topography that is characterized with lot of tropical forests, rivers, wetlands and high humidity, which creates ideal conditions for the breeding and survival of mosquitoes. Also, mosquitoes require warm temperatures to develop and mature (Carrington et al., 2013), and they prefer a humid environment because it helps keep their bodies hydrated (Lemery & Auerbach, 2017). The high rainfall in Ghana creates standing water, which is essential for mosquito larvae to develop into adults. Mosquitoes lay their eggs in water and the larvae need to be in water to develop and survive (Coon et al., 2014). According to Vinti et al. (2023), improper sanitary conditions, such as open defecation, poor waste management, indiscriminate refuse and water disposal, choked gutters and stagnant waters provide breeding sites for mosquitoes.

Malaria is a significant health issue in Ghana and has a profound impact on various sectors of the country's economy. According to the Global Burden of Disease (GBD), malaria represents the largest cause of death and morbidity in Ghana as measured by disability-adjusted life years (Diawara et al., 2021). In 2017, the disease was responsible for around 19,000 deaths, almost as much as the combined death toll from HIV/AIDs and tuberculosis (Basiru et al., 2022). According to the World Health Organization (WHO), malaria was responsible for about 44% of outpatient visits, 13% of admissions and 25% of all deaths among children under five years of age in Ghana (WHO, 2021). The 2019 World Malaria Report also estimated that there were 5.5 million confirmed cases of malaria in Ghana, with malaria incidence rate of 213 cases per 1,000 population at risk (Yeboah et al., 2023).

In addition to being the number one cause of disease and death burden in Ghana, malaria is also a major cause of poverty in the country (Aheto, 2022; Akazili et al., 2007). This stems from the financial expenditure required for the prevention and treatment of malaria by the government, households and individuals. The economic burden is particularly severe for the poorest households, who have limited resources to pay for treatment and may have to choose between paying for treatment or other essential needs like food, education, or shelter (Ankomah et al., 2015). The cost of malaria prevention and treatment is not only borne by households but also by the government, which must allocate significant resources to address the disease. The cost of treatment and prevention exerts a major drain on Ghana’s economy, impacting the government's ability to invest in other essential services like education, infrastructure, social welfare and other developmental projects (Eggers & Macmillan, 2013). According to Asante and Asenso-Okyere (2003)), a 1% increase in malaria morbidity reduces economic growth by about 0.41%. This is attributed to the government’s loss of funds through malaria treatment and prevention and the loss of productivity associated with malaria-related employee absenteeism. It is also on record that malaria is the leading cause of workdays lost due to illness (Asante & Asenso-Okyere, 2003). The significant mortality and morbidity rates associated with malaria place a huge drain on Ghana’s economy, which retards economic development in the country.

The costs of treating malaria can be prohibitive for many households in Ghana, especially those living in poverty. The costs of treatment may include the cost of drugs, hospitalization and transportation to healthcare facilities. The cost of treatment can be particularly high if the disease is severe, requiring

hospitalization or specialized care. It was estimated that a single episode of malaria costs households between US$10.20 and US$46.62 in treatment (Abotsi, 2012). Malaria also exerts significant adverse impacts on education in Ghana. Both teachers and students who suffer from frequent malaria attacks are often absent from school, which affects their academic performance and ultimately ruins their chances of getting a good job. Malaria leads to cognitive impairment, which affects a child's ability to learn and perform well in school (Tapajós et al., 2019).

Agriculture is the backbone of Ghana's economy and malaria has a significant impact on agricultural productivity. For instance, a research in Ghana has shown that malaria causes 90.2% of farmers with the disease to refrain from work (Asiamah et al., (2014). Malaria leads to absenteeism among farmers, reducing their ability to attend to their crops and ultimately reducing yields and productivity (Bukari et al., 2021). Malaria also increases the cost of production by requiring farmers to invest in protective measures like insecticide-treated nets or to use more expensive labour to replace sick workers. Mabe and Dafurika (2020) argue that malaria has considerable impacts on agricultural output since it results in the loss of valuable time for both the infected individual and their caregiver, thereby affecting their productivity.

Scholarly evidence on the economic burden of malaria on businesses in Ghana shows that malaria takes a huge toll on businesses in terms of productivity and labour. According to Nonvignon et al. (2016), businesses in Ghana lost about US$6.58 million to malaria in 2014, 90% of which were direct costs and a total of 3913 workdays were lost due to malaria during the period 2012–2014. For example, in the year 2004, AngloGold Ashanti, a mining company in Ghana, incurred up to $55,000 per month on treatment of malaria in its employees and their dependents (Nonvignon et al., 2016). This was further exacerbated by the huge loss of productivity due to absenteeism associated with sick employees.

In the health sector, malaria accounted for 41% of outpatient cases, 21% confirmed malaria cases and 18% inpatient cases in 2021. The impact of malaria on maternal health in Ghana is also huge, as malaria in pregnancy is a significant contributor to maternal morbidity and mortality in Ghana. Malaria is a major cause of morbidity and mortality among pregnant women in Ghana and it poses a significant risk to both the mother and the fetus (Moya-Alvarez et al., 2014). Malaria infection during pregnancy can lead to severe anemia, which can increase the risk of maternal mortality. It also causes miscarriage, stillbirth and

preterm delivery, which can result in low birth weight and other complications for the newborn. According to the Ghana Health Service, pregnant women are particularly vulnerable to infection. In 2019, there were over 880,000 confirmed cases of malaria among pregnant women in Ghana, with over 2,300 deaths (Osarfo et al., 2022).

Upon reflecting on the global, continental and national impact of malaria, it becomes clear that malaria is not just a health issue but a multifaceted challenge that has significant economic implications. The high cost of treatment and prevention, coupled with the impact on productivity and workdays lost due to illness and death, places a considerable strain on households and the government's resources, hindering economic growth and development. It is essential to consider a sustainable approach to address the burden of malaria, which will ultimately promote sustained improvement of human well-being and economic progress on a global scale.

1.1 Malaria Prevention Approaches in Ghana

Malaria prevention in Ghana involves the use of ITNs, Indoor Residual Spraying (IRS), Intermittent Preventive Treatment in Pregnancy (IPTp) and Seasonal Malaria Chemoprevention (SMC) (Nice et al., 2020). IRS is the application of insecticide to the inside of dwellings, on walls and other surfaces that serve as a resting place for malaria-infected mosquitoes and kills mosquitoes when they come in contact with treated surfaces, preventing disease transmission (Killeen, 2014). IPTp is a preventive regimen which entails the administration of a dose of the antimalarial drug called sulfadoxine-pyrimethamine (SP) to all at-risk pregnant women in their second and third trimesters (Desai et al., 2015). Seasonal malaria chemoprevention is the intermittent administration of full treatment courses of an antimalarial medicine to children during the malaria season in areas of highly seasonal transmission (Barry et al., 2018). It involves administering a maximum of four treatment courses of SP in addition to amodiaquine at monthly intervals to children aged 3–59 months during the peak malaria transmission season (Barry et al., 2018). An ITN is a mosquito net that repels, disables and/or kills mosquitoes coming into contact with the insecticide on the netting material (Shonga et al., 2018). It is hung above a sleeping space, usually a bed or mat and provides a physical barrier between the malaria-carrying mosquito and the person at risk of getting the disease. ITNs protect the person sleeping under the net even if the net has small holes in it because the insecticide in it kills mosquitoes that land on it before they reach the person sleeping inside (Lindsay et al., 2021). Since insecticide-treated nets kill the mosquitoes, they help reduce malaria

transmission community-wide. There are two types of ITNs, which are the conventionally treated nets and the long-lasting insecticidal nets (LLINs). A conventionally treated net is a mosquito net that has been treated by dipping in a WHO-recommended insecticide while the LLIN is a factory-treated mosquito net made with netting material that has insecticide incorporated within or bound around the fibres. In malaria-endemic areas such as Ghana, ITNs and IRS are the two malaria vector control interventions that have been recommended by the WHO for large-scale use (Sougoufara et al., 2020).

1.2 Justification of the Focus on ITN Approach

As a health promotion-oriented study, this study focused on ITNs because they have been confirmed as an effective approach for preventing malaria (Kumar & Preetha, 2012). According to the WHO, the use of ITN can reduce malaria transmission by up to 90% (WHO, 2020). In randomized controlled trials, it has been found that ITNs are effective in preventing malaria with an efficacy rate of 50-60% (Lengeler, 2004). The use of ITNs for preventing malaria is highly effective in Africa, mainly due to the fact that the primary malaria-transmitting mosquitoes in this region tend to feed indoors (Gleave et al., 2021). Given the crucial emphasis of health promotion on disease prevention and promotion of good health and wellbeing (Kumar & Preetha, 2012), it was necessary to focus on a feasible malaria preventive approach. ITNs work by physically preventing mosquitoes from coming into contact with individuals while they sleep, as well as through the use of insecticides that kill or repel mosquitoes. By preventing mosquitoes from biting and transmitting the malaria parasite, ITNs are an effective way to prevent malaria infections. Also, compared to other malaria prevention strategies, such as IRS or chemoprevention, ITNs are more cost-effective and therefore remain a feasible and sustainable way of fighting malaria in low-income countries (Musoke et al., 2023). Ghana is classified as a low-income country with a gross national income (GNI) per capita of US$ 1,610 in 2020 (World Bank, 2021). Economic conditions in Ghana may hinder the implementation of more expensive malaria prevention interventions because of the limited financial resources available to the government and households. For instance, the cost of implementing IRS for malaria prevention, can be relatively high compared to ITNs (White et al., 2011). IRS also requires trained personnel and the cost of training and retaining these personnel may be expensive for the government. In contrast, ITNs are relatively affordable and can be distributed to households through various channels, including mass campaigns and routine antenatal care visits (WHO, 2020). Additionally, households in Ghana may not have the financial resources to purchase more expensive malaria prevention interventions.

For example, households may not be able to afford to install screens on their doors and windows to prevent mosquito entry, or purchase mosquito repellents and other insecticides. In contrast, ITNs are provided free of charge or at a subsidized cost to vulnerable populations such as pregnant women and children under five years of age in Ghana (Ghana Health Service, 2020). This makes ITNs a more practical and cost-effective option for malaria prevention in the country and therefore the need to focus this study on such malaria prevention approach. Additionally, they are relatively easy to distribute and require minimal maintenance, making them accessible to communities in low-resource settings.

Moreover, this study focused on ITN utilization because ITN use empowers individuals to take control over their health and wellbeing. The use of ITNs provides individuals with knowledge, skills and a tangible tool for malaria prevention, giving them a sense of control over their health (WHO, 2020) . Watanabe (2014) asserts that ITN use is sometimes a community-wide effort, with community members working together to distribute, promote and use the nets. This community involvement creates a sense of ownership and responsibility for health promotion efforts, further empowering individuals and communities to take control of their health (McKenzie et al., 2022). In relation to health promotion, this aligns with the goals of health promotion, which seeks to empower individuals and communities to take control of their health and promote wellbeing through disease prevention and health promotion efforts. In the case of malaria prevention, the individual level health promotion action includes providing access to ITNs and encouraging their regular and proper use every night from dusk to dawn through social marketing campaigns to promote their use (Kumar & Preetha, 2012). Health promotion supports individuals, communities and governments to cope with and address health challenges. This is accomplished by strengthening community action, developing personal skills, building healthy public policies and creating supportive environments (Kumar & Preetha, 2012).

In effect, ITNs are relatively inexpensive and do not require technical knowledge or sophisticated infrastructure to use, making them a sustainable health promotion intervention (Tweneboah-Koduah et al., 2022) that does not only empower individuals and communities, but also focuses on education and individual responsibility. In developing countries with low income levels such as Ghana, the use of ITNs as a malaria prevention strategy is a sustainable approach due to their long-lasting effectiveness and reduced need for frequent replacement. ITNs can remain effective for up to three years, even with regular

washing (Tadele et al., 2014). This reduces the need for replacement, making the intervention more sustainable in low-resource settings, where replacement costs may be a barrier to sustained use.

Also, the study focused on ITNs partly due to the increasing resistance to antimalarial drugs and insecticide by the plasmodium falciparum (Paton et al., 2022). With ITNs, apart from the insecticide in them, the net physically blocks mosquitoes from getting access to the people who sleep under them, so even if insecticidal resistance occurs, ITNs are still effective in preventing mosquito bites (Unwin et al., 2022). According to Alout et al. (2017), parasitic resistance against insecticide is rapidly gaining ground among malaria vectors in Africa, making ITNs the best method of malaria prevention due to their ability to repel, block and kill mosquitoes. Besides, ITNs are easy to distribute and explain by community health workers and have the added advantage in the sense that no specific equipment or technical skill is required in using them (Van Remoortel et al., 2015). According to Rosenthal (2022), ITNs are a key and practical tool for preventing malaria, especially in developing countries because they are cheap and easy to use.

1.3 ITNs' Mode of Action

An ITN is a mosquito net impregnated with insecticide that repels, disables or kills mosquitoes coming into contact with it (Taremwa et al., 2020). ITNs are deployed like a tent under which people sleep for protection against mosquito bites. They reduce contact between the person and mosquito by acting as a physical barrier (Gatton et al., 2013). When mosquitoes come into contact with an ITN, the insecticide on the net kills them. Additionally, the insecticide on the nets acts as a repellent, keeping mosquitoes away from individuals sleeping under ITNs and reducing the likelihood of mosquitoes entering and remaining inside a house (Okumu et al., 2013). The repellent effect adds a chemical barrier to the physical one, further reducing human–vector contact and increasing the protective effect of the mosquito nets. That is, the ITNs are treated with an insecticide called pyrethroid insecticide (Lissenden et al., 2021). This insecticide has an excito-repellent effect that enables it to repel mosquitos that come into contact with it and also kills mosquitoes that attempt to feed on the person sleeping under it (Paaijmans & Huijben, 2020) during their blood-feeding cycle.

The effectiveness of ITNs in malaria prevention have been investigated and confirmed in numerous studies (Ezezika et al., 2022). In their epidemiological model of the effects of ITNs on malaria transmission, Birget and Koella (2015) documented that ITNs are an essential tool for malaria control

because they give personal and wider community protection through their repellent and insecticidal properties. According to Musa et al. (2009), when properly used, ITNs reduce malaria transmission by at 60%. They have been the most effective tool in reducing malaria morbidity and mortality in SSA (Lindsay et al., 2021). They were responsible for averting 69% of 663 million malaria cases in Africa between the years 2000 and 2015 (Bhatt et al., 2015). In addition to this, ITNs are able to reduce severe malaria in areas of stable malaria transmission by up to 45% (Scott et al., 2021). According to Eisele et al. (2010), ITNs are very effective in reducing malaria-related morbidity in children under five years of age up to 55%. Furthermore, ITNs afford a community-wide protection against malaria when their usage is high (Lengeler, 2004). This is because as ITN usage in a community goes high, the insecticide in the net kills mosquitos in the community when they come in contact with it thereby reducing the number of moquistoes and theeir parasite in circulation in the community (Hawley et al., 2003; Howard et al., 2000). Also, according to the Centers for Disease Control and Prevention (CDC), if large numbers of people in a community sleep under ITNs, the number of mosquitoes, as well as their lifespan, will be reduced. When this happens, all members of the community receive some protection, whether or not they own or use an ITN. ITNs also have a good record of reducing the intensity of transmission within the whole community because the physical barrier offered by the net deprives mosquitoes the blood meal needed for a longer lifespan (Birget & Koella, 2015). According to the WHO, field trials indicate that insecticide-treated nets and curtains have the potential to reduce childhood mortality by 15 percent to 35 percent (Alelign & Dejene, 2016). Also, the use of insecticide treated nets in highly malaria endemic areas in Nigeria resulted in a 50% reduction of new cases of uncomplicated malaria as compared to settings that did not use nets (Adeneye et al., 2014).

In view of the effectiveness of ITNs in preventing malaria, the WHO recommends the supply of ITNs free of charge or at a highly subsidized fee in malaria-endemic places using a variety of approaches, including mass campaigns and routine distribution channels in order to achieve greater equity of coverage (Singh et al., 2013). In response to this WHO recommendation, efforts to scale up ITN ownership were set in motion in Ghana (Dun-Dery et al., 2022). The Ghana Health Service (GHS) embarked on a number of ITN distribution strategies, including free ITN mass distribution, school-based distribution, distributions at antenatal clinics (ANC), child welfare clinics (CWC) among others. In addition to the mass ITN distribution, the GHS rolled out an education campaign on how to hung, use and maintain ITNs in Ghana.

It is worthy to mention that Ghana's efforts to fight malaria are mainly funded by the Global Fund (Atun et al., 2011). Ghana receives a huge funding from the Global Fund for AIDS, Tuberculosis and Malaria in its fight against malaria (Shretta et al., 2020). The global Fund grants regular disbursements of USD 506 million to Ghana for malaria prevention (Paintain et al., 2022). Ghana also receives financial support from other donors, including the UK Department for International Development (DFID), the United States President's Malaria Initiative (PMI), United Nations Children's Fund (UNICEF) and World Bank (Paintain et al., 2022).

From the year 2000, Ghana has made substantial strides in scaling up ITN access by employing various ITN distribution strategies. These strategies include mass distribution campaigns, utilization of community health workers, innovative distribution channels, behaviour change communication campaigns and collaboration with development partners. The goal is to ensure that all individuals in the population, irrespective of age or gender, sleep under an ITN and to provide effective protection against malaria for at least 80% of the population at risk (Afagbedzi et al., 2022). As a result of these strategies, over 12.5 million ITNs were distributed nationwide through a door-to-door 'hang-up' strategy in 2018 (Beyl et al., 2018). Also, Ghana witnessed a notable improvement in 2019, with more than 16 million ITNs distributed nationwide (Afagbedzi et al., 2022). According to the Ghana Health Service (GHS), in 2020, as cited by Gyasi (2020), a total of 9,123,442 ITNs were distributed across the country as part of efforts to prevent malaria. This distribution was part of the government's efforts to achieve universal coverage of ITNs among households in the country. The GHS further reported that the ITN distribution was carried out through various channels, including mass campaigns, routine distribution and antenatal care clinics (Ghana Health Service, 2020). These efforts were aimed at ensuring that all households had access to ITNs to protect themselves and their families from malaria. The proportion of households with at least one ITN increased from 36% in 2014 to 79% in 2019 (Baiden, 2019). The proportion of pregnant women and children under five years who slept under an ITN the previous night increased from 35% and 33% respectively in 2014 to 63% and 62% in 2019 (Gyaase et al., 2023). Also, household ownership of at least one ITN remarkably surged from 19% in 2006 to 74% in 2019 (Paintain et al., 2022). The increased distribution of ITNs also resulted in a 30% reduction in malaria cases (Shretta et al., 2020), which underscores the effectiveness of ITNs for preventing malaria in Ghana.

Despite the efforts of the government of Ghana to ensure that many people in the country own and consistently use ITNs for malaria prevention, significant variations in ITN use have been observed between rural and urban areas (Ahorlu et al., 2019). This is indicative of the wider and persistent disparities in both health care delivery and outcomes that have been reported between rural and urban settings (Aboumrad et al., 2023). One notable trend, as revealed by the Ghana Malaria Indicator Surveys (GMIS 2014, 2016 & 2019), is a wide disparity of ITN use between urban and rural residents. For example, the 2019 GMIS reported that the majority (56.7%) of rural residents as compared to 27.8% of urban people who use them. The general assumption is that people in urban areas are expected to have positive attitudes towards disease control measures (Abdelhafiz et al., 2020). This assumption is premised on the points that urban residents have access to health education, information from different media sources, healthcare facilities and possibly high income levels as against people who live in rural areas (Hartley, 2004). Rural residents are more likely to experience some of the contributing social factors that impact health, such as poverty, illiteracy and poor infrastructural (Eshetu & Woldesenbet, 2011). The impact of these challenges can be compounded by the barriers already present in rural areas, such as limited public transportation options and fewer choices to health education (Pullen & Oser, 2014)). It is also documented in the Journal of Rural Health that living in rural areas can make it difficult to provide regular healthcare services, affect the quality of healthcare provided and impact the way people seek healthcare (Aboumrad et al., 2023).

Despite the numerous factors and assumptions that place urban residents in a better position to use ITNs more than rural residents, the reality in Ghana is that more rural residents tend to use ITNs. The 2019 GMIS revealed that rural households have a higher utilization of ITNs as against the urban households. In any case, the majority of people in the higher income prefer to reside in the urban areas of Ghana (Yin et al., 2022). It is also argued that people living in urban areas do not use ITNs because perhaps their economic status allows them to afford other methods of malaria prevention (Silva & Marshall, 2012). On the other hand, rural dwellers, with their little income, may not be able to afford other malaria preventive methods, compelling them to use ITNs, which are usually distributed free of charge and very affordable in circumstances where they are to be bought. Some scholars have attributed the high use of ITN in rural areas to the free distribution of ITNs and also rural residents are less able to afford malaria treatment and therefore take ITNs more seriously than those residing in the urban areas (Kimbi et al., 2014).

These observed disparities in ITN use between rural and urban residents fuel the assumption that the factors that influence or are associated with ITN use are not the same for urban and rural areas. That is, there are differences in the factors that influence the use of ITNs between people who live in rural areas and people who live in urban areas. These factors ought to be established to inform malaria prevention, especially through the use of ITN. For instance, a study conducted in Nigeria found that in rural areas, factors such as marital status, education, higher socioeconomic status, being civil servants and farmers influence ITN use in the rural areas but, in urban areas, the same factors were not significant predictors of ITN utilization (Nwachukwu et al., 2022). These revelations underscore the importance of understanding the unique factors that influence ITN utilization in different settings and tailoring interventions accordingly. According Adongo et al. (2005), people living in rural settings where socio-cultural norms are deeply entrenched assign the cause of malaria to many different factors apart from mosquitoes.

Also, in Ghana, rural and urban populations differ demographically, in socio-economic and cultural compositions and in proximity to formal and informal sources of health care (Okeke & Okeibunor, 2010) that may influence their health interventions. These rural–urban differences imply that urban residents use biomedical or modern services and drugs more often than rural residents, who more readily turn to bio-cultural or traditional means of promoting health (Okeke & Okeibunor, 2010). Specifically, in the case of malaria prevention, the WHO global framework for the response to malaria in urban areas revealed that differences between rural and urban areas elicit a different response to malaria and its prevention (M'bondoukwé et al., 2022). Most housing types in urban areas reduce indoor biting but in rural areas, most housing types allow high levels of indoor mosquito biting that drive the need to sleep under ITNs (Kaindoa et al., 2018). For this reason, various studies have identified and documented diverse housing characteristics associated with mosquito entry (Kirby et al., 2008; Lindsay et al., 2002; Lindsay et al., 2003; Lwetoijera et al., 2013). For instance, houses with eave gaps, ceilings and screening over windows and doors emerged to prevent mosquitoes from entry (Tusting et al., 2017). Such house designs are typical features of most houses in urban areas in Ghana, which are not common in the rural parts of the country.

Since these differences are not known, a research into the area becomes necessary as it will yield useful findings that will inform malaria prevention. Many studies have shown that factors such as wealth,

education level and residence type are key determinants of ITN use (Akuffo et al., 2021; Moon et al., 2016; Scott et al., 2021). In their recommendation for future research, the researchers stated that setting (rural or urban) can influence ITN use. They asserted that wealthier and more urban households are less likely to use ITNs even when they are available for use. The authors gave a clarion call, stressing the need for future research to focus on the rural-urban divide and also on wealth to better understand the predictors of household net use in these areas (Ricotta et al., 2019). Moreover, Axame et al. (2016) argued that in Ghana ITN utilization in rural areas is higher than urban areas and suggested that this disparity needs to be further examined.

Reflections on the various arguments on the rural-urban disparity in ITN uptake calls for a study that adopts separate analyses for rural and urban areas when studying factors that influence ITN utilization for malaria prevention. Indeed, rural and urban areas have different socioeconomic, cultural and environmental factors that can impact ITN utilization. For example, rural areas may have more limited access to healthcare facilities, transportation and information about ITNs, which can affect the availability and awareness of ITNs. In contrast, urban areas may have higher population densities, which can affect the demand for and distribution of ITNs. Additionally, there may be differences in the prevalence of malaria and other vector-borne diseases between rural and urban areas, which can influence the perceived need for ITNs and the willingness of individuals to use them. By conducting separate analyses for rural and urban areas, researchers can identify factors that are specific to each setting and develop targeted interventions to improve ITN utilization (Tusting et al., 2017). This approach can lead to more effective and efficient use of resources to address the unique challenges faced by the population in each contexts or setting.

1.4 Statement of the Problem

Malaria is one of the biggest public health and development challenges in Ghana, causing high morbidity, mortality and poverty among individuals (Asante & Asenso-Okyere, 2003; Tay & Ocansey, 2022). The use of ITNs is a proven strategy for preventing malaria transmission (Eisele et al., 2010). So, Ghana implemented the use of ITNs as a measure for preventing malaria transmission after the WHO

recommended their widespread use in countries that are malaria endemic. The Government of Ghana, through the Ghana Health Service, has since made huge efforts to ensure that households and individuals across the country get access to ITNs and sleep under them (Diema Konlan et al., 2019). The Government established the Malaria Control Programme and aggressively launched the Roll Back Malaria (RBM) initiative. It further set up the National Malaria Strategic Plan and signed unto the Abuja Declaration. The National Malaria Control Program (NMCP) recently launched its National Strategic Plan (2021-2025), which aims to reduce malaria mortality by 90 percent and malaria case incidence by 50 percent, by 2025. Also, significant among the aims of these initiatives was to ensure that 100% of Ghanaian households own at least one ITN and also 80% of the general population sleep under ITNs across the country.

Despite the efforts from the Government of Ghana to ensure ITN usage for malaria elimination in the country, ITN utilization is still low in many parts of the country, especially in urban areas (Manu et al., 2017). A wide disparity exists in the utilization of ITNs between urban and rural areas (Mubarick Nungbaso et al., 2021). The GMIS has consistently reported a wide disparity in ITN use between urban and rural areas, creating the need to consider context-specific factors in malaria prevention via ITNs. For instance, in the 2019 GMIS, it was reported that 56.7% of households in the rural areas of Ghana use ITNs compared to only 27.8% of households in urban area that use ITNs (*Ghana Malaria Indicator Survey*, 2019). Many studies have been conducted into the reasons for ITN use and nonuse in other parts of Africa (Al-Eryani et al., 2017; Pulford et al., 2011; Vanden Eng et al., 2010). However, in Ghana, studies that have explored factors that influence ITN utilization have not paid due attention to the rural-urban context and its nuances (Ameyaw et al., 2020a). Besides, such studies have almost always focused on the vulnerable sections of the population, such as children under five (Ahorlu et al., 2019; Cruz et al., 2006; De La Cruz et al., 2006) and pregnant women (Dako-Gyeke & Kofie, 2015; Duut & Alhassan, 2022; Manu et al., 2017). The factors that influence ITN utilization in rural and urban areas may differ due to contextual differences, such as socioeconomic status, housing quality and access to healthcare services (Chuma & Molyneux, 2009). Therefore, there is the need to investigate the factors that influence ITN utilization in rural and urban areas separately and compare them to understand the similarities and differences (Adejoh et al., 2023). Knowledge as to whether the factors that influence the use if ITNs are the same for urban and rural areas in Ghana is still nonexistent, necessitating the present study. Therefore, this study aims to fill this gap by investigating the factors that influence ITN utilization in rural and urban

areas separately and compare them to understand the similarities and differences. By doing so, targeted and effective interventions can be developed to improve ITN utilization and ultimately reduce malaria transmission in both settings.

1.5 Justification of the Study

According to Creswell (2017), the justification of a study is an essential element of research design, as it provides a clear rationale for why the research is being conducted and what questions it seeks to answer. This study's justification is to bridge knowledge gap and provide insight into the factors that influence ITN usage in rural and urban settings. The low utilization of ITN in urban areas of Ghana as compared to the rural areas has raised concerns about the contextual factors that influence ITN use (Ahorlu et al., 2019). Previous studies have highlighted an association between residence and ITN use (Adongo et al., 2005; Singh et al., 2013; Watanabe et al., 2014). However, in Ghana, there is lack of research on the factors that drive ITN use in each of these two contexts. This has led to a growing debate founded on mere assumptions regarding the variation in ITN use between rural and urban residents. Some studies suggest that the factors influencing ITN usage are similar across rural and urban settings. For example, a study conducted in Tanzania found that the determinants of ITN use were similar in both rural and urban areas (Mboera et al., 2013). However, other studies suggest that the factors influencing ITN usage differ between rural and urban settings. For instance, a study conducted in Ethiopia found that the factors influencing ITN usage were different between rural and urban areas (Astatkie & Feleke, 2009). In Ghana, it is still unclear whether the factors that drive ITN usage are similar across rural and urban settings. This study's justification is to bridge this knowledge gap and provide insight into the factors that influence ITN usage in rural and urban settings. Understanding these factors is crucial in developing effective malaria prevention programs that target specific populations. By identifying the similarities and differences in ITN usage factors, appropriate interventions can be designed to address the unique challenges faced by rural and urban populations. Also, one key factor in the effectiveness of malaria prevention, specifically through the use of ITNs is having a deep understanding of the contextual and socio-cultural factors that influence ITN usage (Murindahabi, 2014). This understanding is essential to ensure that efforts to increase ITN distribution, access and ownership translate into actual usage.

1.6 Research Objective

The overarching objective of this study is to investigate the factors that influence ITNs use for between rural and urban areas. The study specifically analyses the factors that influence ITN usage for each residence type separately.

1.7 Research Questions

Research questions refer to the questions a researcher asks in a study in order to obtain answers to the problem they want to solve at the end of the study (White, 2017). According to Thomas et al. (2022), research questions must relate directly to the research objectives to keep the research organized and within context. Both the objectives and research questions have to be in line with the overall problem that is being studied (Farrugia et al., 2010). To achieve the objectives of this study, therefore, this study posed the following questions in line with the objectives of the research:

1. Is residence type (urban-rural) associated with ITN use for malaria prevention in Ghana?
2. What are the factors that determine ITN use for malaria prevention among rural households in Ghana?
3. What factors determine ITN use for malaria prevention among urban households in Ghana?
4. Are there differences in the factors that influence ITN use between rural and urban households?

1.8 Significance of the Study

The study on the factors that influence ITN utilization in rural and urban areas of Ghana has significant implications for malaria prevention and control efforts. Firstly, the findings of the study will provide insights into the factors that affect ITN utilization in both rural and urban areas, which will inform the development of targeted interventions to increase ITN coverage and utilization. This is particularly important as the malaria burden is concentrated in rural areas where access to healthcare services and resources is limited (Mbunge et al., 2021). Secondly, the study will contribute to the existing literature on ITN utilization and malaria prevention and control, particularly in the context of Ghana. The findings of the study will add to the body of knowledge on the factors that influence ITN utilization in rural and urban areas, which can be used to inform future research and policy decisions. Thirdly, the study will have practical implications for malaria control programs in Ghana. By identifying the factors that influence

ITN utilization in rural and urban areas, the study will provide recommendations for the development and implementation of effective malaria prevention and control interventions. This can include strategies to improve access to ITNs, increase awareness and knowledge about malaria and address barriers to ITN utilization. Also, the investigation of factors that drive ITN usage across rural and urban settings can contribute to a better understanding of the broader factors that influence health behaviours in different contexts. This understanding can inform the development of more effective health promotion interventions that take into account the unique factors that drive health behaviours in different populations. Finally, the study has broader implications for public health in Ghana and beyond. Malaria is a major public health challenge, particularly in sub-Saharan Africa and the findings of the study can contribute to efforts to improve malaria prevention and control in other settings. Ultimately, the study has the potential to contribute to the global health promotion goal of reducing the burden of malaria and improving health outcomes for populations affected by the disease.

1.9 Organization of the Study

Organization of a research study provides a map that guides readers through the reading and understanding of the thesis or dissertation by clearly showing how the various chapters have been sequenced or organized (Turabian, 2013). Thus, the final section of this chapter spells out how the study is organized. This study is organized into five chapters.

In chapter one, the background to the study was introduced within which the global health and development challenge of malaria, its epidemiology and impacts across the globe, SSA and Ghana were discussed. Afterwards, malaria prevention in Ghana using ITNs was explored. The research problem, research questions, justification of the study and the significance of the study were also tackled in this chapter, as they constitute important sub headings of this thesis.

Chapter two covers the theoretical framework that underpins the study as well as empirical review of studies of past studies on factors that influence ITN utilization. These were mainly informed by the current research problem statement, the research questions and the author's specialization in health promotion. Also, the decision to use the theory was informed by their ability to support the research and to further prove that this research work is grounded in established ideas. Chapter two wraps up with a summary of literature and areas for further research.

Chapter three describes the methodology used to investigate the phenomenon. It begins by selecting a philosophical perspective based on the positivist paradigm, which then guides the choice of subsequent research methods. Also, in this chapter, the research design, study setting, data collection instrument, procedures and method of data analysis were explained and justified. It is also worthy to state that the ethical considerations observed were thoroughly delineated in this chapter. The of this chapter is to provide insight into how the research was conducted and provides a transparent and systematic account of the research process.

Chapter four presents the results from data analysis. It begins with a description of the general characteristics of the respondents. The chapter begins with an introductory paragraph that summarizes the purpose of the chapter and gives an overview of the data analysis methods used. Also in this chapter, a description of the sample characteristics, such as demographics, socio-economic status and other relevant information are captured to yield insights into the context of the study and the characteristics of the participants. Results of the data analysis have been discussed in this chapter in line with the research questions.

Last but not least, chapter five marks the final chapter of this study. It contains a more detailed discussion of the results that emerged from the data analysis. The study's implications for research and practice, thesis limitations and directions for future health promotion research addressed in this chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

A literature review is defined as the process of analysing, synthesizing and summarizing past knowledge on a topic or domain of interest (Xiao & Watson, 2019). The purpose is to identify the current state of

knowledge on the topic, important biases, knowledge gaps and to propose corresponding future research directions (Rowe, 2014). A good literature review does not just summarize sources, but it also analyses, synthesizes and critically evaluates to give a clear picture of the state of knowledge on the subject (Pautasso, 2013). The quality of a literature review is extremely important, as its purpose is to identify knowledge gaps or research needs in the problem domain or research area in which the paper is intended to make a contribution to knowledge (Maier, 2013). Critical reflections from these definitions suggest that literature review, in relation to the current study, involves identifying studies that have been conducted on factors that influence ITN utilization, evaluation of the approaches used, gaps and areas that need further research. Accordingly, the literature review informed the theoretical basis of the current study, allowing the researcher to identify gaps and research needs in the existing studies on factors that influence ITN use in malaria prevention. It also enabled the researcher to situate this study in the rural-urban context as two different settings that need to be studied separately. This chapter of the thesis, therefore, details the social ecological theory as the appropriate theoretical framework for the study, presents a review of literature on factors that influence ITN uptake for malaria prevention and presents a summary of the literature at the end.

2.2 Theoretical Framework

A theoretical framework is defined as a logically developed and connected set of concepts and premises developed from one or more theories that a researcher creates to scaffold a study (Varpio et al., 2020). Also, a theoretical framework introduces and describes the theory that explains why a research problem under study exists (Abend, 2013). From the two definitions, it is clear that theories form the basis of theoretical frameworks and are essential elements of the research process, guiding researchers in developing hypotheses, designing studies, collecting analyzing and interpreting results (Cohen et al., 2017).

A theory is a set of interrelated constructs (concepts), definitions and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting phenomenon (Kivunja, 2018). Theory is important in research, as it is one of the major pillars of research that helps in explaining the research variables and contributes to the production of transformative knowledge (Ngulube, 2020). Considering the importance of theory in research, a theoretical framework

was deployed in this study to explain the existing theory that supports the current research, demonstrating that the study is firmly grounded in established ideas.

2.2.1 The Social Ecological Model (SEM) of Health Promotion

This study was informed by McLeroy et al. (1988) social ecological model of health promotion. The theory posits that health behaviours are influenced by multiple factors that operate at different levels, including the individual, interpersonal, organizational, community and policy levels. These factors interact with each other and contribute to the development and maintenance of health behaviours (McLeroy et al., 1988). McLeroy et al.'s (1988) SEM was developed in response to the need for a more comprehensive approach to health promotion that recognizes the multiple influences on health and behaviour (Aghazadeh & Aldoory, 2023). McLeroy et al. offered five levels of influence specific to health behaviour, which include intrapersonal factors, interpersonal factors, institutional factors, community factors and public policy.

2.2.1.1 Intrapersonal/Individual Factors

The first level as represented in Figure 1 below deals with factors at the individual level or within the individual that influence health behaviour (ITN utilization). In other words, it involves the individual's personal characteristics such as knowledge about malaria transmission and attitude towards ITN usage that affect ITN use among individuals. For example, a person with wrong knowledge of malaria transmission will not use an ITN but will resort to a preventive intervention that aligns with their knowledge of malaria transmission. The intrapersonal or individual factors may be biological (i.e. age, gender, body composition and health status), behavioural (i.e. lifestyle, physical activity and sedentary habits), psychological (i.e. stress, mental health, attitudes and perceptions) or socio-economic factors (education level, employment status, and income). Using education as an example, Greenaway et al. (2012) argued that the higher the level of education of a person, the more likely they are to be knowledgeable on accessibility and use of health services and health products, including ITN use. This underscores how variables at the individual level can influence ITN utilization and the need to explore them in malaria preventive interventions.

2.2.1.2 Interpersonal Factors

The second level in the SEM explores social influence from friends, families and norms within one's social network (McLeroy et al., 1988). The influence of interpersonal factors on health behaviour has been widely researched. It has been documented that interpersonal relationships have a significant influence on health behaviour and affect people's motivation to consult a health expert (Ashida et al., 2010). For example, perceived social support has been linked to better health behaviours such as fruit and vegetable consumption and exercise (Emmons et al., 2007). In the case of ITN uptake for malaria prevention, the relationship between family members, friends and co-workers can influence ITN use as they observe or learn from each other. Accordingly, social relationships facilitate healthier behaviours and adherence to medical regimens, which in turn protect the subject from developing the disease (Dinis et al., 2019).

2.2.1.3 Institutional Factors

This entails the way relevant institutions are managed and how that can influence health behaviour. It comprises factors such as such as price of ITNs, attitude of health workers, supply of ITN and their influence on ITN on utilization (Barffo et al., 2021). Institutions include health care organizations, ranging from primary care physicians to health centres, which provide information on ITN utilization. In areas where there are functional institutions and competent health professionals who ensure regular supply of ITNs and educate people on their use, ITN uptake will be higher than areas where such institutions are non-existent.

2.2.1.4 Community Factors

This deals with the formal and informal systems, cultural norms, economic inequalities, limited access to health facilities and health products, such as ITN and its influence on usage. In settings or communities where ITN distribution centres are located close to individuals in the community, people are likely to obtain ITNs and use them. In relation to the current study, in Ghana, such centres are usually healthcare facilities. It has been revealed that longer distance to such healthcare facilities where individuals obtain ITNs limits access and in turn hinders ITN use (Nketiah-Amponsah, 2010). In the same way, Tsegay et al. (2013) reported that proximity of villages to health facilities is a strong predictor of the utilization of antenatal health services where most women in rural areas obtain ITNs. Similarly, it has been discovered that inadequate health facilities, long distances to health facilities, lack of effective and efficient

transportation systems and inadequate health personnel as major hurdles constraining rural people from accessing health services (Lu et al., 2010).

2.2.1.5 Public Policy

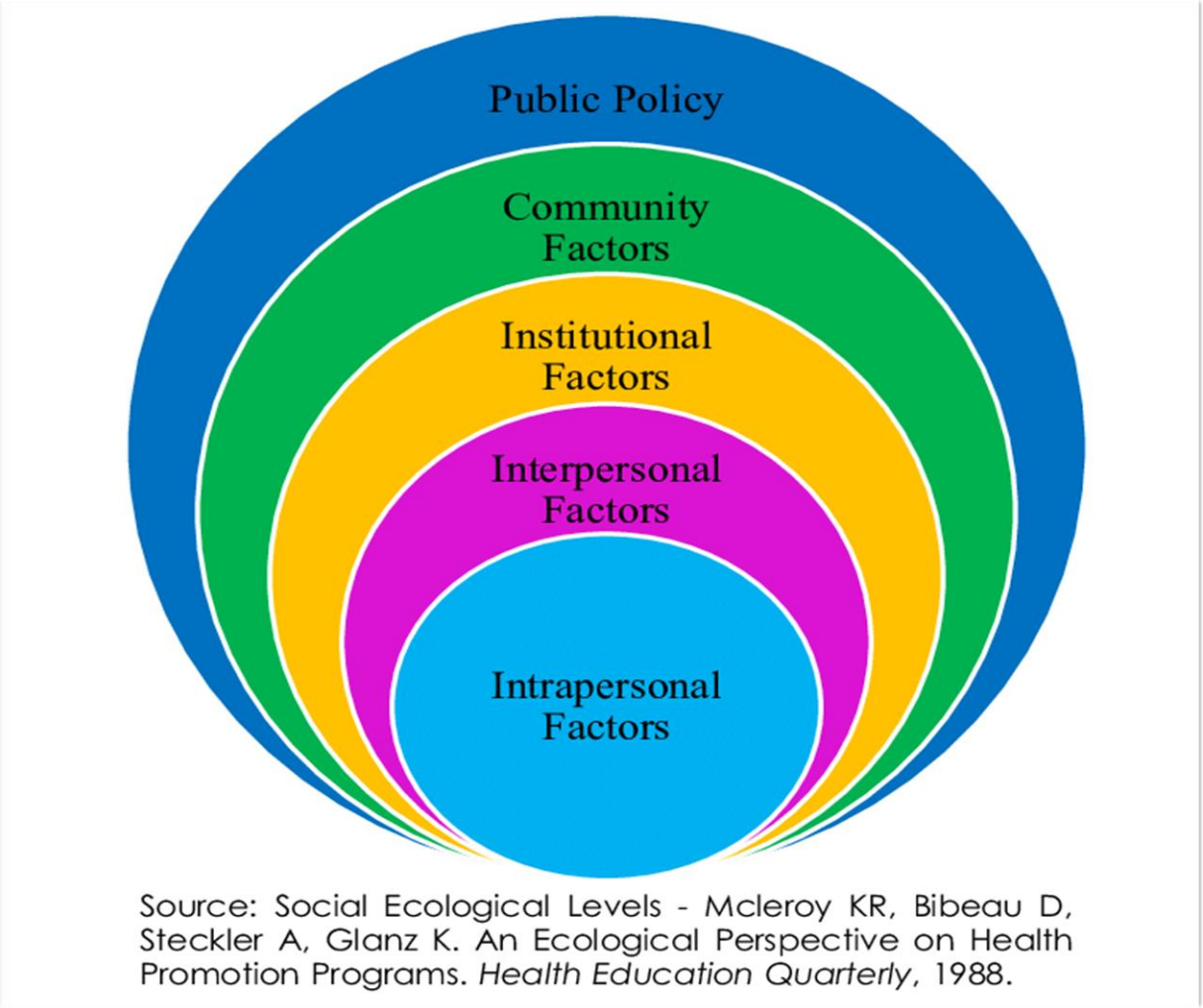
The fifth and final level on the SEM examines regulations and policies at the district and national levels, including policy on access to ITNs by households. Policies regarding ITN distribution affect ITN utilization in the sense that countries with little funding for malaria prevention may enact a policy to either subsidize or freely distribute ITNs to only vulnerable or critical population groups such as pregnant women or children under a specified age group. Policies that promote community participation and ownership in ITN distribution programs can also increase ITN utilization. When communities are involved in the distribution process, they are more likely to understand the importance of ITNs in preventing malaria and are more likely to use them consistently. Other individuals and groups that are also at increased risk of malaria include the rural poor, orphans, child-headed households, people living with HIV/AIDS and people living in refugee camps or in chronic emergency circumstances. For example, where government policy allows the rural poor to have ITNs free of charge, ITN utilization in rural areas will be higher compared to its use among urban areas. Public sector actions such as demand creation initiatives and the removal of tax and tariff barriers facilitate ITN use (Magesa et al., 2005). Overall, policies regarding ITN distribution can have a significant impact on ITN utilization by making them more widely available, accessible, and affordable to those who need them the most. Such policies can also promote community participation and ownership in ITN distribution programs, leading to increased utilization and better health outcomes.

The SEM conceptualizes health broadly and focuses on multiple factors that might affect health behaviours (Kilanowski, 2017). This broad approach to thinking of health encompasses physical, social and mental wellbeing (Van Druten et al., 2022). The SEM understands health to be affected by the interaction between the individual, the group/community and the physical, social and political environments (Sharma et al., 2022). Also, the SEM recognizes the complex role played by context or settings in sustaining healthy life practices as well as in the success or failure of health promotion interventions (Baral et al., 2013). Further support for the role of settings in determining the sustained adoption of health-related behaviour was provided by Richard et al. (2011), who asserted that the settings

in which behaviour occurs are the best predictor of the behaviour. The SEM suggests that factors at the individual level (e.g., age, gender, race/ethnicity, perception, and attitude) and those beyond, such as family relationships at the interpersonal level, neighbourhood support at the community level and national policy at the policy level, should be considered when examining health behaviour (Jang, 2022). This section of the study details the various levels of SEM by McLeroy et al. (1988) in relation to ITN utilization in malaria prevention.

In the context of ITN use for malaria prevention, this model suggests that effective interventions should target these multiple levels of factors to promote behaviour change and sustained use of ITNs. At the individual level, interventions may focus on increasing knowledge and awareness of the benefits of ITN use for personal health. Interpersonal interventions may involve encouraging social support for ITN use among family and friends. Community-level interventions may involve creating supportive social norms around ITN use and ensuring access to ITNs. Organizational interventions may involve working with healthcare providers to promote ITN use and providing resources for ITN distribution. Societal-level interventions may involve policy changes or advocacy efforts to prioritize malaria prevention and ensure funding for ITN distribution programs.

Figure 1: McLeroy et al. (1988) Social-Ecological Model of Health Promotion



Source: Social Ecological Levels - Mcleroy KR, Bibeau D, Steckler A, Glanz K. An Ecological Perspective on Health Promotion Programs. *Health Education Quarterly*, 1988.

2.2.2 McLeroy et al. (1988) SEM's Relation to Health Promotion

Like health promotion, the model recognizes that health is not solely determined by individual behaviours, but also by a complex interplay of various factors, including social, environmental, and policy factors (Parkinson et al., 2022). This model aligns well with the fundamental principles of health promotion, which include advocating, enabling, and mediating.

Advocacy is about raising awareness and mobilizing support for a particular health issue or behaviour (Nutbeam & Muscat, 2021). In the socio-ecological model, this corresponds to the societal level, which includes policies, laws and social norms. By influencing these factors, health advocates can create an environment that supports healthy behaviours and discourages unhealthy ones. Enabling refers to creating opportunities and resources that support healthy behaviours (Nutbeam & Muscat, 2021). In the socio-ecological model, this corresponds to the community level, which includes social networks, organizations, and community services. By providing access to resources such as health education, health care, and social support, health promoters can enable individuals to adopt and maintain healthy behaviours. Mediating involves facilitating communication and collaboration between different levels of the socio-ecological model to promote health. This corresponds to the interpersonal and individual levels, which involve personal attitudes, beliefs, and behaviours. Health promoters can mediate by facilitating communication and collaboration between individuals, organizations and communities to address health issues and promote healthy behaviours.

The SEM emphasizes the importance of considering multiple levels of influence when designing and implementing health promotion interventions. This means that interventions should not only focus on individual-level factors but also address factors at the interpersonal, organizational, community, and policy levels. The SEM consists of five interrelated levels of influence, including the individual, interpersonal, organizational, community and policy levels. Each level has a unique set of determinants that influence health behaviour and outcomes. The model guides health promotion practitioners and researchers to understand the multiple factors that influence health behaviours and outcomes (Washburn et al., 2020). The SEM suggests that health is determined by a complex interplay of individual, interpersonal, organizational, community and societal factors, and that interventions should target each level to create sustainable change. At the individual level, the focus is on individual characteristics such as knowledge, attitudes, beliefs and behaviours that may impact health outcomes. Health promotion efforts at this level include educational programs, health communication and behaviour change interventions. The model acknowledges how individual characteristics can affect their health behaviour and the importance of empowering individuals to make informed decisions about their health behaviours. This can include providing education and information about health risks and promoting self-efficacy, or an individual's belief in their ability to take action to improve their health.

The model also directs health promotion efforts to examine the interpersonal aspects that affects people's health. At this level, the focus is on the relationships between individuals and their social networks such as family, friends, and peers. Health promotion efforts at this level include social support interventions, peer education programs, and family-based interventions. Positive interpersonal relations can provide individuals with social support, which can improve their overall health and well-being (Ruvalcaba-Romero et al., 2017). For example, individuals who have strong social networks are more likely to engage in healthy behaviours, such as exercising regularly, eating a healthy diet and avoiding risky behaviours like smoking and excessive alcohol consumption (Latkin & Knowlton, 2015). On the other hand, negative interpersonal relations, such as conflict or social isolation, can have adverse effects on health. Individuals who experience high levels of stress due to conflicts in their relationships may be at higher risk for chronic diseases like cardiovascular disease, depression, and anxiety. Social isolation and loneliness have also been linked to poor physical and mental health outcomes. At the organizational level, it urges attention to be placed on the organizations and institutions that individuals interact with such as workplaces, schools and healthcare settings. Health promotion efforts at this level include workplace wellness programs, school-based health promotion programs and healthcare system interventions. The institutional level in the SEM can have a significant impact on health promotion by shaping the social and environmental context in which individuals live and work. Effective health promotion efforts must take into account the institutional factors that influence health behaviours and outcomes and work to create supportive environments that facilitate healthy living. At the community level, the model directs health promotion focus unto the physical and social environment in which individuals live such as the neighbourhood, community and society. Health promotion efforts at this level include community-based interventions such as community health fairs, social marketing campaigns and community organizing efforts. At the community level, the SEM emphasizes the importance of empowering communities to take action to improve their health. This can include promoting community engagement in health promotion efforts, supporting community-based organizations and initiatives and working to address social and environmental factors that impact health. For example, health promotion is concerned with empowering individuals and communities to take control of their own health (Nutbeam & Muscat, 2021). The model enables stakeholders in health promotion to identify the barriers to ITN uptake and develop interventions that address these barriers. By involving communities in the development of these interventions, health

promotion can promote community participation and ownership of the interventions, leading to sustainable changes in health behaviour (Farnsworth et al., 2014).

Finally, at the policy level, the model focuses on the laws, regulations and policies that impact health outcomes. Health promotion efforts at this level include policy advocacy, policy change initiatives and legislative actions. The policy level in the SEM plays a crucial role in determining the success or failure of health promotion efforts. Policies that support healthy behaviours and environments can make it easier for individuals to adopt healthy habits and can reduce the prevalence of chronic diseases. In contrast, policies that do not prioritize health promotion can make it more difficult for individuals to make healthy choices, which can contribute to poor health outcomes (Travers et al., 2022).

The SEM helps practitioners and researchers understand the contextual factors that influence health behaviours and outcomes (Parkinson et al., 2022). For example, a health promotion intervention that targets individuals without considering the community or societal factors that may influence their behaviours may not be effective. Understanding the broader context can help practitioners and researchers design interventions that are more likely to be effective and sustainable (Walugembe et al., 2019).

The SEM suggests that health behaviour is influenced by multiple levels of factors, including individual, interpersonal, community, organizational, and policy factors (McLeroy et al., 1988). Health promotion aims to improve health by intervening at each of these levels (Ewald et al., 2023). For instance, at the individual level, health promotion may focus on increasing knowledge and awareness of healthy behaviours, such as sleeping regularly under ITNs, engaging in regular exercise and eating balanced diet. At the interpersonal level, health promotion may aim to improve social support networks that can encourage healthy behaviours. At the community level, health promotion may focus on creating supportive environments that make healthy choices easier, such as providing access to ITNs. At the organizational level, health promotion may work to create policies and practices that promote health, such as offering healthy food options in the workplace. At the policy level, health promotion may aim to change laws and regulations that affect health, such as smoking bans in public places.

Over all, the SEM is useful for health promotion because it recognizes that individual health behaviours and outcomes are shaped by multiple levels of influence. It encourages the use of a comprehensive approach to health promotion that considers the broader social and environmental factors that impact

health (Townsend & Foster, 2013). This model has been widely adopted by health promotion practitioners and researchers because it provides a systematic and holistic approach to health promotion that considers the complex interplay of factors that influence health outcomes (Golden et al., 2015; Wendel & McLeroy, 2012). The model upholds the central focus of the Ottawa Charter for Health Promotion that health is influenced by social, economic, and environmental factors and that effective health promotion requires action at multiple levels (Bloch et al., 2014). The model helps to integrate and articulate health considerations into policymaking across sectors to improve the health of all communities and people thereby fulfilling the health promotion central focus of health in all polies (Golden et al., 2015).

2.3 Justification of the Theoretical Framework

The theoretical underpinnings of this study was founded on the SEM of health promotion by Mcleroy et al. (1988). The model was chosen for this study because it explores variables that align with the aims of this study and also because of it is very relevance in health promotion (Choongo et al., 2023; Rothwell et al., 2010; Trego & Wilson, 2021). This study aimed to investigate the factors that influence the different levels of ITN uptake for malaria prevention in two different contexts: rural areas and urban areas. Thus, the key variables of the study are settings, ITN utilization, age, wealth, household size, gender, education, marital status among others. Given these variables, the author found the SEM appropriate in this study because it provides a better understanding of how these factors influence health ITN utilization (Bumbokuri, 2021). The factors that influence ITN utilization are complex and multifaceted (Stebbins et al., 2018). Given the complex and multifaceted nature of the factors that influence ITN use, this study required a theoretical framework that could account for the various levels of influence on health behaviours and provide a comprehensive understanding of factors that shape ITN utilization. The model cuts across multiple levels, allowing for the analysis of numerous factors affecting ITN utilization (Barffo et al., 2021). Also, in relation to the current study, the SEM makes reference to individual, household, community and different levels of societal organization that influence health behaviour, making it an ideal model for the current study.

Moreover, as a study in the field of health promotion, it was important to choose a theoretical framework that is firmly rooted in the discipline of health promotion and can provide a robust and comprehensive understanding of the factors that shape health behaviours, including the utilization of ITNs. The socio-

ecological model neatly ties in with health promotion (Gebhard & Mir, 2021), allowing the researcher to examine diverse influential factors in ITN utilization for the purpose of malaria prevention. This model recognizes that health outcomes are shaped by a range of factors, including individual behaviour, social and cultural norms, environmental conditions and policy and regulatory frameworks. Health promotion efforts that are based on the socio-ecological model aim to address these factors at multiple levels in order to improve health and well-being (Rao et al., 2019). This approach recognizes that individual behaviour change is just one part of the equation and that health promotion efforts must also address social, cultural and environmental factors in order to be effective (Barry, 2019). For example, a health promotion campaign aimed at encouraging ITN use to prevent malaria might use the socio-ecological model to design interventions that address factors at multiple levels. At the individual level, the campaign might focus on providing education and resources to help people use ITNs. At the social and cultural level, the campaign might work to shift social norms around ITNs and increase awareness of the benefits associated with sleeping under ITNs. At the environmental level, the campaign might advocate for policies that enforce ITN use. Thus, by addressing factors at multiple levels, health promotion efforts based on the socio-ecological model can be more comprehensive and effective in improving health and well-being.

Finally, Guardia and Patrick (2014) argue that the social environment directly influences the extent to which people initiate and maintain health behaviours. Rural and urban residence represents two different social settings or environments so factors that influence the health behaviours of residents in rural areas may differ from those of residents of urban areas. Based on this argument, various scholars (Duhl et al., 1999; Giles-Corti & King, 2009; Roux, 2007) have suggested the use of the social-ecological framework to ensure a comprehensive understanding of the factors influencing health behaviours at different hierarchical levels and in different settings.

2.4 Empirical Literature Review

An empirical review of literature is the review of many aspects of an empirical study that holds some level of significance to the study being conducted (Brown, 2013). An empirical literature review process involves the evaluation of previous empirical studies to bring to rest a specific research issue (Hart, 2018).

According to Paul and Criado (2020), once the relevant studies have been identified, researchers critically evaluate and synthesize the findings of these studies, highlighting the similarities, differences and gaps in the research. This process involves a careful analysis of the study's research questions, methods, results and conclusions, as well as the strengths and limitations of the study. In line with these assertions, this study reviewed various studies that have been conducted on the factors that influence the use of ITNs for malaria prevention. The goal was to provide a comprehensive and objective summary of existing empirical evidence on factors that influence ITN utilization.

2.4.1 Literature Search Strategy

A literature search strategy is a systematic approach used to identify and locate relevant literature on a specific topic or research question (Booth et al., 2021). Thus, it involves a series of steps and techniques to ensure a comprehensive and thorough search of relevant databases, journals and other sources of information.

In order to retrieve accurate results for this study, the author adopted an electronic search for scientific articles on factors influencing ITN use in malaria prevention. The author identified the main concepts in in the research topic “factors influencing ITN utilization”, which were "ITN utilization" and "factors influencing.” A list of keywords and synonyms for each concept was then developed. Some of the potential keywords and synonyms were “ITN use”, “mosquito net use”, “bed net use”. For "factors influencing", some potential keywords and synonyms that were developed were “determinants”, “barriers”, “facilitators”, “predictors”, “drivers”, “correlates” and “influencing factors.”

Such queries were constructed and refined severally to retrieve the most relevant studies while minimizing the number of irrelevant results. Using the search queries, the search was conducted on the following databases: PubMed, PsyncInfo, Google Scholar, Biomed and Oria to retrieve relevant literature (Bramer et al., 2013). To broaden the scope of the search, Boolean operators were used to combine some search terms. This search strategy generated a wide pool of results as there was no limit set on the quantity. But the search results were carefully evaluated to determine if they were relevant to the current study by reviewing the abstracts or summaries of the articles to determine if they provided information on factors that influence ITN utilization.

The results were carefully filtered using the inclusion and exclusion benchmarks established for the search. Specifically, the inclusion criteria used was that articles that addressed ITN utilization for malaria prevention were selected for inclusion whiles articles that talked about other malaria preventive methods were excluded because that was not the focus of this study. To obtain rich literature for the study, the researcher included both articles in Africa and other parts of the world. Also, in order to achieve recent literature on ITN utilization, the researcher included only articles published within the last ten years (i.e 2013-2023). Published articles were included for review because of their high quality standards (Ouyang et al., 2022). Also, in order to get access to valuable information, unpublished articles such as conference papers, technical reports and dissertations were selected for review. This decision was informed by the argument that both published and unpublished articles in literature search can provide a more comprehensive and well-rounded understanding of the research topic, help the researcher avoid publication bias and provide valuable information that may not be available in published articles (Song et al., 2013). Besides, unpublished articles may contain findings that contradict or challenge published research (Bonato, 2018). It is also worth stating that the search was limited to only English literature. The selected articles were thoroughly read and evaluated and finally imported into a reference managing software (Endnote) for thorough reading and for future reference. The majority of the articles selected were peer reviewed articles. This is because peer review is a process of quality control in academic publishing (Tennant & Ross-Hellauer, 2020) and that manuscripts are evaluated by independent experts to ensure that they meet the standards of scholarly communication (Cooper et al., 2020).

2.4.2 Major Determinants of ITN Utilization

2.4.2.1 Age

A variety of research studies have shown that age is a key factor that determines ITN utilization. Tassembed, Coulibaly & Ouedraogo (2021) conducted a cross-sectional survey to assess factors associated with ITN use in Burkina Faso. The researchers found age to be a significant determinant of ITN use in both pregnant women and children under five. These findings are similar to the finding of a community-based cross-sectional study conducted in Nigeria by Esomonu et al. (2021). The study aimed to determine knowledge of malaria and utilization of ITNs amongst moth ers of under-five children in rural communities of Nigeria's Federal Capital Territory. The outcome of the study showed that utilization of ITNs was associated with age of respondents. Women who were aged 30 years and above were 2.5

times more likely to have good utilization of ITNs when compared with those aged less than 30 years. The study used appropriate procedures and provided useful perspectives on ITN use. However, the study's use of cross-sectional design makes it difficult to establish causal relationships (Maier et al., 2023) and may be prone to potential recall bias in the data collection process.

Sena, Deressa & Ali (2013) conducted a cross-sectional comparative household survey in Ethiopia to investigate the predictors of long-lasting insecticide-treated bed net ownership and utilization. The findings of the study revealed that age of household heads is an important predictor of bed net use. It was discovered that households with heads aged 60 years or above used bed net more than households whose heads were less than 30 years of age. A review of this study shows that the authors included both urban and rural areas, allowing for a more comprehensive understanding of bed net use in different locations in Ethiopia. But the study can be critiqued for including only households with at least one child under five years old because that could limit the generalizability of the findings to other populations. Notwithstanding this, the findings could inform interventions aimed at increasing bed net use and reducing malaria transmission in Ethiopia.

Tchinda et al. (2012) also conducted a two-stage cluster random sampling study in Cameroon to examine factors associated with ITN use. Results of the study showed that age had a significant association with ITN usage. Reflecting on the approaches adopted in these studies, it can be pointed out that the researchers interviewed only heads of the selected households and thus the findings may represent only the views of these household heads. Moreover, in evaluating this study, it was seen that the study relied solely on self-reported data, which can be biased and may not reflect actual ITN use. Individuals might have over-reported their use of ITNs due to social desirability bias or under-reported their use due to recall bias (Dhewantara et al., 2019). Apart from this, the study was also conducted in a typical rural setting whose findings may not be the same as that of an urban area.

In search of evidence on whether age influences ITN utilization, Olapeju et al. (2018) conducted a cross-sectional study on age and gender trends in sub-Saharan Africa. The results of the study showed that ITN use was consistently higher among children under 5 years and non-pregnant women 15–49 years. The results reinforce claims that children under the age of five are the most vulnerable to malaria and are therefore the target group for ITN use (Roberts & Matthews, 2016). In a related survey conducted in a

fishing community along Lake Victoria, Kenya by Larson et al (2014), it emerged that after infancy, ITN use sharply declined until the late teenage years then began to rise again, plateauing at 30 years of age. These findings seem to suggest that ITN usage is more prevalent during the vulnerable periods of the human life course and might be the reason why most researchers situate their studies on these vulnerable groups. Some authors contend that young children are often more vulnerable to malaria than adults (Walldorf et al., 2015). Therefore, it is important to ensure that children sleep under ITNs to protect them from mosquito bites that can cause malaria. To adduce further evidence as to whether any relationship exists between age and ITN utilization, Konlan et. (2019) conducted a descriptive cross-sectional study in the Ho Municipality in Ghana to examine the utilization of ITN among caregivers of children under five. Among other findings, the study also found that the age of caregivers was strongly associated with utilisation of ITN. Caregivers aged 26-35 were 49% times less likely to use an ITN as compared to those aged between 17 and 25.

It is also imperative to state that a review of studies that have investigated the association between age and ITN utilization have generated mixed results in some cases. Graves et al (2011) assumed generalized linear latent and mixed models to study factors associated with mosquito net use by individuals in households owning nets in Ethiopia. Results of the study showed that increased net use was associated with age group 25-49 years compared to children under five, while reduced net use was associated with ages 5-24 years. Another study by Koenker et al. (2015) conducted in sub-Saharan Africa found that households with more children under the age of five were more likely to utilize ITNs. The authors suggested that this may be due to the increased awareness of the importance of ITN use for young children, as well as the fact that children are more vulnerable to malaria. This suggestion aligns with the observations of Njatosoa et al. (2021) that children under 5 years of age are known to be the most vulnerable age group for acquiring malaria and therefore are prioritized for LLIN use when there are limited supplies in households. In contrast, children over 5 years of age, who are perceived to be at less risk for malaria, often sleep without LLINs (Bawuah & Ampaw, 2021).

Comparing this to other studies, it can be seen that results have shifted from results of other earlier studies that used cross-sectional approaches. It then becomes difficult to confidently attribute the different trends of results to the different approaches that the researchers adopted or the different contexts that the studies

were carried out. By implication, it suggests the need for different approaches to study factors that influence ITN utilization even in the same contexts to compare results.

2.4.2.2 Wealth

In a study conducted by Bawuah and Ampaw (2021) to explore the ownership and use of ITNs under Ghana's National Malaria Control Program, wealth emerged as one of the most important predictors of ITN ownership and use in Ghana. The study revealed a contrasting association between wealth and ITN use. While affluent households in urban areas owned more ITNs than the extremely poor, the poor, on the other hand, used ITNs more. It was revealed that affluent households used other methods of malaria prevention, such as mosquito repellents, spraying, and fans to blow off mosquitoes. In terms of the study approach, Bawuah and Ampaw used a rigorous methodology to collect and analyse the data. The sample size was relatively large and represented four regions of Ghana, which enhances the generalizability of the findings. The structured questionnaire used in the study was also well-designed, allowing for the collection of relevant data. However, the study relied on self-reported data, which may be subject to social desirability bias. Additionally, the study did not explore other potential factors that may influence ITN ownership and use, such as access to healthcare services or cultural beliefs about malaria prevention. Overall, Bawuah and Ampaw's study provides valuable insights into the socioeconomic and demographic determinants of ITN ownership and use among Ghanaian families. However, further research is needed to explore additional factors that may contribute to ITN ownership and use in Ghana and other malaria-endemic countries.

Economic conditions influence the choice of malaria prevention and control practices and have featured prominently in malaria prevention discourse. Dako-Gyeke and Kofie (2015) conducted a cross-sectional study to investigate the factors that influence the prevention and control of malaria among pregnant women living in urban slums in southern Ghana. The authors identified socio-economic status as a key factors that influences the prevention and control of malaria, such as ITN use. The study found that pregnant women from households with higher income level were more likely to use ITNs and to seek healthcare services for malaria prevention and treatment. Despite the valuable findings of the study, the sample size was relatively small, which could affect the generalizability of the findings. The cost of prevention and control measures such as bed nets, insecticides and drugs can be a major barrier to their

adoption, particularly for those living in poverty (Ricci, 2012). Households with limited financial resources may choose to forego preventative measures in favour of more immediate needs such as food, clothing and shelter (Heflin et al., 2011).

Ricotta et al. (2019a) conducted a cross-sectional survey to study the determinants of bed net use in Ghana. The researchers found that increasing wealth was associated with decreased net use when compared to the poorest category. Contrary to this, the outcome of a study conducted by Singh et al. (2013) showed a strong positive association between wealth and ITN utilization. Also, Idowu et al. (2016) used a descriptive epidemiological design to assess factors associated with ITN use in the rural settings of Nigeria. The authors found that respondents whose household monthly income was more than $64 had significantly higher odds of ITN use compared to households that earned less. Consistent with previous studies, Kanmiki et al. (2019) utilized a cross-sectional study to assessed the disparities in ownership and utilization of ITNs among reproductive-aged women in a rural impoverished setting of Ghana. The findings indicate that ownership and use of ITNs among rural reproductive-aged women in northern Ghana are significantly associated with socio-economic factors such as household income.

Kateera et al. (2015) conducted a qualitative study in Rwanda to explore long-lasting insecticidal net source, ownership and use in the context of universal coverage. The outcome of the study showed that, individuals living in households with middle/high SES showed two fold higher odds of net use compared to those living in household low SES household. Consistent with the previous study, Kanmiki et al (2019) carried out a population-based cross-sectional study in the Upper East Region of Ghana to assesses the disparities in ownership and utilization of ITNs among reproductive-aged women in a rural impoverished area. Findings of the study showed that respondents in the relative richest wealth quintile were more likely to own ITNs compared to those in the poorest quintile. However, those in the relative richest wealth quintile were less likely to use ITNs compared to the poorest. The researchers stated that people with high SES often have access to other methods for preventing man-vector contact and may therefore not use ITN even if they have them in their households. Also, wealthier people who live in houses with door and window screens often believe they are sufficiently protected from mosquito bites and therefore do not make use of ITNs even if they have them in their households (Goesch et al., 2008).

2.4.2.3 Settings

The concept of settings, which can refer to location, contexts, or residence, is considered a significant determinant of ITN utilization (Watanabe et al., 2014). One of the key factors influencing ITN utilization is knowledge and awareness (Kouamé et al., 2022). Studies have shown that people in rural areas are more aware of the dangers of malaria and the benefits of ITNs compared to urban areas. A study conducted in Ghana found that rural residents were more likely to have heard of ITNs and were also more likely to know that they should sleep under them to prevent malaria (Adongo et al., 2005). Another important factor in this regard is accessibility and availability. ITNs are often distributed through public health campaigns and programs. In rural areas, these campaigns are more common and better organized than in urban areas. Rural areas also have more community health workers who can distribute ITNs directly to households. In Ethiopia, it is stated that ITN distribution was more effective in rural areas due to the presence of health extension workers (Kebede et al., 2021).

Seyoum, Andualem and Yalew (2023) conducted a cross-sectional study on insecticide-treated bed net use and associated factors among households having under-five children in East Africa. It was found in the study that children from rural areas had higher odds of ITN use as compared to their urban counterparts. The researchers concluded that the possible reason for this may be the low incidence of malaria in urban areas, which leads to low perceived threat of mosquito bite.

Difference in housing and living conditions in rural and urban areas can also impact ITN utilization rates. Rural areas often have poorer housing conditions, with houses made of materials that provide less protection against mosquitoes (Mitchell et al., 2022). As a result, people in rural areas may be more likely to use ITNs as a protective measure. A study conducted in Uganda found that ITN utilization was higher in households with poorer housing conditions (Snyman et al., 2015). Rural areas also tend to have less access to healthcare services, making ITNs a crucial preventive measure. In urban areas, where poverty rates are generally lower, the cost of ITNs may be a significant barrier to access (Dako-Gyeke & Kofie, 2015). However, in rural areas where poverty rates are typically higher, the government and other NGOs often provide free or heavily subsidized ITNs to the population, making it more accessible (Sexton, 2011).

Given the influential nature of the rural-urban dimension in the malaria prevention discourse, it is evident that more research is needed to disentangle and highlight the rural urban dimension of ITN use. According

to Ricotta et al. (2019a), it will be necessary in the future to focus on rural settings, urban settings and wealth status independently to better understand predictors of household net use in these areas. Numerous studies have discovered that the rural urban contexts influence ITN utilization. However, because these studies aggregate both rural and urban contexts, it becomes difficult to determine whether the factors that influence ITN utilization are the same in both rural and urban contexts. In a descriptive cross-sectional study on factors influencing the utilization of ITNs by Pregnant Women in the Wa East District of Upper West Region in Ghana, Asumah et al. (2021) found a significant association between residence and ITN utilization. Again, in a study conducted by Ameyaw et al. (2020b) to assess the rural-urban dimension of ITN use in Nigeria, a chi-square test was employed to assess the association between residence, socio-demographic characteristics and ITN utilization. The study found a higher ITN utilization among rural residents compared to the low level of ITN use among urban residents. The high use of ITNs in rural communities in Nigeria was attributed to the prioritization of rural communities by previous interventions. In reflection, although the study engaged the appropriate methodology and had a large sample size, it only included individuals from selected states in Nigeria, which limits its generalizability to the entire country. In addition, the study relied solely on quantitative data, which limits the depth of the findings. Qualitative data, such as focus group discussions, could have provided more insights into the reasons why some individuals do not use ITNs. The study also relied on self-reported data, which may be subject to social desirability bias or recall bias. Participants may have over reported their ITN use to please the interviewer, or they may not have accurately recalled their ITN use. Social desirability is considered as an evident threat to the validity of research which involves measurement of self-report scales, since it may produce spurious results, hide real results (suppression) or moderate relationships (Durmaz et al., 2020)

Over years, the need for a separate analysis into the rural-urban contexts with regard to ITN utilization for malaria prevention has become increasingly pressing as more researchers continue to find association between residence and ITN utilization. Consistent with other studies, Yirsaw (2021) conducted a community-based cross-sectional mixed study to address ITN utilization among pregnant women in Ethiopia. The researchers found a strong association between residence and ITN utilization. Nonetheless, like other previous studies, the researchers analysed the two contexts together, making it difficult to ascertain whether the factors that influence ITN utilization are the same or differ in both contexts. This further fuelled the need for a study that will address these two contexts separately. Notwithstanding this

limitation, the researchers' mixed approached used in their studies allowed them to capture rich information in the study because other studies examine a limited number of variables as dictated by the data used. The association between residence and ITN utilization was also discovered in a recent study conducted by Kuse et al. (2022), who assessed the variation in insecticide-treated nets (ITNs) usage and its associated factors among pregnant women in Ethiopia. They found that most rural residents slept under ITNs unlike their urban counterparts who sparingly slept under ITNs. The variations observed across rural and urban contexts provide enough justification for further research that will investigate these contexts independently.

Forty and Keetile (2022) conducted a descriptive cross-sectional study in Malawi to explore the patterns and correlates of ownership and utilization of ITNs for malaria control among women of reproductive age. Contrary to the findings of previous studies, the study results showed a pattern of greater use of ITNs among women living in urban areas rather than rural areas.

2.4.2.4 Gender

Several studies have demonstrated that gender plays a significant role in ITN utilization. In many cultures, women are responsible for the health and well-being of their families, including malaria prevention (Thorsteinsen et al., 2022). As such, women often have a greater awareness of malaria prevention measures and are more likely to use ITNs than men. For example, a study conducted in Uganda found that women were more likely to use ITNs than men and that women who were pregnant or had young children were particularly likely to use ITNs (Musoke et al., 2015). Similarly, a cross-sectional survey conducted in Kisii District of Kenya to assess ITN ownership, the study found that women were more likely to use ITNs than men (Githinji et al., 2010). But while women may be more likely to use ITNs, there are still significant barriers that prevent them from doing so (Ahorlu et al., 2019). One major barrier is gender-based violence, which can prevent women from accessing and using ITNs. For example, a study conducted in Ghana found that women who reported experiencing intimate partner violence were less likely to use ITNs (Ackerson & Subramanian, 2008). Another study conducted in Tanzania found that women who reported experiencing violence from a partner were less likely to use ITNs (Chilanga et al., 2020)

Furthermore, traditional gender roles and power dynamics can also prevent women from using ITNs (Hildon et al., 2020). In many cultures, men are the primary decision-makers in households and women may not be able to access ITNs without their husbands' permission (Howard et al., 2000). For example, a study conducted in Ghana found that women who reported having less decision-making power in their households were less likely to use ITNs (Adongo et al., 2005) Similarly, a study conducted in Tanzania found that women who reported having less decision-making power were less likely to use ITNs (Shoo, 2011). In addition to these findings, female-headed households have been found to be associated with lower odds of ITN use as compared to male-headed households (Seyoum et al., 2023)

Some studies have shown that different roles dictate different sleeping patterns for men and women that impacts ITN use (Toé et al., 2009). Izugbara et al. (2020) conducted a study that explored how gender roles affect the utilization of insecticide-treated nets (ITNs) in sub-Saharan Africa. The study used qualitative research methods, including focus group discussions and in-depth interviews to gather data from both men and women in two African countries: Kenya and Ghana. The study found that gender roles, norms and power dynamics greatly influence the use of ITNs in these two countries. Women, who are traditionally responsible for household tasks, such as caring for children, are more likely to use ITNs than men. However, women often face barriers to ITN use, such as limited access to nets and a lack of control over household decisions, including the use of ITNs. In contrast, men are often the primary decision-makers in the household and have greater access to resources, including ITNs. But, men are less likely to use ITNs themselves or ensure that their families use them because of perceived negative social and cultural implications. Men may also prioritize other household expenses over ITNs. The study highlights the need for interventions that address gender roles and power dynamics within households to increase ITN use. Interventions should involve both men and women and take into account their respective roles and decision-making power. The study also underscores the importance of addressing broader social and cultural norms that contribute to gender inequalities and limit ITN use. Izugbara et al.'s study provides valuable insights into how gender roles affect the utilization of ITNs in sub-Saharan Africa. It highlights the need for gender-sensitive interventions that address power dynamics within households and broader social norms to increase ITN use and reduce the burden of malaria in the region.

Also, the use of long-lasting insecticide-treated nets (LLINs) to prevent malaria are dictated by gender norms and practices, including sleeping patterns, household decision-making power imbalances and gendered risk perceptions. While women are primarily responsible for ensuring the use of LLINs, men have ultimate decision-making authority as the household head. In a study conducted by Garley et al. (2013) on gender difference in the use of ITN in Kano State, Nigeria, the results showed that most females used ITNs compared to males. Contrary to this, a community-based cross-sectional study to assess ITN utilization and associated factors among households in Ilu Galan District, Oromia Region, Ethiopia by Mekuria et al. (2022) indicated that women were less likely to use ITN than men. The findings of this study showed that participants under the age of 25 years were negatively associated with ITN utilization. Gender roles and norms are significant determinants of ITN utilization. In most African societies, women are responsible for child care and household chores, while men are the primary breadwinners. This means that women have limited access to ITNs because they are not involved in purchasing or distributing them. In a study conducted in Ghana to assess inequality in ITN use, Budu et al. (2022) found that women had limited access to ITNs because they had to seek permission from their husbands before accessing them. In addition, women were found to be more likely to use ITNs when they had a say in household decision-making.

Evaluations and reflections from these studies show that gender plays a significant role in ITN utilization. While women are generally more likely to use ITNs, there are still significant barriers that prevent them from doing so. Gender-based violence and traditional gender roles and power dynamics can prevent women from accessing and using ITNs. Therefore, interventions to increase ITN utilization should be tailored to address these gender-specific barriers, such as promoting women's empowerment and addressing gender-based violence.

Uhomoibhi et al. (2022) used a cross-sectional study to investigate the drivers of long-lasting insecticide-treated net (LLIN) and parasitaemia among under-five children in 13 States with high malaria burden in Nigeria. The study revealed that LLIN utilisation was less likely among children in female-headed households. Although these studies focused on ITN utilization, they took narrow views by focusing mainly on vulnerable groups such as pregnant women and children under five, creating limitations in the external

utility and application of their findings. Over the years, however, findings from studies aimed at investigating ITN utilization have yielded inconsistent results.

2.4.2.5 Household Size

Household size has been identified as a potential predictor of ITN utilization, as larger households may have more competing priorities and challenges in ensuring that everyone sleeps under an ITN. To establish evidence for this, several studies have explored the relationship between household size and ITN utilization.

In a cross-sectional study conducted in Guinea, the authors found that households with larger sizes were less likely to use ITNs compared to smaller households (Diallo et al., 2023) Similarly, a study conducted in Tanzania showed that household size was negatively associated with ITN utilization. In a quest to provide research evidence on this, Gathitu (2016) conducted a descriptive cross-sectional survey to assess the determinants of ITN utilization in Kenya. The researcher found a significant association between household size and ITN utilization. Odufuwa et al. (2020) conducted a baseline cross-sectional survey in urban Dar es Salaam and rural Ulunga in Tanzania and found household size to be significantly associated with ITN use.

A study by Ng'ang'a et al. (2021)) conducted in Kenya found that larger households were less likely to utilize ITNs. The study revealed that households with more than four members had significantly lower ITN utilization rates than those with fewer than four members. The authors suggested that larger households may face more logistical challenges in ensuring that everyone sleeps under an ITN such as limited space, insufficient ITNs and differing sleeping patterns. Reflections on this trend suggest that household size is a significant predictor of ITN utilization in sub-Saharan Africa. Larger households are less likely to utilize ITNs compared to smaller households due to limited access to ITNs or competition for ITNs within the household.

A systematic review of studies by Kilian et al. (2013) found mixed evidence regarding the relationship between household size and ITN utilization. While some studies showed a negative association between household size and ITN utilization, others found no significant relationship. The authors highlighted the importance of contextual factors, such as cultural beliefs and socioeconomic status, in understanding the relationship between household size and ITN utilization.

Overall, the relationship between household size and ITN utilization remains complex and context-specific. While some studies have found a negative association between household size and ITN utilization, others have found no significant relationship or even a positive association.

2.4.2.6 Education Status

Many researchers have examined the relationship between education status and ITN use. In a hospital-based cross-sectional study conducted by Yitayew et al. (2018) at Addis Zemen Hospital, North-Western Ethiopia to assess the utilization and associated factors of insecticide treated bed net among pregnant women, the results of the study showed that mothers who had an educational status of college and above were many times more likely to utilize insecticide-treated bed net than mothers who could not read and write. Njumkeng et al. (2019) conducted a cross-sectional study to assess the use of ITNs among women of reproductive age (15-49 years) in the Muea Health Area of Cameroon. Apart from other findings, education was also found to be significantly associated with ITN use. A reflection on this study acknowledges the strengths of the study, which include its large sample size, the use of a structured questionnaire to collect data. However, the study has some limitations, including the use of self-reported data, which may be subject to social desirability bias. Additionally, the study was conducted in a single health area in Cameroon, which limits the generalizability of the findings to other regions or countries. In all, the study provides valuable insights into ITN use among women of reproductive age in Cameroon. The findings suggest that efforts to improve ITN use should focus on addressing some factors, especially education and that such efforts should be tailored to the specific needs and characteristics of the target population.

Research has shown that education level influences many aspects of health-related behaviour in human societies (Kraft et al., 2022). Also, education is said to be associated with health literacy and positive health habits and healthcare utilization (Jansen, 2014). People with higher education are expected to have knowledge and understanding about the usefulness and essence of using ITN for malaria prevention (Klu et al., 2022). This assertion is supported by a study conducted by Ndjinga & Minakawa (2010) in Kinshasa, Democratic Republic of Congo, which reported that women who had general secondary education or higher were between three to four times more likely to have an ITN and two to eight times more likely to use an ITN in bed when compared to women with less education. Also, in a cross-sectional

study conducted by Oresanya et al. (2008) to assess ITN utilization, education was found to be one of the key factors that predicted ITN use.

Baume and Franca-Koh (2011) in their cross-sectional study aimed to examine the predictors of mosquito net use in Ghana also found an association between education level and ITN utilization. Results of the study revealed that mother's or guardian's educational level and knowledge was found to be associated with a net being used. The likelihood of a net being used in a household where the mother or guardian had at least 10 years of education was very high compared to a net owned by a respondent with no education.

2.4.2.7 Marital Status

A cross-sectional study conducted in Nigeria to ascertain the socio-cultural factors influencing the rate of utilization of ITNs in a malaria endemic city of Makurdi, north central Nigeria, Jombo et al (2010) found that being married was a significant predictor of ITN utilization. The study showed that married women were more likely to use ITNs compared to unmarried women. The authors suggest that this may be due to the fact that married women are more likely to have ITNs available in their households, as their husbands may be more likely to purchase or obtain ITNs than unmarried women. By reviewing this study, it was found that both quantitative and qualitative data was generated from adult women using structured and semi structured questionnaires and focused group discussions to obtain information on rate and patterns of utilization of ITNs. This offered the authors in-depth information for the study.

Esimai and Aluko (2015) conducted a cross-sectional study in an urban local government area in Osun State, Nigeria to assess the use of insecticide treated nets and the determinants of its use among caregivers of under five children. The study showed that marital status was one of the factors that determined the use of ITNs amongst the respondents. The study also collected both qualitative and quantitative data that yielded rich data for the study but the study was conducted only in an urban area and therefore the results might reflect issues pertaining to the rural context. In Mananjary and Farafangana areas of Madagascar, ITNs are intrinsically part of the kits offered on the occasions of weddings or births, so they are part of the family tradition in these regions (Njatosoa et al., 2021). Thus married people obtain and use ITNs from the onset of their nuptial rites.

Obol et al. (2013) conducted a cross-sectional study to address the prevalence and factors associated with ITN utilisation among pregnant women in Gulu district of Uganda. The authors found marital status to be

highly significant at determining ITN utilisation. Pregnant women who were single/widow/divorce were less likely to utilise ITN than married/cohabiting pregnant women. The researchers attributed this to social support that married women received from their husbands, such as reminding them in case they had forgotten to hang their ITN up or encouraging them to use their ITN in case they are feeling lazy/reluctant to use ITN. The authors also suggested that married women are more likely to receive ITNs through their husbands, who may have access to ITNs through their work or social networks.

Adebayo et al. (2014) conducted a cross-sectional study to investigate the ownership and utilisation of ITNs among caregivers of under-five children and pregnant women in a rural community in Southwest Nigeria. Unlike the other studies, the authors found no association between marital status and ITN utilization. The authors suggest that this may be due to the fact that ITN distribution programs in Nigeria target households rather than individuals, and therefore, marital status may not play a significant role in ITN utilization.

Choonara et al. (2015) conducted a cross-sectional study in Kenya to assess factors influencing the usage of different types of malaria prevention methods during pregnancy. The authors found that marital status was associated with the non-use of ITNs among pregnant women. Pregnant women who had never been in a union were less likely to use an ITN. The authors argued that pregnant women in union may be influenced by their partner's decision to sleep under an ITN. Supporting evidence for this finding was also demonstrated in DR Congo in a cross-sectional study conducted by Song et al. (2016) to investigate ITN use by pregnant women. The study demonstrated that ITN use by married pregnant women was significantly higher than that of other women. Research study conducted in Ghana has further confirmed that marital status is associated with the regular use of ITNs (Dun-Dery et al., 2022). The authors reported that single pregnant women were less likely to use their ITNs compared with married pregnant women.

Tobin-West and Kanu (2016) performed a descriptive cross-sectional survey to explore the factors influencing the use of malaria prevention methods among women of reproductive age in peri-urban communities of Port Harcourt City, Nigeria. The study established that married women had 3 times higher odds of ITN usage than the unmarried.

2.4.3 Other Determinants of ITN Utilization

2.4.3.1 ITN Side Effects

Several studies have reported that ITN side effects can lead to decreased ITN utilization. In a cross-sectional study conducted in Uganda, participants reported that the side effects of ITNs, particularly skin irritation and heat, led to discomfort and interrupted sleep, which in turn led to decreased ITN use (Taremwa et al., 2017). A study conducted in Ethiopia found that participants who reported ITN side effects were less likely to use ITNs consistently (Tomass et al., 2011). Similarly, Eteng (2014) conducted a cross-section study in Cross River and Bauchi States in Nigeria to examine the socio-economic determinant of ITN ownership and use. From the study, it was found that ITN side effect was a major determinant of whether a person will sleep under ITN or not. The respondents recounted the discomfort associated with sleeping under ITNs in the forms of itching, nausea and even infertility or death. Mensah and Anto (2020) conducted a cross-sectional study in the Sunyani West District of Ghana to investigate individual and community factors associated with household ITN use. Among their findings, the researchers also found that people who experienced irritation from sleeping under ITNS were less likely to use ITNs.

Khanam et al (2018) to assess the gap between coverage, access to and use of LLINs among the households in malaria-endemic settings in Bangladesh. The study was based on a cross-sectional survey conducted in four rural districts of Bangladesh. The study found that fear of physical side effects was a significant barrier to ITN utilization among the study population. Specifically, respondents who reported fear of physical side effects were less likely to use ITNs compared to those who did not report such fear. Overall, the study highlights the importance of addressing fear of physical side effects in promoting ITN utilization. The authors suggest that efforts to increase ITN utilization should focus on addressing misconceptions about ITNs and their side effects, and providing accurate information about the benefits of ITN use. Additionally, the study underscores the need for targeted interventions to reach vulnerable populations who may be more likely to experience fear of physical side effects. However, other studies have reported conflicting results. A study conducted in Tanzania found no significant association between ITN side effects and ITN utilization (Protas et al., 2016). Another study conducted in Nigeria found that although participants reported ITN side effects, such as skin irritation and discomfort, these side effects did not significantly affect ITN utilization (Ovadje, 2014).

2.4.3.2 Cultural Beliefs

A study conducted in Tanzania found that cultural beliefs and practices such as using traditional remedies for malaria treatment and preference for traditional mosquito repellents influenced the use of ITNs. Participants who believed in traditional remedies and did not perceive mosquitoes as a significant threat were less likely to use ITNs (Ezezika et al., 2022). Njatosoa et al.(2021) conducted a secondary analysis of three qualitative studies to examine family, social and cultural determinants of long-lasting insecticidal net (LLIN) use in Madagascar. The researchers found cultural beliefs to be a strong determinant of ITN use. For example, it was found that in the highlands of Moramanga, Ankazob and the west coast of Morondava, people installed dead bodies under mosquito nets during the 3 days of the funeral rites to avoid contact between the body and environmental elements such flies, which participate in the decomposition of the body. This painful event imprints a macabre image associated with the use of a mosquito net, sleeping under a net sparks fears of the anguish of dying. White mosquito nets are culturally used for the dead causing many respondents in these areas to express an aversion to such ITNs.

Jombo et al. (2010) conducted a cross-sectional study in a malaria endemic city of Makurdi, north central Nigeria to explore the socio-cultural factors that influence ITN use. The researchers found that cultural beliefs about illness causation and prevention influenced the use of ITNs. For instance, women who believed that malaria was caused by supernatural forces were less likely to use ITNs. Additionally, cultural beliefs about the role of women in the household and their preferences for using traditional remedies also influenced ITN utilization.

This study conducted in Ghana found that cultural beliefs about malaria causation, prevention, and treatment influenced ITN utilization (Laar et al., 2013). Participants who believed that malaria was caused by supernatural forces and that it could be treated with traditional remedies were less likely to use ITNs. Additionally, participants who perceived ITNs as uncomfortable to sleep under or who preferred traditional methods of mosquito control were also less likely to use ITNs.

2.4.3.3 Access

A study conducted in Zambia found that households with easy access to ITNs were more likely to use them regularly compared to households with limited access (Mwangu et al., 2022). The study also revealed that ITN utilization increased significantly after the distribution of free ITNs in the area. A review of

studies conducted in sub-Saharan Africa found that increasing ITN access through mass distribution campaigns or routine health services was associated with increased ITN use. The review also showed that ITN use was higher among households that had multiple ITNs available. A study conducted in Uganda found that ITN access was positively associated with ITN utilization among pregnant women (Bashinyora, 2010). Women who lived within a 30-minute walking distance of a health facility were more likely to use ITNs regularly. Another study conducted in Tanzania found that increasing ITN access through community-based distribution programs was associated with increased.

2.4.3.4 Public Education

A study conducted in Tanzania found that providing information about ITNs and their importance through public education campaigns significantly increased the likelihood of ITN ownership and use among pregnant women and children under five (Nankinga et al., 2012). Another study in Ghana found that community-based education programs on malaria prevention, including the use of ITNs, led to increased ITN ownership and use (Owusu Adjah & Panayiotou, 2014). A study in Uganda found that ITN use was significantly higher among individuals who received information about ITNs through community education programs compared to those who did not receive such information (Singh et al., 2013).

Fuge, Ayanto and Gurmamo (2015) conducted a community based cross-sectional study in Shashogo District, Southern Ethiopia to assess the knowledge, attitude and practice about malaria and ITNs utilization. The study reported information from health extension workers and the media were found to be important predictors of pregnant women's ITN utilization. A review of their study spotted that the researchers used a small sample size for such a quantitative study. The study can be critiqued for its small size. The size of the sample might have impacted the study in different ways, including decreased statistical power, decreased sample representativeness, decreased external validity and as well as the study results prone to Type I and Type II errors.

2.4.3.5 Religion

Several studies have examined the influence of religion on the utilization of insecticide-treated nets (ITNs), which are a key intervention for preventing malaria. The literature suggests that religion can have both positive and negative effects on ITN utilization. Some studies have found that religious beliefs and practices can be positively associated with ITN use. For example, a study in Ethiopia found that

individuals who reported praying frequently were more likely to use ITNs (Birhanu et al., 2017). Another study in Ghana found that individuals who attended religious services regularly were more likely to use ITNs (Awoonor Williams, 2022) These findings suggest that religious leaders and institutions may be effective channels for promoting ITN use. Maternal religious affiliation also played a role in the respondents' decision to use ITNs. Muslim pregnant women were less likely to use ITNs than Christian pregnant women (Dun-Dery et al., 2022).

However, other studies have found that religion can also be a barrier to ITN utilization. For example, a study in Nigeria found that religious beliefs that malaria is caused by spiritual factors rather than mosquitoes were associated with lower ITN use (Rumun & Terungwa, 2015).

2.4.3.6 Ethnicity

A cross-sectional study carried out by Auta (2012) in Nigeria utilized data from the Nigeria Demographic and Health Survey 2008 to examine the use of insecticide-treated nets (ITNs) among women and children. The study revealed a significant association between participants' ethnicity and the utilization of ITNs. Similarly, a mixed-effect study analysis by Klu et al. (2022) demonstrated higher odds of ITN use among pregnant women belonging to the Akan ethnic group. Research has shown that cultural beliefs and social norms, which are influenced by ethnicity, can play a crucial role in shaping various health behaviors (Weber Cullen et al., 2002). These findings suggest that a person's ethnicity can have a considerable impact on their attitudes and practices related to health.

2.5 Summary of Literature

A lot of studies have been done on factors that influence ITN utilization in malaria prevention using different approaches. a critical review of these studies revealed some gaps, limitations and areas within the field that have not been researched. It was identified from the literature that in many of the studies, the major focus was on vulnerable groups such as pregnant women, children under five and women of reproductive health. In most cases, such sample sizes do not yield adequate external validity, hence it limits the utility of their findings to their immediate focus group and settings. It was also spotted from the analysis that studies that used similar approaches found similar results regardless of the settings in which they were conducted. It is important to note that most authors used cross-sectional designs in their studies which makes it difficult to assume any causal relationships in such studies. Besides, cross-sectional studies

only capture data from a single time point. They do not allow for the examination of changes in ITN utilization over time or the identification of trends that may influence utilization.

Many studies focused on individual-level socio-demographic factors that influence ITN utilization, such as age, income, knowledge and attitudes and ignored the wider community and policy level factors that also influence ITN use. It is worth acknowledging that the studies that adopted mixed approaches yielded additional findings that were not revealed by studies that assumes simplistic designs. Apart from this, it was also revealed from the literature review that studies that assessed factors that influence ITN use in both rural and urban areas failed to discover whether these factors are the same or differ in each context. They aggregated the two contexts, which only showed that residence is associated with ITN utilization. It is, however, worthy to acknowledge that most of the researchers saw the need for further studies that will look at the rural-urban contexts separately to know the determinants of ITN utilization in each context, hence necessitating this study. Studies that follow individuals over time with respect to their ITN utilization are limited in the literature despite their ability to provide comparatively better assessment of changes in ITN use and identify factors that influence the changes. Some studies relied on simple measures of ITN utilization, such as whether or not individuals own or slept under ITN the night before, rather than more detailed measures such as frequency of use and reasons for non-use. Apart the biases that will be embedded in the responses to such simplistic measures, the season or period of the data collection can impact the results in a cross-sectional study. A research study that will follow same individuals over a specified period of time is necessary.

Addressing these limitations and gaps in research studies can improve our understanding of the factors that influence ITN utilization and help to develop more effective interventions to promote ITN use. Overall, while cross-sectional studies can provide valuable insights into the factors influencing ITN utilization, they should be interpreted with caution and in conjunction with other types of research, such as longitudinal studies and randomized controlled trials, to strengthen the evidence base.

CHAPTER THREE: METHODOLOGY

3.0 INTRODUCTION

According to Creswell (2017), the methodology of a research refers to "the overall approach, strategy and plan of action that guides the research project" (p. 18). This definition suggests that methodology is a framework that sets out the overall approach of the research project, including the methods and procedures to be used in the study. The methodology outlines important details such as the study's design, participants,

equipment and materials used, variables examined, participant, ethical approval, and analysis and statistical methods employed (Shah, 2015). The methodology articulates the logic and flow of the systematic processes followed in conducting a research project, so as to gain knowledge about a research problem (Khatri, 2020). Reflecting on these definitions, it is evident that the methodology plays a vital role in research because a systematic and rigorous approach enables researchers to ensure the credibility and accuracy of their findings (Denzin & Lincoln, 2011). This underscores the need for a carefully and scholarly written methodology for a study on factors that influence ITN utilization. In line with this, this section of the study presents a thorough and chronological description of its paradigm, research design, study setting, data, questionnaire, data quality assurance, measures, data analysis and ethical considerations.

3.1 Research Paradigm

A research paradigm refers to a set of assumptions, concepts, values and practices that define the nature of research and guide the process of knowledge generation within a particular discipline or field of study (Creswell & Creswell, 2017). It refers to a researcher's basic beliefs and assumptions about how knowledge is developed, what can be known and how research should be conducted. According to Willis et al. (2007), a research paradigm is a comprehensive belief system, worldview or framework that guides research and practice in a particular field. Similarly, Hughes (2020) sees a research paradigm as a researcher's way of seeing the world and influences the way the researcher thinks about the topic. A paradigm consists of four elements: epistemology, ontology, methodology and axiology (Guba & Lincoln, 1994). Ontology deals with the nature of reality and epistemology is concerned with the philosophy of knowledge or how we come to know (Trochim, 2006) and the relationship between the knower and what is known. The methodology aspect of a research paradigm deals with the appropriate approach to systemic inquiry (Khatri, 2020). Axiology, the final component of research paradigm, has to do with the ethical issues that need to be considered during a research work (Mertens, 2010). From this discussion, it is evident that research paradigms are very important in the research process. Being aware of a researcher's paradigm will help us to better understand the relevance of the research study (Rehman & Alharthi, 2016). The research paradigm defines a researcher's philosophical orientation and exerts significant implications for every decision made in the research process (Khatri, 2020). This is further supported by Dobson (2002) who asserts that the researcher's theoretical lens plays an important role in the choice of methods to use

for investigating a particular phenomenon. Thus, adopting a research paradigm is necessary in a study on factors that influence ITN utilization as it helps to provide a clear direction, facilitate data collection and interpretation, increase the credibility of the study and facilitate replication.

This study adopted the positivist paradigm. Positivism is a research paradigm that seeks to explain and predict what happens in the social world. It does so by searching for regularities and causal relationships between its constituent elements. The positivist paradigm sees the world as being based on unchanging, universal laws and the view that everything that occurs around us can be explained by knowledge of these universal laws (Hughes, 2020). The positivist paradigm supports the use of quantification to represent and evaluate aspects of social reality. These elements of social reality are deemed to be constant throughout time and contexts. Scales of numbers can be used to represent these elements as values (Gall et al., 2003). This thesis aims to achieve factual and objective findings on factors associated with insecticide-treated net utilization. This aligns with the positivist paradigm, which believes in factual and objective means of inquiry (Irshaidat, 2022). Studies with positivist paradigm are based purely on facts and consider the world to be external and objective. Grix (2004) provides further justification for this by stating that positivist researchers tend to use highly structured research methodology in order to allow the replication of the same study in the future. The relevance of the positivist paradigm in relation to this study is that it is a quantitative study. As quantitative thesis, the positivist paradigm, which advocates for the use of quantitative data to measure relationship between variables (Crossan, 2003) emerged as the appropriate worldview to deploy in this investigation. Researchers who adopt a positivist stance choose quantitative methods in their research. This is because positivists believe that the nature of human behaviour and society is objective and can be scientifically measured, and quantitative methods emphasize objective measurements through numbers. The goal of positivist research is to study patterns and relationships between social factors, which can help researchers make accurate predictions about society and social change. According to positivists, this is best done through quantitative methods. Quantitative methods allow positivist researchers to collect data from large samples and collate it into data sets, tracing patterns, trends, correlations, and finding cause-and-effect relationships through statistical analysis (W Lawrence, 2014).

3.2 Research Design

Robson (2011) defines research design as a structured and systematic approach that involves selecting the appropriate research methods and techniques to address research questions and objectives. This stresses the need for researchers to carefully consider which methods and techniques are best suited to answering their research questions and achieving their research objectives. A research design is the blueprint for the collection, measurement and analysis of data (Creswell & Creswell, 2003). This emphasizes the importance of having a clear and well-defined plan for how data will be collected, measured, and analyzed in order to ensure that the research is conducted in a rigorous and systematic way. According to Bryman (2018), a research design is the plan, structure and strategy of investigation that is adopted so as to obtain answers to research questions or otherwise resolve a problem. This definition highlights the need for researchers to carefully consider how they will approach their research questions and how they will obtain answers to those questions in a systematic and rigorous way.

The type of research design that is used depends on the research problem being investigated (Creswell & Creswell, 2017). For example, if the research problem involves testing a specific hypothesis, relationship or theory, a quantitative research design may be more appropriate. On the other hand, if the research problem involves understanding the experiences of individuals living with a particular condition, a qualitative research design may be appropriate. In some cases, the research problem may require a mixed-methods research design, which combines both qualitative and quantitative methods. This approach can be useful when the research problem involves both exploring complex phenomena and testing specific hypotheses (Sammons & Davis, 2016).

This study adopted a cross-sectional design to investigate the factors that influence insecticide net utilization disparity between rural and urban populations in Ghana. The cross-sectional design was appropriate for this study because it allowed the researcher to assess relationships between the variables in the study. The study aimed to investigate factors that influence the utilization of insecticide nets in rural and urban populations. The design is often used to study differences between groups or to identify factors associated with certain outcomes (Naiji et al., 2013).

A cross-sectional design is a type of research design in which data is collected from many different individuals at one point in time (Levin, 2006). It is described as taking a “snapshot” of a group of

individuals (Wang & Cheng, 2020). The defining feature of a cross-sectional study is that it can compare different population groups at a single point in time. In cross-sectional research, variables are observed without influencing them (Setia, 2016). The cross-sectional design was used in this study because it is scholarly said to be appropriate for identifying associations between variables (Levin, 2006). Also, cross-sectional designs are used for population-based surveys and to assess the prevalence of diseases (Setia, 2016). A cross-sectional study involves the review of information from a population demographic at a specific point in time (Omair, 2015). Reflecting on the above interpretations of a cross-sectional design, the author of this thesis summarized a cross-sectional design as a research design that measures the relationship between variables by collecting data at a specific point in time in a target population.

The dataset for this study is a quantitative data that was sourced from the 2019 Ghana Malaria Indicator Survey (GMIS), which partly influenced the decision to engage the cross-sectional design in this study. The is because the Demographic and Health Survey (DHS) program which collected the original data utilized a cross-sectional research design. Besides, the cross-sectional design allowed the researcher to obtain information from a large population in a relatively fast and inexpensive manner. Another reason that informed the choice of the cross-sectional study design is that it allowed the researcher to compare many different variables that influence ITN utilization at the same time. It has also been reported that cross-sectional designs are very useful for measuring the prevalence of health outcomes, understand determinants of health and describe features of a population (Wang & Cheng, 2020). However, it is difficult to determine causal relationships using a cross-sectional design. Regardless of this minor pitfall, the cross-sectional design emerged as the most appropriate for this study considering the larger size of the population under study and its past applicability in similar studies.

3.3 Study Setting and Population

This study was carried out in Ghana, a country located in West Africa and shares borders with Ivory Coast in the west, Burkina Faso in the north and Togo in the east. It also borders with the Gulf of Guinea and the Atlantic Ocean in the south. Ghana covers an area of 238,535 km2 and has a vegetation that is mainly coastal savannas and tropical rainforests. This makes it a fertile breeding ground for malaria-causing

mosquitoes, making malaria one of the main health challenges in Ghana. The dominant occupation in Ghana is farming, which is mostly practiced in the rural forest areas of the country. Fishing is practiced by most inhabitants who reside along the coastal areas of Ghana. According to the Ghana Statistical Service (2021), the total population of Ghana as of the year 2021 stood at 32.83 million spread into 5,467,054 households. Of this population, 48.8% were males and 51.2% were females. Urban residential households were 3,049,366 while rural residential households stood at 2,417,688. The comparison according to the rural-urban divide indicates a slightly higher proportion of the population to be female in the urban than the rural localities. This may be due to the phenomenon of relatively more female than male, especially children who migrate from rural communities into urban areas (Anarfi & Appiah, 2009). More than one-half of the population is Christian. About one-fifth is Muslim and a small segment adheres to the traditional indigenous religions.

Ghana is divided into 16 administrative regions, each with its own capital city as shown in Figure 2. The regions are further divided into districts and sub-districts, which are responsible for delivering basic services to the population. Each region has a unique cultural and ethnic identity, and their economies are mainly based on agriculture, mining, and tourism. The administrative regions of Ghana play a crucial role in the delivery of essential services to the population, including healthcare, education, and infrastructure development. Understanding the specific needs and challenges of each region is essential for effective policymaking and resource allocation to promote sustainable development and improve the quality of life of the people of Ghana.

Malaria is a major public health concern in Ghana, with approximately 3.5 million cases reported annually, and it is the leading cause of morbidity and mortality in the country (Shretta et al., 2020). The government of Ghana, in partnership with several international organizations, has implemented various malaria control interventions, including the distribution of insecticide-treated nets (ITNs).

Figure 2: The Map of Ghana

3.4 Data Source

The data for this study was secondary data obtained from the 2019 GMIS dataset, which forms part of the DHS program. The DHS collects, examines and disseminates nationally representative data on demographics, health, HIV and nutrition across more than 90 countries in the world. The 2019 GMIS was implemented by the Ghana Statistical Service (GSS) in close collaboration with the Ghana National Malaria Control Programme (NMCP) and the National Public Health and Reference Laboratory (NPHRL) of the Ghana Health Service (GHS). Financial support for the survey was provided by the United States Agency for International Development (USAID). The Noguchi Memorial Institute for Medical Research (NMIMR) was responsible for external laboratory quality assurance. The primary objective of the 2019 GMIS was to provide current estimates of key malaria indicators. The 2019 GMIS was the second in the series. The first survey was conducted in 2016. The 2019 GMIS was a national survey designed to obtain population-based estimates of malaria indicators to complement routine administrative data that are used to inform strategic planning and evaluation of the Ghana Malaria Control Program. The survey provides information on malaria prevention, treatment, and prevalence in Ghana. More specifically, the survey collected data on ownership and use of mosquito bed nets. It also assessed coverage of intermittent preventive treatment to protect pregnant women against malaria, identified practices and specific medications used to treat malaria, measured indicators of malaria knowledge and communication messages. It further estimated the prevalence of malaria and anaemia among children age 6-59 months.

3.5 Sampling Procedure

A stratified sampling technique was used in the data collection. Stratified random sampling is a method of sampling that involves the division of a population into smaller subgroups known as strata (Pirzadeh et al., 2011). The stratification is usually based on shared attributes or characteristics. The rational for the choice of stratified sampling technique in the data collection was to ensure that the diversities in the population were properly represented in the sample.

The sampling frame used for the 2019 GMIS is the frame of the 2010 Population and Housing Census (PHC). At the time, Ghana had ten regions, so the sampling frame was based on those 10 regions. The frame is a complete list of all census enumeration areas (EAs) created for the PHC. The sampling frame contains information about EA location, type of residence (urban or rural), the estimated number of

residential households, and the estimated population. The 2019 GMIS sample was stratified and selected from the sampling frame in two stages. Each region was divided into urban and rural areas. This yielded 20 sampling strata. Samples of EAs were selected independently in each stratum in two stages. In the first stage, 200 EAs (97 in urban areas and 103 in rural areas) were selected with probability proportional to EA size and with independent selection in each sampling stratum. A household listing operation was conducted from 24 June to 10 August 2019 in all of the selected EAs. The list of households was directly recorded on tablet PCs, using the computer-assisted personal interviewing (CAPI) system. This list served as a sampling frame for the selection of households in the second stage. Some of the selected EAs were very large. To minimise the task of household listing, each large EA selected for the 2019 GMIS was segmented. Only one segment was selected for the survey with probability proportional to segment size. Household listing was conducted only in the selected segment. Thus, in the 2019 GMIS, a cluster is either an EA or a segment of an EA. As part of the listing, the field teams updated the necessary maps and recorded the geographic coordinates of each cluster.

In the second stage of selection, a fixed number of 30 households was selected from each cluster to make up a total sample size of 6,000 households. All women age 15-49 who were either permanent residents of the selected households or visitors who stayed in the household the night before the survey were eligible to be interviewed. With the parent's or guardian's consent, children age 6-59 months were tested for anaemia and malaria infection.

A total of 6,000 households were selected for the survey. Out of this number, 5,833 were occupied at the time of fieldwork. Of the 5,833 households that were occupied at the time of the visit, 5,799 were successfully interviewed. This yielded a massive response rate of 99%. In the interviewed households, 5,246 eligible women were identified for individual interviews and 5,181 were successfully interviewed, yielding a response rate of 99%.

The 2019 GMIS used four types of questionnaire for the data collection. These include the Household Questionnaire, the Woman's Questionnaire, the Biomarker Questionnaire and the Fieldworker Questionnaire. The questionnaires were adapted to reflect issues relevant to Ghana. Modifications were determined after a series of meetings with various stakeholders. These stakeholders were from the NMCP, government ministries, nongovernmental organizations and international partners. The Households,

Biomarker and Women Questionnaires were written in English and also translated into four local Ghanaian languages namely Akan, Dagbani, Ewe, and Ga. The Household and Woman's questionnaires were then programmed into tablet computers. This enabled the use of computer-assisted personal interviewing for the survey. The Biomarker Questionnaire, however, was filled out on hard copy and entered into the CAPI system after completion.

This study placed its focus on the household questionnaire because it captured information on persons who slept in the selected households the night before the survey as well as their mosquito net usage which are important variables of interest in this research. The Household Questionnaire was used to list all of the usual members of and visitors to the selected households. Basic information was collected on the characteristics of each person listed in the household, including age, sex, and relationship to the head of the household.

3.6 Data Quality Assurance

The data for this study is of high quality and provides accurate measurement of indicators due to multiple steps in the data collection, processing and data reporting (Croft et al., 2018). All the staff involved in the data collection were taken through an intensive course on interviewing and field procedures. The training was facilitated by experts from the DHS Program, NMCP and GSS. A detailed review of the questionnaire content, instructions on questionnaire administration were done. A highly skilled team comprising supervisors, interviewers and health technicians practiced data collection at Winneba in the Central Region of Ghana.

During the actual data collection, when eligible respondents were absent from their homes, two or more call backs were made to offer respondents the opportunity to participate in the survey. Apart from the field supervisors, there were also national and regional monitors who supervised field activities. NPHRL field monitoring staff were responsible for data collection quality control, timely collection and transfer of slides from the field teams to the NPHRL.

The Census and Survey Processing (CSPro) program was used for data editing, cleaning, weighting and tabulation. Data received from the field teams' CAPI applications were registered and thoroughly checked for any inconsistencies and outliers at the GSS Head Office. Missing cases were given special codes. Data

editing and cleaning included an extensive range of structural and internal consistency checks. All anomalies were communicated to field teams, which resolved data discrepancies. The corrected results were maintained in master CSPro data files.

The quality of data for this study has also been confirmed by different authorities. Surveys conducted in the context of the DHS programme are an important source of data (Ties Boerma & Sommerfelt, 1993) for analyzing trends in populations in developing countries. His argument is based on the high credibility associated with the DHS Program. In addition to this, data quality assessment reports conducted over the period have also confirmed it to be of high quality (Pullum, 2019).

3.7 Data Access and Authorization

Access to the 2019 GMIS data used for this study was gotten through an online application to the DHS Program. As a rule, before the DHS data could be used by individuals, the author must first seek authorization from the DHS Program. This involves a written submission of the intended use of the data, in this case, the topic and abstract of this thesis. On the 18th October, 2022, permission to use the dataset for this academic purpose was granted (see permission letter attached in appendix). The DHS data is collected in various countries in the global south and can be accessed freely through application by the general public.

3.8 Data Analysis

Data for this research was analyzed with IBM Statistical Package for Social Sciences (SPSS) version 16. The demographics of the respondents were analyzed using descriptive statistics and presented in the form of frequencies and percentages. To determine the factors associated with ITN use, a multiple logistic regression model was employed. Also, bivariate analysis was conducted to assess the association between the independent and dependent variables. To know the correlation among the variables, multiple regression analysis was further conducted.

3.8.1 Data Examination

Data examination is a vital process prior to the main data analysis (Creswell & Poth, 2016). Preliminary analyses on any data set include checking the reliability of measures, evaluating the effectiveness of any manipulations, examining the distributions of individual variables, and identifying outliers (Shaughnessy et al., 2000). Guided by this, preliminary data examination was done to fully understand the data structure

and to ensure that the variables of interest were present. Special attention was paid to issues of missing values and outliers because they have the potential to distort the true results of the analysis if not well resolved (Tabachnick et al., 2007). The data for this study was initially run to obtain descriptive statistics. These included checking out for the mean, normality, missing values and the distribution of the data.

The guide to DHS statistics spells out how missing values are handled. Responses such as 'missing', 'don't know', 'not applicable' 'inconsistent' and 'blank' are assigned special codes. In this study, missing values were handled by listwise deletion. Listwise deletion means any individual in a data set is deleted from an analysis if they are missing data on any variable in the analysis (Bell et al., 2009). Cases with missing values were dropped or removed from the analysis. The advantage of this method is that the remaining dataset is complete. The fewer nature of missing values informed the decision to use listwise deletion. It is recommended that if a missing data problem can be resolved by discarding only a small part of the sample, then listwise deletion can be quite effective (Schafer & Graham, 2002). Listwise deletion is described as the only approach that assures that no bias is introduced under any circumstances (Miettinen, 2012). However, the method could prove harmful if there are many missing cases as the deletions result in significant reduction in sample size for the analysis (Enders, 2010). In any case, it is the most frequently applied data handling method in many fields of research, especially in medical, epidemiological and population studies (Eekhout et al., 2012) and remains the default way of handling incomplete data in many statistical packages, including the SPSS used for the data analysis in this study.

3.9. Measures

3.9.1 Variables

The two main variables of this study were ITN use and residence (urban or rural). Other demographic variables that were of interest in this study were wealth index, educational attainment and sex. A bivariate analysis was initially conducted to find out the relationship that existed between these variables. Logistic regression was used to identify factors associated with ITN use. ITN use was measured by the number of de jure individuals who slept in the house the night before the survey. The relationship between the independent variable (residence) and the dependent variable (residence) was assessed in a bivariate model while the social demographics of age, sex, wealth index and educational attainment were controlled for.

3.10 Ethical Consideration

The cornerstone of ethical research is informed consent (Denzin & Lincoln, 2011). Researchers conducting research in Norway are required to seek ethical clearance from the Norwegian Centre for Research Data (NSD). This study, however, used secondary data so this was not applicable. The DHS Program followed strict ethical standards. The consent of the respondents in the survey was first sought before the questionnaires were administered. Informed consent statement was read out to the respondents, who may accept or decline to participate in the survey (Mishra et al., 2006). Information collected from respondents under the DHS is anonymous (Adetunji & Shelton, 2011). The data for this study was transformed and coded to protect anonymity and privacy of respondents. Names and addresses were not retained in DHS data files. Moreover, the Inner City Fund institutional review board examined and approved the Ghana DHS survey. This was to ensure that it conformed with the rules set forth by the U.S. Department of Health and Human Services for the protection of human subjects. The survey was also examined by the institutional review board of Ghana. This was done through the Noguchi Memorial Institute for Medical Research.

CHAPTER FOUR: RESULTS

4.0 Introduction

This chapter presents the results of the study which aimed at investigating factors that influence ITN utilization in rural and urban areas. First, data were subjected to descriptive analysis to gain a better understanding of the dataset's characteristics. Furthermore, the social-ecological model was used as the basis to enter variables into the hierarchical multiple regression model to help determine the predictors of rural and urban ITN use.

4.1 Descriptive Statistics

According to Creswell (2017), descriptive statistics is a preliminary examination of data that aims to meaningfully describe, show, or summarize the data. This process involves examining data distribution and identifying any patterns, trends, or outliers, to provide a comprehensive overview of the data before further analysis is conducted (Field, 2013). In agreement with these views, Tabachnick and Fidell (2013) explain that descriptive statistics are important in identifying any problems with the data, such as missing values, outliers, or anomalies, before further analysis is conducted. In relation to this study, the use of descriptive statistics was essential for understanding the characteristics of the 2019 GMIS data and identifying any issues that may impact the results of the main analysis. Although descriptive statistics do not draw any inferences from the data that have been analysed or from any hypotheses, it helps in describing and identifying patterns in a dataset (Loeb et al., 2017).

Univariate analysis to detect missing data and outliers was conducted. The variables examined are mostly categorical and no outliers were identified by the researcher. Additionally, the percentage of missing data was relatively low, with an average of less than 10%. Statistical guidance articles have stated that bias is likely in analyses with more than 10% missing values (Dong & Peng, 2013; Jakobsen et al., 2017). Thus, with the percentage of missing values below this threshold, it was unlikely to have a significant impact on the study's results. Also, since the number of missing cases was minimal, listwise deletion was used to eliminate all cases with one or more missing values. Listwise deletion produces unbiased estimates of variances and regression weights (Allison, 2010). Table 1 presents the descriptive statistics for each variable explored in this study.

Table 1: Descriptive characteristics of study variables

	N	(%)
Total sample	25316	100
ITN use		
Yes	13135	51.9
No	12149	48.0
Missing	32	0.1
Residence		
Urban	9957	39.3
Rural	15459	60.7
Number of people in household		
1 person	9957	39.3
2 persons	7366	29.1
3 persons	4160	16.4
4 persons	2067	8.2
5 or more persons	1766	7.0
Number of ITN		
3 or less	15282	60.4
4 to 7	8957	35.4
8 or more	1077	4.2
Way net was obtained		
2014-2017 Mass distribution campaign	20786	82.1
ANC	1610	6.3
Immunization visit	548	2.2
Missing	2372	9.4
Education of household head		
Pre-primary or none	8842	34.9
Primary	3667	14.5
JSS/JHS/Middle	7900	31.2
SSS/SHS/Secondary	2701	10.7
Higher	2184	8.6
Missing	22	0.1
Ethnicity		
Akan	8519	33.7
GA/Damgme	1783	7.0
Ewe	3041	12.0
Guan	946	3.7
Gruma	1060	4.2
Mole Dagbani	6821	26.9
Grusi	1174	4.6
Mande	87	0.3
Missing	1885	7.4
Household with an under-5 child		

Yes	10095	39.9
No	15221	60.1
Rural wealth index quintile		
Poorest	7319	28.9
Second	4791	18.9
Middle	4482	17.7
Fourth	4246	16.8
Richest	4478	17.7
Age of household head		
40 years or less	9015	35.6
41 years and above	15674	61.9
Missing	627	2.5
Sex of household head		
Male	16377	64.7
Female	8312	32.8
Missing	627	2.5

4.1.1 Sample characteristics

The majority (60.7%) of the households were sampled from rural areas whereas 39.3% of households were sampled from urban areas. Most of the participants' household heads had no education/ pre-primary education (34.9%) or had junior high school education (31.2%). Only 8.6 per cent of participants' household heads had higher education. Most of the households sampled were headed by members from the Akan ethnic group (33.7%) while fewer households were headed by members from the Mande ethnic group.

Out of 25316 households surveyed, only 39.9% of them had a child or children under-five years in their households. The majority (60.4%) of the households had 3 or fewer insecticide-treated nets. The majority of household heads were above 40 years (61.9%) and were men (64.7%). The majority of the participants obtained their nets from the 2014 to 2017 mass distribution campaign (82.1%) by the Ghana government. Only a few households obtained their nets from antenatal visits (6.4%) and immunization visits (2.2%).

4.2 Bivariate Analysis

Bivariate analysis refers to the analysis of two variables to determine relationships between them (Bertani et al., 2018). Bivariate analysis is an essential first step in data analysis as it allows researchers to explore the relationship between variables to determine whether a more complex analysis is necessary (Kline, 2023). Accordingly, to determine the relationship between residence an ITN use, bivariate analysis was conducted to explore the correlations between these variables, allowing the researcher to build a foundation for further analysis.

4. 2.1 Bivariate analysis of the association between residence type and ITN use in Ghana

The association between residence type (rural and urban) and ITN use was tested using a Chi-square test of independence. Table 1 presents the results of the Chi-square test.

Table 2: Chi-square test of association between residence and ITN use in Ghana

Variable	Category	ITN use (%)	N (total)	χ^2	*P-value*
Residence	Urban	37.5%	9949	1373.781	0.000
	Rural	61.3%	15335		

The results from Table 2 show that among the total sample of 25,284 participants, 9,949 lived in urban areas and 15,335 lived in rural areas. The percentage of ITN use among urban residents was 37.5%, while the percentage of ITN use among rural residents was 61.3%. The Chi-square test statistics were χ^2 (1, N = 25284) = 1373.78, $p < 0.001$, indicating a significant association between residence and ITN use in Ghana. Rural residents were more likely to use ITN than urban residents.

Bivariate analysis was also conducted to find out which factors are associated with usage of ITN in rural and urban areas. Table 3 presents the results of the analysis of factors associated with ITN use in urban areas.

Table 3: Bivariate analysis of the association between independent variables and ITN use in urban Ghana

Variables	Category	Urban ITN use (%)	N (total)	χ^2	*p-value*
Sex of household head	Male	37.6%	6119	0.021	0.884
	Female	37.8%	3552		
Age of household head	40 years and below	37.6%	3604	0.003	0.957
	41 years and above	37.7%	6067		
Number of people in household	1	46.2%	4224	369.48	0.000
	2	37.3%	2929		
	3	28.6%	1548		
	4	24.5%	710		
	5 or more	13.9%	547		
Number of mosquito net	3 or less	39.7%	6560	45.75	0.000
	4 to 7	34.0%	3042		
	8 or more	26.8%	347		
Wealth index	Poorest	52.8%	1936	322.66	0.000
	Second	41.8%	1879		
	Middle	33.0%	2022		
	Fourth	32.9%	1984		
	Richest	28.2%	2128		
Education level of household head	Pre-primary or none	41.6%	1158	37.17	0.000
	Primary	41.0%	645		
	JSS/JHS/Middle	36.6%	2347		
	SSS/SHS/Secondary	36.6%	1069		
	Higher	32.6%	997		
Ethnicity	Akan	37.0%	4436	80.71	0.000
	GA/Damgme	27.1%	971		
	Ewe	39.6%	1400		
	Guan	35.2%	244		
	Gruma	47.2%	197		
	Mole Dagbani	40.7%	1716		
	Grusi	50.2%	243		
	Mande	40.4%	47		
Way net was obtained	2014-2017 Mass distribution	37.9%	4852	1.13	0.570
	ANC	38.3%	439		
	Immunization visit	34.3%	132		
Households with Under 5 children	With under 5 children	38.4%	4029	2.37	0.124
	No under 5 children	36.9%	5920		

The analysis revealed that the number of people in a household, number of mosquito nets in a household, wealth index (quintile), education level of household head and ethnicity were significantly associated with ITN usage in urban areas ($p < 0.001$). The way ITN was obtained, households with children under five years, age and sex of household heads did not have a significant association with ITN usage in urban areas ($p > 0.05$) (See details in Table 3).

The bivariate analysis results from Table showed that, number of people in households, number of mosquito nets in households, wealth index, education level of household head, ethnicity and the way net was obtained were significantly associated with rural ITN use in Ghana (P<0.001). Sex of household head, age of household head and household with under-five children were not significantly associated with rural ITN use in Ghana (P>0.05) (See details in Table 4).

Table 4: Bivariate analysis of the association between independent variables and ITN use in rural Ghana

Variables	Category	Rural ITN use (%)	N (Total)	χ^2	*P-value*
Sex of household head	Male	60.8%	10239	2.802	0.094
	Female	62.2%	4747		
Age of household head	40 years and below	60.8%	5399	0.884	0.347
	41 years and above	61.5%	9587		
Number of people in household	1	71.9%	5729	822.7	0.000
	2	63.7%	4436		
	3	54.5%	2606		
	4	44.6%	1353		
	5 or more	35.9%	1211		
Number of mosquito net	3 or less	64.6%	8707	129.75	0.000
	4 to 7	58.4%	5898		
	8 or more	46.2%	730		
Wealth index (quintile)	Poorest	67.2%	4367	272.54	0.000
	Second	63.6%	3466		
	Middle	63.4%	2702		
	Fourth	58.2%	2586		
	Richest	47.2%	2214		
Education level of household head	Pre-primary or none	64.5%	6839	76.11	0.000
	Primary	61.5%	2571		
	JSS/JHS/Middle	58.5%	4189		
	SSS/SHS/Secondary	57.5%	1015		
	Higher	51.9%	705		
Ethnicity	Akan	54.5%	4080	208.35	0.000
	GA/Damgme	53.7%	812		
	Ewe	68.0%	1638		
	Guan	50.6%	701		
	Gruma	68.7%	863		
	Mole Dagbani	63.4%	5099		
	Grusi	67.8%	913		
	Mande	57.5%	40		
Way net was obtained	2014-2017 mass distribution	62.1%	4906	15.79	0.000
	ANC	61.8%	342		
	Immunization visit	51.6%	168		
Households with Under 5 children	With under 5	61.0%	6055	0.585	0.444
	No with Under 5	61.6%	9280		

Despite the lack of statistically significant association between some of independent variables and ITN use in the bivariate analysis, these variables were still included in the hierarchical multiple logistic regression. This is because cross-tabulation analysis only examines the bivariate relationship between two variables and does not take into account potential confounding factors that may affect the relationship between the predictor and outcome variables (Momeni et al., 2018). In addition, including all relevant variables in a regression analysis means the researcher can control for potential confounders and obtain more accurate estimates of the effect of each predictor variable on the outcome (Wysocki et al., 2022). Equally important is that variables that may not be associated with the outcome variable in the bivariate analysis may still have a significant effect when other variables are taken into account.

4.3 Multivariate analysis of predictors of ITN usage in Ghana

Factors that influence ITN use in both rural and urban Ghana were grouped according to the SEM. Sex, age and education level of household heads were grouped under the individual level of the SEM. At the household or interpersonal level, factors such as the number of people in a household, the presence of children under-5, household wealth and number of mosquito nets in a household were considered. Factors such as ethnicity and the way ITN was obtained were grouped under community level of the SEM. In conducting the hierarchical multiple binary logistic regression, the individual level factors were entered in the first model (Model 1), followed by household level factors (Model 2), and lastly community level factors were entered into the hierarchical multiple binary logistic regression model (Model 3).

4.3.1 Multivariate results of predictors of ITN use in urban areas

Table 5 presents the multivariate results of predictors of ITN use in urban Ghana. In Model 1, individual level variables age, sex and education level of household heads were entered. These variables together explained 0.6% (Pseudo R^2 Nagelkerke =0.006) variance in ITN use in urban Ghana. In Model 1, compared to household heads with pre-primary or no education, household heads with middle (AOR=1.350, CI = 1.190-1.533) secondary (AOR=1.346, CI= 1.157-1.565) and higher (AOR= 1.518, CI= 1.293-1.782) education were significantly more likely to use ITN in urban Ghana. Age and sex of household heads were not significant predictors of ITN use.

When household variables (wealth, number of mosquito nets, number of people in a household and households with children under-5) were added to the model (Model 2), it explained 10.3% of variance (Pseudo R^2 Nagelkerke =0.103) in ITN use in urban Ghana. In Model 2, household heads with secondary (AOR=0.818, CI =0.690-0.969) and higher (AOR= 0.772, CI= 0.639-0.933) education were significantly less likely to use ITN in urban Ghana compared to household heads with pre-primary or no education. Also, compared to poorest households, second (AOR = 1.753, CI =1.510-2.034), middle (AOR= 2.597, CI =2.231-3.022), fourth (AOR = 2.666, CI = 2.276-3.124) and richest (AOR = 3.652, CI = 3.071-4.343) households were significantly more likely to use ITN in urban Ghana. Households with 2(AOR =1.753, CI =1.510-2.034), 3(AOR = 2.597, CI =2.231-3.022) 4 (AOR = 2.666, CI =2.276-3.124) and 5 or more (AOR = 3.652, CI = 3.071-4.343) people are significantly more likely to use ITN compared to households with only one person in urban Ghana. Household with 4-7 ITNs (AOR = 0.757, CI = 0.672-0.853) were significantly less likely to use ITN in urban Ghana as compared to. Urban households without under-5 children were significantly more likely to use ITN (AOR = 1.116, CI= 1.013-1.229). Age and sex of household heads were not significant predictors of ITN use in urban Ghana.

In Model 3, ethnicity and way ITN was obtained were added to the model and this explained 10.9 percent (Pseudo R^2 Nagelkerke =0.109) variance in urban ITN use in Ghana. Thus, the addition of the community level variables explained additional 0.6 variance in urban ITN use in Ghana. Household heads with secondary (AOR =0.793, CI =0.667-0.943) and higher (AOR = 0.772, CI = 0.638-0.934) education were significantly less likely to use ITN. Compared to poorest households, second (AOR = 1.702, CI =1.465-1.978), middle (AOR= 2.552, CI =2.188-2.977), fourth (AOR = 2.586, CI = 2.202-3.039) and richest (AOR = 3.530, CI = 2.955-4.217) households were significantly more likely to use ITN in urban Ghana. Comapred to household with only one person, households with 2(AOR =1.547, CI =1.384-1.730), 3(AOR = 2.441, CI= 2.105-2.829), 4 (AOR = 3.298, CI = 2.637-4.126) and 5 or more (AOR = 6.495, CI =4.756-8.871) people are significantly more likely to use ITN in urban Ghana Households with 4-7 ITNs (AOR = 0.765, CI =0.678-0.862) were significantly less likely to use ITN compared with those with 3 or less ITNs. Households without under-5 child (AOR = 1.115, CI = 1.012-1.228) were significantly more likely to use ITN. Compared to household heads with Akan ethnic group, household with GA/Damgme heads (AOR = 1.502, CI = 1.266-1.782) were significantly more likely to use ITN whereas Grusi (AOR = 0.701, CI = 0.523-0.941) were significantly less likely to use ITN in urban Ghana. The way household obtained ITN as well as age and sex of household heads did not influence ITN usage in urban Ghana.

Table 5: Hierarchical multiple binary logistic regression analysis of predictors of ITN use in urban Ghana

Variable	Model 1		Model 2		Model 3	
	Odds Ratio	95%CI	Odds Ratio	95%CI	Odds Ratio	95%CI
Age of household heads						
40 years and below	Ref	Ref	Ref	Ref	Ref	Ref
41 years and above	0.985	0.897-1.083	0.994	0.902-1.097	1.001	0.907-1.104
Sex of household heads						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	0.981	0.892-1.078	0.992	0.900-1.095	0.985	0.893-1.087
Household head education level						
Pre-primary or none	Ref	Ref	Ref	Ref	Ref	Ref
Primary	1.092	.923-1.291	0.944	0.792-1.126	0.926	0.773-1.109
JSS/JHS/Middle	1.350***	1.190-1.533	0.958	0.833-1.101	0.934	o.807-1.081
SSS/SHS/Secondary	1.346***	1.157-1.565	0.818**	0.690-0.969	0.793**	0.667-0.943
Higher	1.518***	1.293-1.782	0.772**	0.639-0.933	0.772**	0.638-0.934
Wealth index (quintile)	-	-				
Poorest			Ref	Ref	Ref	Ref
Second			1.753***	1.510-2.034	1.702***	1.465-1.978
Middle			2.597***	2.231-3.022	2.552***	2.188-2.977
Fourth			2.666***	2.276-3.124	2.586***	2.202-3.039
Richest			3.652***	3.071-4.343	3.530***	2.955-4.217
Number of mosquito net	-	-				
3 or less			Ref	Ref	Ref	Ref
4-7			0.757***	0.672-0.853	0.765***	0.678-0.862
8 or more			0.865	0.614-1.217	0.870	0.617-1.226
Number of people in household	-	-				
1			Ref	Ref	Ref	Ref
2			1.753***	1.510-2.034	1.547***	1.384-1.730
3			2.597***	2.231-3.022	2.441***	2.105-2.829
4			2.666***	2.276-3.124	3.298***	2.637-4.126
5 or more			3.652***	3.071-4.343	6.495***	4.756-8.871
Household with children under-5	-	-				
Yes			Ref	Ref	Ref	Ref
No			1.116*	1.013-1.229	1.115*	1.012-1.228
Ethnicity	-	-	-	-		
Akan					Ref	Ref
GA/Damgme					1.502*	1.266-1.782
Ewe					1.065	0.922-1.229
Guan					1.296	0.954-1.762
Gruma					0.805	0.587-1.105
Mole Dagbani					1.035	0.903-1.186
Grusi					0.701*	0.523-0.941
Mande					0.912	0.498-1.670
Way ITN was obtained	-	-	-	-		
2014-2017 Mass distribution					Ref	Ref
ANC					1.009	0.848-1.201
Immunization					1.233	0.897-1.695
Pseudo R^2 Nagelkerke	**0.006**		**0.103**		**0.109**	

***p<0.001; **p<0.01; *p<0.05

4.3.2 Multivariate results of predictors of rural ITN use in Ghana

Table 6 presents the multivariate results of predictors of ITN use in rural Ghana. In Model 1, Age, sex and education of household head were first entered into the model. This explained 0.5% (Pseudo R^2 Nagelkerke =0.005) of variance in the model. Household heads with middle (AOR=1.224, CI= 1.124-1.334), secondary (AOR= 1.262, CI = 1.090-1.462) and higher (AOR = 1.645, CI= 1.385-1.955) education were significantly more likely to use ITN as compared to. Age and sex of household heads did not have a significant influence on ITN use in rural Ghana.

In the second model (Model 2), household level variables (household wealth, number of ITNs, number of people living in households and households with children under-5) were entered into the hierarchical logistic regression model. The addition of the variables resulted in explaining 9.6% (Pseudo R^2 Nagelkerke =0.096) variance in rural ITN use. Compared to poorest households, second (AOR = 1.156, CI =1.039-1.286), middle (AOR = 1.154, CI = 1.026-1.297), fourth (AOR = 1.355, CI = 1.201-1.529) and richest (AOR = 2.051, CI =1.793-2.346) households were significantly more likely. Also, compared to households with one person, households with 2(AOR= 1.502, CI = 1.369-1.648), 3(AOR= 2.432, CI= 2.180-2.714), 4(AOR =4.403, CI= 3.779-5.130) and 5 or more (AOR= 6.028, CI= 5.069-7.168) people are significantly more likely to use ITN in rural Ghana. Household with 4-7 ITN (AOR=0.717, CI = 0.653-0.786) or 8 or more (AOR = 0.717, CI = 0.584-0.880) ITNs were significantly less likely to use ITN in rural Ghana. Household with under-5 did not make a significant influence in predicting ITN use in rural Ghana. Similarly, age, sex and education level of household heads did not have a significant influence on ITN use in rural Ghana.

In the final model (Model 3), two community factors (ethnicity and way household ITN was obtained) were entered in into the hierarchical logistic regression model which explained additional 1.2% variance in rural ITN use (Pseudo R^2 Nagelkerke =0.108). Compared to poorest households, fourth (AOR=1.184,

CI= 1.039-1.349) and richest (AOR = 1.745, CI = 1.510-2.018) household were significantly more likely to use ITN in rural Ghana. Compared to households with one person, households with 2(AOR= 1.519, CI = 1.383-1.667), 3(AOR= 2.476, CI= 2.217-2.765), 4(AOR =4.491, CI= 3.851-5.238) and 5 or more (AOR= 6.254, CI= 5.254-7.445) people are significantly more likely to use ITN in rural Ghana. Households with 4-7(AOR= 0.734, CI =0.668-0.806) and 8 or more (AOR = 0.764, CI =0.621-0.940) ITNs are significantly less likely to use ITN in rural Ghana. Household with Ewe (AOR= 0.578, CI = 0.505-0.662), Gruma (AOR = 0.593, CI = 0.494-0.711), Mole-Dagbani (AOR = 0.749, CI = 0.668-0.840) and Grusi (AOR=0.627, CI = 0.526-0.748) heads were significantly less likely to use ITN in rural Ghana. Finally, households that received ITN through immunisation (AOR= 1.510, CI= 1.193-1912) were significantly more likely to use ITN in rural Ghana compared to household that obtained ITN through the 2014-2017- mass distribution campaign. Age, sex and education level of household heads did not have a significant influence on rural ITN use.

Table 6: Hierarchical multiple binary logistic regression analysis of predictors of ITN use in Rural Ghana

Variable	Model 1		Model 2		Model 3	
	Odds Ratio	95%CI	Odds Ratio	95%CI	Odds Ratio	95%CI
Age of household heads						
40 years and below	Ref	Ref	Ref	Ref	Ref	Ref
41 years and above	0.971	0.902-1.046	0.981	0.90-1.060	0.983	0.910-1.062
Sex of household heads						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	0.952	0.882-1.028	0.969	0.895-1.049	0.972	0.897-1.053
Household head education level						
Pre-primary or none	Ref	Ref	Ref	Ref	Ref	Ref
Primary	1.103	0.996-1.221	1.061	0.952-1.181	1.038	0.930-1.159
JSS/JHS/Middle	1.224***	1.124-1.334	1.088	0.986-1.201	1.002	0.901-1.115
SSS/SHS/Secondary	1.262**	1.090-1.462	1.083	0.923-1.271	1.072	0.911-1.261
Higher	1.645***	1.385-1.955	1.168	0.961-1.418	1.152	0.946-1.402
Wealth index (quintile)	-	-				
Poorest			Ref	Ref	Ref	Ref
Second			1.156***	1.039-1.286	1.105	0.990-1.232
Middle			1.154***	1.026-1.297	1.041	0.921-1.177
Fourth			1.355***	1.201-1.529	1.184*	1.039-1.349
Richest			2.051***	1.793-2.346	1.745***	1.510-2.018
Number of mosquito net	-	-				
3 or less			Ref	Ref	Ref	Ref
4-7			0.717***	0.653-0.786	0.734***	0.668-0.806
8 or more			0.717**	0.584-0.880	0.764*	0.621-0.940
Number of people in household	-	-				
1			Ref	Ref	Ref	Ref
2			1.502***	1.369-1.648	1.519***	1.383-1.667
3			2.432***	2.180-2.714	2.476***	2.217-2.765
4			4.403***	3.779-5.130	4.491***	3.851-5.238
5 or more			6.028***	5.069-7.168	6.254***	5.254-7.445
Household with children under-5	-	-				
Yes			Ref	Ref	Ref	Ref
No			0.972	0.901-1.048	0.969	0.898-1.045
Ethnicity	-	-	-	-		
Akan					Ref	Ref
GA/Damgme					1.010	0.854-1.194
Ewe					0.578***	0.505-0.662
Guan					1.183	0.989-1.414
Gruma					0.593***	0.494-0.711
Mole Dagbani					0.749***	0.668-0.840
Grusi					0.627***	0.526-0.748
Mande					1.048	0.537-2.047
Way ITN was obtained	-	-	-	-		
2014-2017 Mass distribution					Ref	Ref
ANC					1.048	0.899-1.223
Immunization					1.510**	1.193-1.912
Pseudo R^2 Nagelkerke	**0.005**		**0.096**		**0.108**	

***p<0.001; **p<0.01; *p<0.05

4.4 Comparing predictors of ITN use in urban and rural Ghana

This comparison was done to assess the differences and similarities of predictors of ITN use for in urban and rural areas according to the levels of SEM.

4.4.1 Individual level predictors (Model 1)

In model 1, when only sex, age and education level of the household head were considered in the logistic regression model, increasing education level of household head was significantly associated with ITN use in both urban and rural Ghana. Sex and age of the household head was not significantly associated with ITN use in both urban and rural Ghana.

4.4.2 Household level predictors (Model 2)

When household factors were considered in the logistic regression model, education status of the household head did not have a significant association ITN use in rural Ghana. Also, urban household heads with secondary and higher education status were less likely to use ITN. In both rural and urban Ghana, second, middle, fourth and richest households significantly more likely to use ITN use. Also, households with 4-7 ITN and 8 or more are less likely to use ITN use in both rural and urban Ghana. Whereas urban household without a child under-5 increased ITN use, the opposite was the case of rural Ghana. Age and sex of household heads did not have significant influence on both rural and urban ITN use.

4.4.3 Community level predictors (Model 3)

When community level factors were added to the logistic regression model, urban household heads with secondary and higher education status were significantly less likely to use ITN while the education level of the household head was not associated with ITN use in rural Ghana. In rural Ghana, only fourth and richest households were significantly more likely to use ITN whereas in urban Ghana second, middle, fourth and richest households were significantly more likely to use ITN compared to poorest households. In both urban and rural households, households with 4-

7ITNs and above are more likely to use ITN compared to households with 3 or less ITN. Whereas, households without with under-5 did not have a significant influence on ITN use in rural Ghana, urban households without under-five child were more likely to use ITN. In urban Ghana, household heads by GA/Damgme were more significantly likely to use whereas household with Grusi heads were significantly less likely to use ITN. In rural Ghana, households with Ewe, Gruma, Mole-Dagbani and Grusi heads were significantly less likely to use ITN. Age and sex of the household head did was not significantly associated with ITN use in both rural and urban Ghana.

CHAPTER FIVE: DISCUSSION

5.0 Introduction

A discussion of a study results explains the significance of the research findings, interprets the results and relates them to the existing literature (Dunton, 2022). Explaining the meaning of the results to make sense to the reader is the purpose of the discussion section of a research paper (Conn, 2017). According to Hess (2004), the discussion involves stating the major findings of the study, explaining their meaning, relating them to literature, considering alternative explanations, articulating their practical relevance and acknowledging limitations. In line with these conceptualizations, this chapter of the study presents the discussion of the study's findings. In sequence, the chapter starts with a summary of the findings, discusses these findings as they were analyzed on the SEM, which forms the theoretical foundation of the study. This chapter also details the findings' implication for health promotion, the strengths and limitations of the study and ends with a conclusion.

5.1 Summary of Findings

The objective of this study was to investigate the factors that influence the use of ITNs for malaria prevention. Analysis of the data revealed a significant association between residence and ITN use, showing that rural households were more likely to use ITNs than urban households in Ghana. Also, the study found that, when considering only the individual level variables (sex, age and education of household heads) of McLeroy et. al (1988) SEM, the study showed that education level of households was significantly associated with ITN use in both rural and urban areas of Ghana. When household factors of the SEM were considered, the study revealed that education level did not have significant association with ITN use in rural areas whereas in urban areas, secondary and higher education levels of household heads were significantly less likely to use ITN. Furthermore, the results of the study indicated that, in both rural and urban areas, second, middle, fourth and richest households were more likely to use ITN use. Additionally, the evidence presented in the study suggested that the number of ITNs in a household was significantly associated with ITN use in both urban and rural areas. The study further provides evidence that, in urban areas, households without a child under-5 were significantly more likely to use ITN whereas, household with child under-5 did not significantly predict ITN use in rural areas. Also, the data suggest that, at the community level of the SEM, only fourth and richest households were significantly more likely to use ITN in rural households whereas in urban areas, second, middle, fourth and richest households

were significantly more likely to use ITN compared to poorest households. The analysis indicates that the number of ITNs in a household is significantly associated with ITN use in both rural and urban ITN. Whereas household without under-5 did not influence ITN use in rural Ghana, it did in urban areas. Also, ethnicity of household head significantly predicted both urban and rural ITN use in areas.

5.2 Discussion of findings

5.2.1 The association between residence type (rural and urban) and ITN use in Ghana

This study found a significant association between residence type and ITN use, showing that rural households were more likely to use ITN in Ghana. These results align with previous studies that have found a significant association between residence and ITN utilization (Asumah et al., 2021; Ricitta et al., 2019b; Watanabe et al., 2014; Yirsaw et al., 2021). There are several potential explanations for why this finding aligns with those of previous research on the association between residence and ITN utilization. One possible explanation is that rural households may have a greater risk of malaria due to factors such as proximity to mosquito breeding sites or limited access to healthcare services, which could lead to increased awareness and uptake of ITNs (Asumah et al., 2021). Additionally, rural households may face fewer barriers to accessing ITNs, such as financial or logistical constraints, compared to households in urban areas (Ricotta et al., 2019b). The consistency between this finding and those of previous studies has several implications. Firstly, it suggests that residence type is an important determinant of ITN utilization and that interventions to increase ITN coverage should target rural populations in particular. Secondly, it highlights the need for context-specific approaches to malaria prevention and control, which take into account the unique factors that influence ITN utilization in different settings. Finally, the consistency between our findings and those of previous research strengthens the overall evidence base on the importance of residence in shaping ITN use, and provides further support for the development and implementation of policies and programs to promote ITN utilization in malaria-endemic areas.

Furthermore, previous studies have found that people in rural settings are more likely to utilize ITN (Ameyaw et al., 2020; Kuse et al.,2022). In Africa and most developing countries, rural settings and hard-to-reach areas are prioritized by malaria control efforts or prevention programs since these populations are mostly affected by compromised health infrastructure and access to healthcare (Sarfo et al., 2023). Rural areas tend to have a higher burden of malaria and as such,

individuals living in these areas may have a greater awareness of the importance of using ITNs for malaria prevention. Additionally, rural areas may have limited access to healthcare services, making ITNs a more accessible and cost-effective prevention method compared to other interventions. Perhaps, the free distribution of ITN largely targeting rural communities in Ghana may explain the high use of ITN in rural communities. Moreover, evidence shows that compared to urban households, rural households in Ghana are more likely to own ITN which might help explain the high utilization of ITN in rural settings (Kanmiki et al., 2019). The relatively high utilization of ITN in rural settings may translate that government and civil society organisations through malaria control efforts are making tremendous progress in reducing the burden of malaria in rural communities. High utilisation of ITN in rural areas may provide a safety net for the protection of under-five children and pregnant women who suffer most from malaria in terms of morbidity and mortality (Kuse et al., 2022; Sarfo et al., 2023).

This finding has significant implications for health promotion regarding ITN use. Given that rural households tend to use ITNs more frequently, health promotion strategies or initiatives should capitalize on this practice and emphasize its significance. Thus, it is possible to use rural homes as a model for urban households by stressing the advantages of ITN use in avoiding mosquito-borne diseases and the excellent results they have achieved. Health promotion efforts can influence urban households to adopt comparable behaviors by demonstrating the effectiveness of ITN use in rural areas.

This finding may help devise effective health promotion strategies to address the barriers to ITN use in urban areas. Though ITN use rates in rural areas may be greater, it is crucial to overcome the obstacles that may make ITN use more difficult in urban households. Urban homes may experience a variety of difficulties, including a lack of space, insufficient mosquito control, or a sense of a lower risk of malaria. Urban-specific barriers to health should be identified and addressed through tailored messaging, awareness-raising campaigns, and community involvement.

This finding may help health promotion experts and campaigns to tailor messages and strategies that is sensitive to the differences in urban and rural ITN use in Ghana. Thus, campaigns for health promotion should be aware of the distinctions between urban and rural populations and adjust their messaging and tactics accordingly. Developing effective communication strategies can benefit

from an understanding of the particular traits, interests, and lifestyles of each environment. In contrast to rural areas, where the emphasis might be on sustaining and maintaining ITN use, metropolitan areas might place more emphasis on urban poor areas and urban populations such as the homeless and refugee camps that are mostly ignored by policies (Sarfo et al., 2023).

This finding also suggests that there should be health promotion campaigns aimed at rural and urban households to ensure equity in ITN distribution and access in Ghana. Even if ITN usage in rural homes may be greater, it is vital to guarantee equity in ITN distribution and access. Health promotion initiatives should aim to provide ITNs with equal access in both urban and rural locations, taking into account elements like cost, accessibility, and distribution methods. This can entail removing financial obstacles, working with local government, and promoting laws that enable fair access to ITNs.

This finding also suggests that continual monitoring and evaluation-assured health prevention programs be followed. In both urban and rural locations, it is crucial to regularly monitor and assess ITN usage rates as well as the results of health promotion initiatives. This makes it easier to spot behavior changes or shifts, gauge the success of interventions, and develop new tactics. It is possible to keep interventions effective and relevant in both urban and rural environments by tracking trends and modifying health promotion initiatives based on data.

5.2.2 The association between individual factors and ITN use rural and urban areas

Findings of this study suggest that that age and sex of household a household head did not predict ITN use in both rural and urban Ghana. This finding has been reported by Olapeju et al. when they studied ITN use among urban and rural households in 16 countries in sub-Saharan Africa (Olapeju et al., 2019). However, the findings of this study do not support the conclusions of previous research that has found age and sex as significant predictors of ITN use in Africa (Fokam et al., 2017; Sena et al., 2013; Tassembed et al., 2021). Age and sex of household heads may not be significantly associated with ITN use in both rural and urban Ghana for several reasons. The age and sex of the household head may not be the only factors influencing ITN use within homes (Fokam et al., 2017; Olapeju et al., 2019). Multiple household members may make decisions on the usage of ITNs, and these decisions may be influenced by information, opinions about the risk of malaria, and the accessibility of ITNs. Regardless of their age or gender of household heads,

other family or household members may actively take part in the decision-making process and have a say in how ITNs are used.

Also, household sex and age may not accurately reflect the make-up of the entire household. Multiple generations, extended family members, or people who live together frequently make up homes. Instead of being purely based on the age and sex of the household head, the choice to employ ITNs may take into account the requirements and preferences of all household members. In addition, if household members, regardless of their age or sex, possess similar levels of knowledge and awareness of the benefits of ITNs in preventing mosquito-borne diseases, they may be more likely to use ITNs consistently (Kuse et al., 2022). In such cases, the age and sex of the household head may not be significantly associated with ITN use. Furthermore, the use of ITNs can be significantly influenced by socioeconomic factors including education and wealth (Sarfo et al., 2023). Thus, socioeconomic status affects the availability, accessibility, and cost of ITNs within families. Age and sex may not be important indicators of ITN use if access to ITNs is not restricted based on the age or sex of the household head but rather by other socioeconomic considerations.

Finally, ITN use may be influenced by cultural values, customs, and other contextual factors like misconceptions and attitudes towards ITN use (Ankomah et al., 2014). These factors may have an impact on ITN usage behaviours across households regardless of the age and gender of the household head. The predictive value of age and sex may be outweighed by cultural factors, community norms, and contextual dynamics in predicting ITN usage in rural and urban settings.

This finding may influence health promotion strategies in several ways. Health promotion should develop messaging strategies that addresses the entire household and emphasising the importance of ITN use rather than focusing on household heads. Moreover, inclusive approaches that seek to engage all household members in decision making processes and consider the opinion, needs and preferences should be prioritised. Also, there is the need to improve knowledge and awareness of the benefits of ITN use considering various age and sex groups within households as a key strategy to address knowledge gaps.

5.2.3 The association between education and ITN use in rural and urban areas

When only individual level factors were considered in the regression model, education was significantly associated with ITN use in both urban and rural Ghana. These findings concur with previous studies that found the higher education is significantly associated with ITN use (Diallo et al., 2023; Klu et al., 2022; Ndjinga & Minakawa, 2010; Yitayew et al., 2018). Educated household heads may prioritise the use of ITN which is free and easily accessible to help protect their households from malaria infection. Besides, educated household heads are more likely to own ITN and educate household members on its proper use and associated benefits. Higher education gives people more information and understanding about a range of health-related topics, including the significance of preventive actions like ITN use. Higher educated household heads are more likely to have access to information, be aware of the dangers posed by mosquito-borne illnesses, and comprehend how well ITNs work to prevent such illnesses (Klu et al., 2022). They are better able to decide what is best for the health and well-being of their families because of this, which increases the adoption and regular use of ITNs. Higher educated household heads frequently have more effective decision-making abilities and interpersonal impact (Kraft et al., 2022). They might be more adept at problem-solving, critical thinking, and the analysis of health-related data. They can then prioritize health and preventive measures in their households, such using ITNs (Kraft et al., 2022). Their advocacy for ITN use can have a favourable effect on other family members, resulting in higher rates of ITN utilization.

Household head with higher education may be important for health promotion. Thus, educated household heads may influence behaviour change at the household level. Knowledgeable household heads can enable other family members to make knowledgeable decisions about their health by actively participating in discussions, offering instructional resources, and acting as a trustworthy source of information. They may dispel myths, answer questions, and spread the word about how successful ITNs are at warding off malaria and other diseases spread by mosquitoes.

When household factors were considered in the model, education level of household head did not have a significant association with ITN use in rural Ghana. Konlan et al. (2019) did not find the education of household heads a significant predictor of ITN use. The reason may be that, the introduction of household variables such as number of house members, number of ITNs and wealth may introduce confounding variables that may impact the association between education level of

household heads and ITN use. For instance, socio-economic status which may be correlated with educational attainment, may be a key factor in deciding the use of ITNs. However, the direct impact of education on ITN use may be diminished or rendered statistically insignificant once socioeconomic status is accounted for in the model. Also, the significance of education level of household head can be impacted by the existence of interactions between variables in Model 2. When one variable's impact on the result (ITN use) depends on the magnitude or values of another variable, there is an interaction. There might be connections between other household factors, including household size or wealth, and education level in this scenario.

The finding that ITN use in rural Ghana may not be associated with household education level for some reasons. For instance, access to and availability of ITN may be problematic in rural locations. The lack of proper healthcare facilities, isolated locations, and limited distribution networks can limit ITN availability in rural areas. Even if the household head is informed and aware of the significance of using ITNs, their efforts to encourage ITN usage within the household may be undermined by a lack of access to ITNs (Konlan et al., 2019). Besides, rural areas frequently have deeply ingrained cultural traditions and beliefs that may hinder the adoption of new behaviors. These cultural characteristics may have an impact on how diseases including malaria are viewed, how they are prevented, and how they are traditionally treated. Even if the household head is educated and supports the use of ITNs, deeply rooted cultural attitudes may prevent the community from accepting and using ITNs.

In urban Ghana, household ITN use was less likely in household with higher educated heads. Urban residents with higher levels of education might believe they are less vulnerable to mosquito-borne illnesses than people in rural areas. They might believe that urban areas have superior cleanliness, infrastructure, and access to healthcare, which would lessen the perceived necessity for ITN use. In families headed by more educated people, utilization rates of ITNs may decline as a result of this sense of lower disease risk. Also, urban households with higher levels of education frequently have better housing systems, such as well-built structures, screened windows, and improved ventilation. They might believe that there is less of a need for ITN use because they believe their dwellings are less susceptible to mosquito infiltration. A lesser chance of using ITNs may result from this feeling of a safe physical environment. Alternative mosquito-borne disease prevention strategies are more prevalent in urban settings. Urban residents with higher levels of

education may rely on these substitutes, like air conditioning, bug spray, or insect screens, believing them to be just as effective as ITNs. This preference for alternate approaches may result in reduced ITN adoption in households with higher levels of education.

5.2.4 Household wealth and ITN use in rural and urban areas

The results indicate household wealth is significantly associated with ITN use in both urban and rural households in Ghana. Thus, compared to poorest households, richer households were more likely to use ITN. A previous study has also found that poorest households were less likely than less poor households to use ITN in Kenya (Were et al., 2019). However, some previous studies in Ghana have reported contradictory results indicated that increasing wealth is associated with increased use of ITN (Dako-Gyeke & Kofie, 2015; Ricotta et al., 2019b). There may be reasons for this shift in the relationship between ITN use and wealth. ITNs may become more affordable and accessible as wealth increases. As households gain in wealth, they have the resources to buy ITNs and replace then when needed. Richer people may also have better access to markets and distribution networks, increasing the availability of ITNs in both urban and rural locations in Ghana. Wealthier households may reside in improved housing systems with screened windows, air conditioning, or other infrastructure that minimizes mosquito entry. Such improved housing systems may not only reduce the perceived need for ITN use but also limit exposure to mosquitoes. However, wealthier households may still use ITNs as an additional protective measure or to complement other biomedical preventive strategies, leading to higher ITN usage (Kanmiki et al., 2019; Klu et al., 2022). It is possible that shifting dynamics of poverty have changed the relationship between wealth and ITN use. Previous research had shown a negative correlation between poverty and ITN use (Ricotta et al., 2019b), but this pattern may have changed as a result of poverty rates declining and general living standards rising. Households from various socioeconomic tiers may have better access to resources, such as ITNs, when poverty rates decline and income distribution improves.

The fact that increased wealth increases the usage of ITNs in both urban and rural locations have a number of implications, one of which is that health promotion initiatives should concentrate on raising the affordability, accessibility, and awareness of ITNs among all socioeconomic groups. In order to close the gap in ITN access and utilization among lower-income populations, health promotion efforts can take advantage of the favorable relationship between wealth and ITN use.

Initiatives like community-based information campaigns, subsidized ITN distribution programs, and targeted interventions that address ITN use hurdles in situations with limited resources can help achieve this. Health promotion initiatives can help lessen the burden of mosquito-borne diseases and improve overall public health outcomes by ensuring that ITNs are available and inexpensive to people of all income levels.

5.2.5 Number of people in a household and ITN use

This study analysis shows that the number of people in a household is significantly associated with ITN use in both rural and urban areas. This finding resonates with a previous study reported similar finding, indicating that larger household size or significantly more likely to use ITN in SSA (Njumkeng et al., 2019). The possible reasons for the association between household size and ITN utilization may partly stem from the diversity that comes with increasing household size. Firstly, people who are more susceptible to mosquito-borne diseases, such as young children or elderly family members, are more likely to be present in households with more people. This may result in a greater understanding of the value of using ITNs to protect vulnerable family members from mosquito bites and infections that go along with them (Were et al., 2019). The use of ITNs may be prioritized as a preventive step in larger households that are aware of the elevated risk. Another reason may be that larger households frequently adopt communal decision-making when it comes to making health-related decisions (Taremwa et al., 2020, 2022). Social conventions and group dynamics can have a big impact on how people behave, including how they use ITNs. It is more likely that every member, regardless of age or personal traits, will embrace and utilize ITNs if a family has a consensus or established norm that highlights the value of ITN use. Larger households may use ITNs more frequently since there is a shared responsibility for health and a communal decision-making process present.

The result that larger households use more ITNs, both in urban and rural regions, implies that health promotion initiatives should take family or household dynamics into account and design interventions accordingly. Health promotion efforts can emphasize the value of ITN use for safeguarding all members of the home, especially the elderly and children who are more susceptible to malaria (Were et al., 2020). By emphasizing households' shared responsibility for safeguarding everyone's health and well-being, messages can promote regular and broad ITN use. Health promotion initiatives can successfully increase ITN use and enhance overall health

outcomes by focusing on households with higher family or household sizes and personalizing messages to their unique requirements. Also, given that household size has a substantial impact on the use of ITN, health promotion campaigns can make use of community-based strategies to effectively engage and reach homes. Community leaders, local groups, and community health professionals can be extremely helpful in spreading health promotion messages, giving out ITNs, and educating people on how to use them properly. Engaging with communities enables the creation of context-specific interventions by enabling a better understanding of specific issues and limitations connected to the use of ITNs (Taremwa et al., 2020, 2022). Community-based strategies can increase neighborhood feeling of responsibility, peer influence, and social support, which will improve the efficacy of ITN use-related health promotion initiatives.

5.2.6 Number of ITN in household and ITN use

This study found that Number of ITN in households were significantly associated with ITN use in both rural and urban ITN. Thus, households with more than 4 ITNs were less likely to use ITN. These findings diverge from the results of a study conducted by Koenker et al. (2023), who reported that availability of ITNs in large households did not influence its usage. One possible explanation is differences in the study population. The current study may have sampled households with different characteristics, such as household size, age, or socioeconomic status, which could affect ITN use. Additionally, the cultural and environmental factors may have differed between the study populations, such as the prevalence of malaria, education levels, or access to healthcare resources, which could influence ITN use.

ITNs may be kept extra by households on purpose to replace damaged or worn-out nets (Koenker et al., 2023). It is possible that they believe their current ITNs will degrade over time and would rather have backup nets on hand. They can consistently maintain a level of protection from mosquitoes and diseases spread by vectors.

Perhaps, rural and urban communities living in households with improved housing system such as door and window screens may perceive that they are adequately protected and may not see the essence of using ITN regardless of the number or availability of ITN (Kinmiki et al., 2019). Besides, the dynamics of a household might alter throughout time due to events like the arrival of new family members, visitors, or transient occupants. In these situations, homes might have extra ITNs on hand to adapt to these changes or to protect visitors or guests. Households can make sure

they have enough coverage for varied household compositions and unforeseen circumstances by retaining extra ITNs.

Also, the management and upkeep of more ITNs can present practical difficulties for homes including lack of beds and sleeping rooms especially, in urban poor areas and hard-to-reach people. Multiple ITNs may require more work to constantly clean, hang, and fix. Consistent ITN utilization may encounter difficulties as a result of the increased workload and logistical complexity. Families with multiple ITNs may have a harder time making sure that every net is in excellent shape, is installed correctly, and is being used consistently by every member of the household. The lower ITN utilization rates among households with an oversupply of ITNs may be caused by these practical difficulties.

This finding has implications on health promotion. For instance, households should be informed about the value of continuously using all ITNs that are available as part of health promotion initiatives. This includes educating people about ITNs' short lifespans and the necessity of routine replacement. ITNs should be used as soon as possible, and health promotion messages can emphasize this and encourage households to prioritize this above storing ITNs for later use. Health promotion can maximize the protective advantages of ITNs and lower the risk of diseases spread by mosquitoes by encouraging proper use. Health promotion initiatives can remove obstacles if families are storing ITNs for later use because they are worried about access or availability issues especially, in hard-to-reach areas, displaced communities and urban poor areas. It is critical to guarantee that all households, especially those in areas with greater illness frequency and risk, have fair access to ITNs. ITN distribution networks can be made better, ITN supplies can be made dependable and economical, and ITNs can be made available to all households that require them. Health promotion can encourage households to use their ITNs quickly by removing barriers to access, reducing the need to store nets, and promoting timely protection from mosquitoes and vector-borne diseases.

5.2.7 Households with children under-five and ITN use

The results revealed that in urban areas, households without a child under-5 were significantly more likely to use ITN. In Malawi, Nkoka et al. (2019) reported that ITN usage of ITN was lower for household with children under-five, especially when the child is 2 years old. Families without young children may have alternative sleeping arrangements that make the usage of ITN more

viable and practical (Nkoka et al., 2019). Young children frequently need greater supervision and may have particular sleeping arrangements, such as sharing a bed or crib with their parents or having their own crib or bed in the same room. These arrangements may make it harder for families with small children to use ITNs efficiently. On the contrary, households without young children may have more adaptable sleeping arrangements, such as individual beds or separate sleeping rooms, that enable simpler and more regular ITN usage. Health promotion programs can emphasize informing families with children under the age of five about the value of using ITNs to protect their young children from mosquito-borne infections in urban Ghana. Messaging can highlight young children's increased vulnerability to serious complications from such diseases and the critical role ITNs play in ensuring their protection. Interventions can also address the practical difficulties that families with young children may encounter. For instance, they can offer instructions on how to install and use ITNs correctly in a variety of sleeping arrangements and provide solutions for any particular problems relating to the use of ITNs in families with young children.

In this study, the revelation that in urban areas, households without a child under-5 were significantly more likely to use ITN is an unusual pattern that warrants exploring possible explanations. According to several studies, the presence of young children in a household has often been identified as a key determinant of ITN use. This trend has always been reasonably explained to be due to the fact that young children are more vulnerable to malaria and its complications compared to adults (Eze et al., 2014; Haile et al., 2019). Consequently, parents and caregivers are more likely to prioritize ITN use for their young children in order to protect them from malaria transmission (Mrema et al., 2023). However, the finding from the present study, which shows that households without a child under five were more likely to use ITNs in urban areas, indicates a departure from the established pattern observed in previous studies. It is important to consider potential reasons for this discrepancy. First, households without children under five might have different levels of knowledge and awareness about malaria prevention compared to households with young children. They may be more informed about the benefits of ITN use or have received targeted health education programs that emphasize the importance of ITNs. This could contribute to their higher utilization rates. Also, the socioeconomic status of households without children under five could differ from those with young children. These households might have higher income levels or educational attainment, which could positively influence ITN utilization. They

may have better access to ITNs and greater awareness of the importance of malaria prevention, leading to higher usage rates. Upon reflection and relating this finding to McLeroy et al. (1988) SEM, these factors suggest that the interplay of knowledge, household composition, socioeconomic factors and other factors may contribute to the higher ITN utilization among households without a child under five in urban areas. Further research and qualitative studies could provide deeper insights into the specific reasons underlying this finding.

This results further showed that rural households without ITN were less likely to use ITN however, this association was not significant. ITN availability and access issues may arise in rural locations, especially in low-income settings. These regions may have insufficient infrastructure for ITN supply, less subsidized or economical ITN options, or restricted distribution channels. For instance, if Ghana where the primary distribution channels for ITN to rural people is mostly done through immunization and ANC visits, households without under-five are more likely not to have access to ITN. Therefore, it may be challenging for rural homes without children under five to obtain ITNs, which would result in lower utilization rates. Geographical isolation, a lack of mobility, or insufficient communication about ITN distribution initiatives can all contribute to limited access. Perhaps, households without under-five children may not be the focus of health education and promotion campaign which may affect their knowledge about the proper usage and its associated benefits. Designing interventions tailored for remote populations without young children should be the main emphasis of health promotion initiatives. The challenges identified in these homes, such as limited access to ITNs, a lack of information and awareness, financial limitations, and cultural and societal considerations, should be addressed through these interventions (Sarfo et al., 2023).

5.2.8 Way ITN is obtained and ITN use

The results of the study emerged that, in urban areas, the way ITN was used was not associated with ITN use. This finding shows that the distribution of ITN is key to its usage. In urban Ghana, ITN distribution pays attention to urban poor people, people living in the slums, people living on the street or the homeless (Ahorlu et al., 2019). Efforts directed toward reaching the urban-rich or middle-income earners may not be enough for the distribution of ITN to have an impact on its usage in urban areas in Ghana (Ahorlu et al., 2019). Besides, most urban households are more likely to purchase their ITN from retail shops which may come with less education on its proper

usage and associated benefits (Ahorlu et al., 2019). Rather than highlighting particular ways of acquisition, health promotion initiatives in metropolitan settings can give priority to tactics that focus on overall access and utilization of ITNs. Interventions can concentrate on enhancing accessibility, affordability, and awareness of ITN usage rather than how ITNs are acquired.

In rural areas, households that obtained ITN through immunization are more likely to use ITN compared to obtaining ITN through the 2014-2017 distribution campaigns. It is worth noting that the immunization in rural Ghana may be well-structured and coordinated efforts to provide the rural households with enough evidence-based facts about the benefits of ITN usage. However, education on the benefits and the proper use of ITN during ANC may be compromised due to long queues, few healthcare professionals and long waiting times (Bawuah & Ampaw, 2021). Midwives or public health nurses may not be able to provide sufficient information to all clients seeking ANC may be due to job strain, and high client-to-nurse or midwife ratio. During mass distribution, efforts may not be directed towards improving households with required knowledge of its usage and benefits.

5.2.9 Ethnicity of household heads and ITN use

Findings of this study also suggest that households with Ewe, Gruma, Mole-Dagbani, and Grusi heads were significantly less likely to use ITN in rural Ghana. This evidence is similar to the findings reported by Klu et al. (2022) who found that the Akan ethnic group has the highest odds of sleeping under ITN. With the help of the minority ethnic community, health promotion campaigns may be created, ensuring that the messaging and communication materials are respectful to their culture and align with their values and beliefs. This may entail utilizing well-known and significant cultural symbols, languages, and stories in the work. Health promotion initiatives can successfully convey to the minor ethnic group the value of ITN usage by taking cultural into account.

In urban areas, household heads by GA/Damgme were more significantly likely to use. This evidence is contrary to the findings reported by Klu et al. (2022) who found that the Akan ethnic group has the highest odds of sleeping under ITN. Perhaps, malaria control efforts by governments and civil society organisations are using strategies in the distribution and education that are essential in closing gaps in education and ethnic dominance.

5.3 Implication of the Study for Health Promotion

The research study investigating factors that influence ITN utilization has important implications for health promotion planning. This is because the study findings can help inform the development of effective health promotion strategies aimed at increasing ITN utilization, which is critical for malaria prevention and control. One of the central issues in health promotion that this study supports is the need to understand and address the determinants of health behaviour. The study findings suggest that factors such as geographical context, household size, income and other variables at different ecological levels are important determinants of ITN utilization. Holistic assessment of these factors and addressing them is necessary. Therefore, health promotion interventions aimed at increasing ITN utilization should address these determinants by providing accurate information about malaria prevention and treatment, ensuring that ITNs are widely available and accessible, and promoting the perception of malaria as a serious health threat.

Another central issue in health promotion that this study supports is the importance of using a socio-ecological approach to health promotion. The study findings suggest that ITN utilization is influenced by a complex interplay of individual, social, and environmental factors. Therefore, health promotion interventions aimed at increasing ITN utilization should address these factors at multiple levels, including individual, family, community, and policy levels.

Over all, the research study investigating factors that influence ITN utilization has important implications for health promotion planning, particularly in terms of understanding and addressing the determinants of health behaviour and using a socio-ecological approach to health promotion.

5.4 Strength of this current study

This study utilised large national representative sample which may enhance generalizability of the findings. It is more likely that a study's conclusions will properly reflect the behaviour, actions and opinions of the larger population when it uses a sizable sample that is representative of the entire country (Babbie, 2021). This is so because the population's heterogeneity, which can be captured by a high sample size's greater diversity and variability. As a result, it is possible to securely generalize the study's results to the entire target population. Using a sizable, nationally representative sample, researchers can more confidently make generalizations about the population. The likelihood of bias is reduced and a more accurate image of the issue under study is presented by the findings, which are likely to be more representative of the entire population.

As a result, the study's findings are more credible and valid, which makes them more useful for guiding policies, treatments, and strategies for health promotion. In order to analyze the research this study used a robust statistical technique, hierarchical multiple binary logistic regression. A strong statistical test, such as hierarchical multiple binary regression, has the advantage of simultaneously accounting for the influence of several variables and controlling for potential confounding variables, producing results that are more accurate and reliable (Babbie, 2021).

5.5 Limitations of Current Study

The extent to which a research study takes into account its limitations largely determines the quality and rigour of the study's interpretation (Resnik & Shamoo, 2017). A meaningful presentation of study limitations should describe the potential limitation, explain the implication of the limitation, provide possible alternative approaches and describe steps taken to mitigate the limitation (Ross & Bibler Zaidi, 2019). The acknowledgement of limitations of this study is an essential, as it highlights areas where the study's findings may be less reliable or valid and helps to contextualize the results within the study's scope and context. The major limitation of this study is its use of secondary data.

5.5.1 Lack of context-specific variables

National survey data may not have context-specific variables or measures that are specifically pertinent to the study question or objectives, but they are normally meant to gather a wide range of information about the population. The depth and specificity of the variables associated to the phenomenon under study may be limited by the data that is currently accessible. This may make it more difficult to thoroughly study particular facets or dimensions of the research issue and may need the use of proxy measurements or additional data gathering activities.

5.5.2 Use of cross-sectional data

The data used for this study was a cross-sectional data. Cross-sectional data is collected at a specific point in time from a sample of individuals or groups, and it provides a snapshot of a population. While cross-sectional data is useful in many research settings, there are some limitations to using it. First, cross-sectional data does not allow researchers to establish causal relationships between variables (Cataldo et al., 2019). Researchers can only identify correlations between variables, but they cannot determine if one variable causes the other. In other words, The statistics may indicate correlations between different factors, but they cannot definitively establish

the direction of the link or exclude other possible causes. When drawing conclusions about causal links purely from national survey data, researchers must exercise caution since other unmeasured factors or confounding variables might be affecting the reported associations.

Also, since cross-sectional data is collected at a single point in time, it cannot provide information on changes that may have occurred over time. Therefore, researchers cannot track the development of individuals or groups over time, which can limit the understanding of the phenomena they are studying.

Despite these limitations of the study, the findings have important implications for malaria control and can be used to inform policy, practice or interventions.

5.6 Conclusion

In summary, this study set out to investigate factors that influence ITN use in rural and urban areas in Ghana. Results of the study first demonstrated a significant association between residence and ITN use. Again, the study revealed that wealth, number of ITN in household, household number of people and education are associated with ITN use in both urban and rural households in Ghana. Also, age and sex of household head in both urban and rural Ghana is not associated with ITN use. Furthermore, whereas household without children under-five is significantly associated with ITN use in urban Ghana, in rural areas, the opposite is the case. Also, whereas the way household obtained ITN is not associated with ITN usage in urban areas, in rural areas, households that obtained ITN through immunization are more likely to use ITN. In urban areas, household with Ga/Damgme were more likely to use ITN than households with Akan household heads. In rural households, Ewe, Gruma, Mole-Dagbani, and Grusi heads were significantly less likely to use ITN in rural Ghana than Akan households. Health promotion interventions should be evidence-based, context-specific and focus on improving knowledge and ITN use rather than just improving access and ownerships. Overall, this study has demonstrated that factors that influence ITN use are not always the same for rural and urban contexts. While education and income level drive ITN use in both contexts, each contexts has further factors that predict ITN use. This research finding has important implication for malaria intervention, as it can help to tailor malaria prevention interventions to suit each context. Future research in the field should consider using primary data and employ different data collection techniques, such as interviews and focused group discussion. This will allow the researcher to capture as many variables that influence ITN utilization as

possible and be able to probe further to know the reasons why a given variable influences the use of ITN for malaria prevention. Also, future research in the field should consider using longitudinal data so that causal inferences can be drawn from its findings.

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APPENDIX: Approval Letter from DHS Office

Oct 18, 2022

Alfred Yeboah
University of Bergen
Norway
Request Date: 10/18/2022

Dear Alfred Yeboah:

This is to confirm that you are approved to use the following SPA Datasets for your registered research paper titled: "Knowledge, attitudes and practice about the use of insecticide-treated net (ITN) in the prevention of malaria among pregnant women in Ghana":

Ghana

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

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