Factors Associated with The Use of Insecticide Treated Net to Fight Against Malaria in Democratic Republic of The Congo

Mulolwa Muzaliwa Pascal

Graduate School of Public Health
Yonsei University
Department of Global Health and Disease Control
Division of Health Policy and Financing

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Directed by Professor Tai-Soon Yong

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Mulolwa Muzaliwa Pascal

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This certifies that the Master's Thesis of

Mulolwa Muzaliwa Pascal is approved.

Tai-Soon Yong

Thesis Committee Member: Prof. Tai-Soon Yong

Moonsoo Yoon

Thesis Committee Member: Prof. Moonsoo Yoon

Se Eun Park

Thesis Committee Member: Prof. Se Eun Park

Graduate School of Public Health

Yonsei University

December 2023

DECLARATION

I, MULOLWA Muzaliwa Pascal, affirm that I am submitting the research entitled "Factors Associated with the Use of ITNs in DRC" as my thesis to fulfill the requirements for my master's degree in the Department of Global Health and Disease Control, Division of Health Policy and Financing at Yonsei University in Seoul. The findings presented in this research are the outcome of my investigation and all sources, ideas, and content have been duly acknowledged. Furthermore, I verify that these research results have not been previously submitted for any other degree and are not currently under consideration for any other academic program.

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WHO	World Health Organization
PNLD	National Malaria Control Program
ACT	artemisinin-based combination therapy
ITN	insecticide treated nets.
DRC	Democratic Republic of the Congo
IRS	indoor residual spraying
PBO	piperonyl butoxide
PC	Preschool Clinics
ANC	Antenatal consultation
LLIN	Long-lasting insecticidal nets
UNICEF	United Nations Children's Fund
GTS	Global Technological Strategy for Malaria

ABSTRACT

Background: Malaria remains a global health challenge, with approximately 247 million cases reported in 2021, predominantly in the World Health Organization's (WHO) African region. ITNs have played a crucial role in vector control, contributing significantly to the reduction in malaria morbidity but challenges such as ITN misuse persist. The DRC faces fluctuations in malaria cases and deaths, underscoring the need for ongoing efforts to enhance control interventions. This study addresses a critical gap in understanding factors associated with ITN use in the DRC, where nationwide studies are limited.

Methods: A quantitative-based cross-sectional design using secondary data collected from the MICS-PALU, DRC 2017-2018, involving 21,724 people. Descriptive analysis and logistic regression were utilized to explore socio-demographics and ITN characteristics related to ITN use across the 26 provinces of the DRC.

Results: The findings indicate a substantial ITN utilization rate (84.9%), Obtaining the net from antenatal care was associated with a lower likelihood of utilization compared to distribution campaigns or vaccination (OR=0.588, 95% CI [0.363-0.463], p<0.001). The odds of using a newer ITN were higher compared to older nets aged between 12 and 24 months (OR=0.724, 95% CI [0.842-0.769], p<0.001). Long-lasting insecticidal nets (LLINs) were more likely to be used than other types of ITNs (OR=1.403, 95% CI [0.483-0.615], p<0.001). Furthermore, age, region of origin, marital status, household language, TV watching frequency, reading newspapers habits, and ethnic group significantly influenced ITN usage with p-value <0.05.

Conclusion: This study provides insights into diverse factors shaping ITN utilization in the DRC, emphasizing the importance of tailored interventions addressing socio-demographic dynamics, and ITNs characteristics for effective malaria control.

Keywords: Malaria control, ITN, Reproductive age ,MICS, DRC

I. INTRODUCTION

1.1 Background

Globally, there were an estimated 247 million cases of malaria in 2021 in 84 countries where the disease is endemic, up from 245 million in 2020. Most of these cases were reported in countries within the WHO's African Region. (WHO,2022). The incidence of malaria cases decreased from 82 in 2000 to 57 in 2019, then rose to 59 in 2020. The incidence of cases did not alter between 2020 and 2021.

Long-lasting insecticidal nets (LLIN) are the primary vector control tool in Africa and have been shown to reduce malaria burden and mortality (Staedke et al., 2020), (Katureebe et al., 2016). Malaria continues to be a significant public health issue, especially in the region of sub-Saharan Africa. (Who, 2020).

Various preventive and non-preventive strategies have been employed in Africa to combat malaria. Sleeping under insecticide-treated nets (ITNs), maintaining a clean environment, mass literacy initiatives, using indoor and outdoor insecticide sprays, using mosquito repellents, and using prophylactics are some preventive strategies. In contrast, most non-preventive strategies involve the use of artemisinin-based combination therapies (ACTs) (Bhatt et al., 2015), (Maia et al., 2018).

The WHO report states that the use of ITNs has been praised for its ability to reduce the prevalence of malaria (Ntonifor & Veyufambom, 2016b). According to statistics from the World Malaria Report, 68% of malaria morbidity avoided in Africa between 2000 and 2015 can be attributed to the use of ITNs, which has contributed significantly to the success story in the fight against malaria thus far. The use and distribution of insecticide-treated nets increased dramatically during this time. Indoor residual spraying (IRS) and the widespread use of ACTs (19%) were used in conjunction with this effort. Thus, it is essential to combine these interventions that, between 2000 and 2015, produced the overall success story (Bhatt et al., 2015).

However, a closer examination of the morbidity statistics reveals that the decline in prevalence has stalled, suggesting that the progress made in controlling malaria may be gradually lost (WHO, 2021). Numerous factors are conspiring against the admirable anti-poverty initiatives. These are the reasons why malaria prevalence has not significantly decreased, and Africa continues to be the region with the highest burden. In certain African communities, ITNs are misapplied, and at other times, they are underutilized.

Despite a notable increase in their distribution, less than 30% of children under the age of five in some African countries use ITNs, which is still below the recommended level (UNICEF: Malaria in Africa). Many have resorted to using them as football nets, fishing nets, fences in gardens, and/or nursing seeds instead of using them to cover themselves at night (Ntonifor & Veyufambom, 2016b).

Malpractice or abuse of malaria arsenals: As a result of inadequate diagnosis and insufficient knowledge, certain malaria prevention tactics are either misapplied or abused. Abuse of antimalarial medications is more prevalent. Before starting treatment for malaria and finishing it, the diagnosis is frequently inadequate, inaccurate, or absent. Poor parasite clearance, recrudescence, and possible resistance development result from this. As they act as reservoirs for subsequent transmission to others, patients with poor parasite clearance contribute to the increased transmission of malaria (Manjurano et al., 2015).

The Democratic Republic of Congo (DRC) experienced a gradual increase in malaria cases between 2014 and 2020. However, in 2021, the incidence of malaria improved slightly, rising from 200 cases per 1000 people in 2020 to 185 cases per 1000 people in 2021. It is easy to assume that the methods of prevention would have been better, especially the use of ITNs type LLIN with piperonyl butoxide (PBO) in 2021, but one must exercise caution and watch to see if the downward trend will continue in the years to come. This is because there are still issues with LLIN campaigns that plague their organization, such as the need to revise the distribution key for LLINs in full distribution

after there were not enough of them, the challenges of transporting LLINs, inadequate communication and supervision during the campaigns, etc. (PNLP,2021).

From 2016 to 2019, the number of malaria-related deaths reported in medical facilities gradually decreased; however, starting in 2020, the number of deaths increased. The year 2015 had the highest recorded death toll of 39,054 and the lowest recorded death toll of 13,072 in 2019.

However, the number of deaths overall increased from 18,636 in 2020 to 22,729 in 2021, and hospital mortality increased from 17 deaths per 100,000 people in 2020 to 20 deaths per 100,000 people in 2021. This suggests that the treatment of malaria cases is going to get worse, and more medications will need to be made available. As a result, work to enhance the antimalarial medication and LLIN supply chain is still required PNLP, 2021).

The ownership and use of ITN have been the focus of vector control prevention in the DRC. The COVID-19 pandemic that struck in 2020 poses a dual threat. While it has resulted in many malaria cases and fatalities, it has also made it more difficult to carry out malaria control efforts generally and the free mass distribution of ITN.

The distribution strategy for LLINs has been adopted by the National Malaria Control Program (PNLP) and involves "combining household enumeration with door-to-door distribution of LLINs" by agents wearing personal protective equipment (PPE). Additionally, in 2021, the regular distribution to expectant mothers via Antenatal Clinics (ANC) and to young children via Preschool Clinics (PC) was also completed (PNLP, 2021).

The DRC is dedicated to accelerating high-impact malaria control interventions, such as the widespread distribution of life-saving antimalarial drugs (LLINs), malaria chemoprevention for expectant mothers, the administration of ACTs, and the bolstering of epidemiological surveillance, to positively respond to international and national strategies, approaches, and recommendations for the elimination of malaria.

The main issues with vector control across the nation that are dependent almost

entirely on LLINs are the growing resistance of vectors to insecticides, the low durability of LLINs, the disregard for the scheduled schedule for LLIN mass distribution campaigns, the constant availability of inputs, and the population's ability to access and effectively use preventive interventions. If interventions are not scaled up, it appears nearly impossible to achieve the anticipated impact of a 40% reduction in morbidity and a 50% reduction in mortality from malaria given the low coverage of these efforts and the mixed results they have produced.

Malaria continues to be the leading cause of morbidity and mortality in the Democratic Republic of the Congo (DRC), ranking second in the world in terms of cases and deaths from the disease (Fig.1 and 2).

It also poses a substantial burden on the healthcare system of the DRC. Therefore, it is crucial to enhance initiatives aimed at stopping all forms of malaria (NSP, 2020–2023).

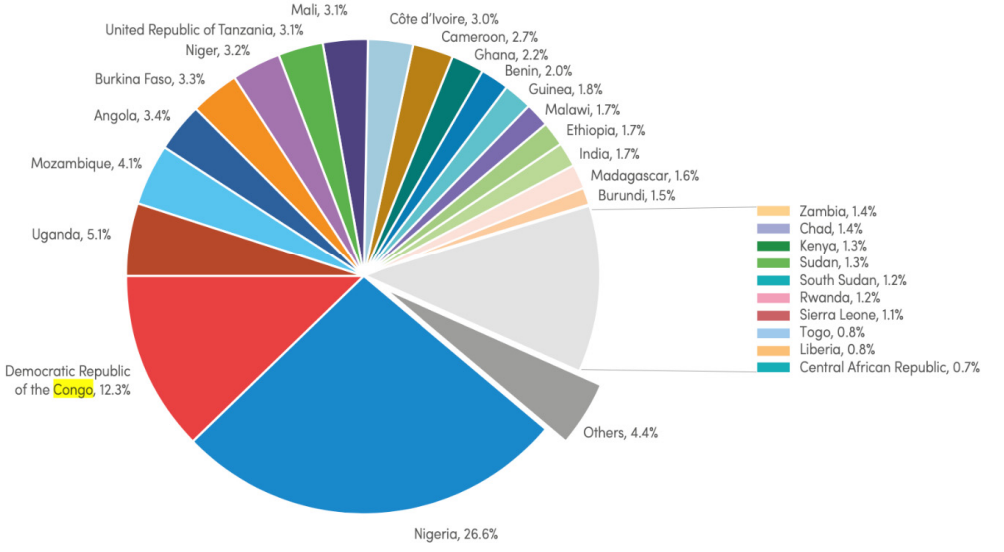

Figure 1. World Malaria cases (WHO,2022)

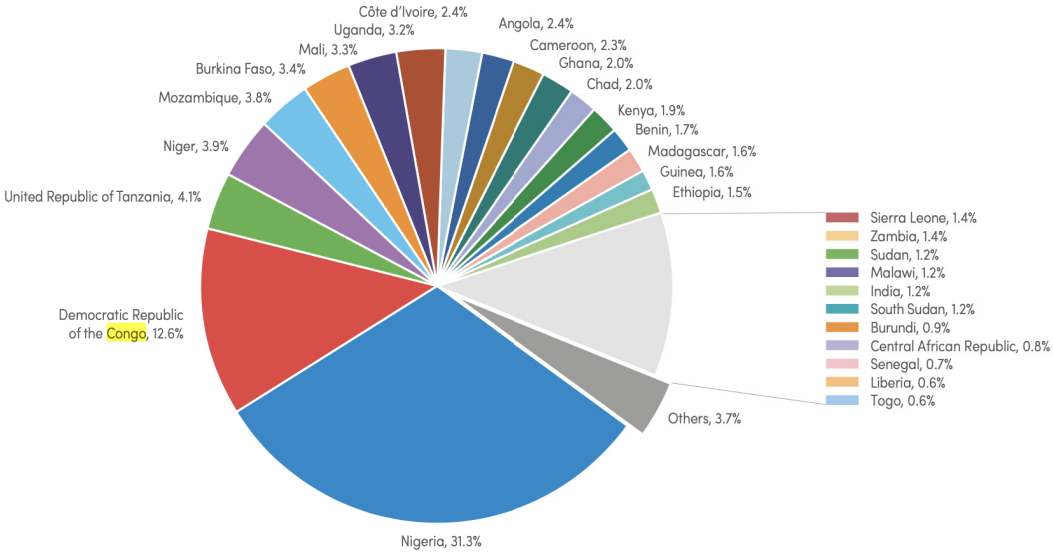

Figure 2. World Malaria Deaths 2022 (WHO,2022)

The alarming security situation, which has resulted in widespread population displacement, mosquito-friendly climate conditions, a lack of coordination in the fight against malaria, including missed deadlines for the mass distribution of individual and collective protection supplies, stockpiling of supplies, poor communication of national prevention guidelines, and low coverage of interventions, are all contributing factors to the resurgence of malaria cases.

Furthermore, the health system has been destabilized and weakened by the emergence of diseases like Ebola and Chikungunya, which have also compromised its ability to continuously provide services for malaria prevention and treatment.

Thus, to fill the knowledge gap regarding the lack of DRC publications on this subject, this study intends to ascertain the prevalence of insecticide-treated net (ITN) use during the 2018–2019 timeframe in DRC while also identifying the variables linked to ITN use.

In addition, the study will give policymakers a basic understanding of how to use ITN when developing and executing policies, especially for vulnerable populations like children under five, pregnant women, and displaced individuals. It will also promote and

advocate for novel approaches that view ITN as a medical device.

1.2. Research question

Is there a correlation between socio-economic, and cultural factors and household adherence in the use of insecticide treated nets (ITN) for malaria control?

1.3. Purpose of the study

a. Main goal: The focus of this study is to examine the factors linked to the utilization of ITNs DRC.

b. Specific Objectives :

- To compare the prevalence of use of ITN between rural and urban areas
- To determine the difference in the use of ITN according to socioeconomic status. o To Investigate factors related to the Misuse/Misapply of ITN, such as Lack of the awareness campaign, misconceptions/misinformation on ITNs, lack of policy, lack of education and knowledge on malaria prevention by using ITN, and other economic factors.
- Determine the household adherence in the use of ITN by ITN characteristics such as ITN type, ITN Density, ITN physical condition, ITN age, ITN subsided or purchased...
- To advocate the ITN as a medical device to raise awareness of the use of ITN by all those involved in the fight against malaria.

II. LITERATURE REVIEW

2.1. Malaria burden

There were an estimated 230 million cases of malaria in 2015, the baseline year for the global technological strategy for malaria 2016–2030 (GTS). The WHO South-East Asia Region was responsible for around 2% of the world's malaria cases.

Malaria cases decreased by 82% from approximately 18 cases per 1000 people at risk in 2000 to around three cases per 1000 population in 2021, a 76% decrease from 23 million cases in 2000 to approximately 5 million cases in 2021.

Over the previous 20 years, the percentage of malaria mortality among children under 5 years old has decreased, going from 87.3% in 2000 to 76.8% in 2015, although it has stayed constant since then. Approximately 96% of malaria cases and deaths worldwide in 2021 were reported from 29 of the 84 endemic countries (WHO, 2022).

Nearly half of all cases were found in four countries: Mozambique (4.1%), Uganda (5.1%), the Democratic Republic of the Congo (12.3%), and Nigeria (26.6%). Moreover, four nations—Nigeria (3.9%), DRC (12.6%), Tanzania (4.1%), and the United Republic of Tanzania (3.9%)—accounted for slightly more than half of all malaria-related deaths worldwide (WHO, 2022).

Malaria is a severe threat to people's health and livelihoods worldwide, even though it is preventable and treated. Malaria disproportionately affects those who are disadvantaged, poor, and marginalized in most endemic nations. These individuals often have limited access to healthcare facilities and cannot afford the prescribed therapy. According to (organization, 2015), poverty and inequality are both causes and effects of malaria.

2.2. ITN as core intervention in malaria prevention

According to the CDC, in areas where malaria is endemic, the ITNs has been

demonstrated to minimize malarial illness, severe disease, and mortality. The advises using insect repellent nets (ITNs) as a primary measure to safeguard individuals who are susceptible to malaria, even in regions where the disease has been eradicated or its transmission has been halted but there is still a chance of resurgence (WHO, 2019).

The immense accomplishment in lowering the worldwide malaria load over the last ten years has been largely attributed to LLIN. Those who are at risk of malaria frequently utilize them as a vital preventive measure. Pillar 1 of the GTS for Malaria 2016–2030 calls for ensuring that everyone at risk of malaria has access to LLINs or IRS (WHO, 2017).

Increased use of ITNs reduces the prevalence of malaria by combining the personal protection provided by the insecticide's repellency with the community protection provided by its insecticidal action, according to a study conducted by Birget & Koella (2015).

Through a herd effect, fewer mosquitoes are killed by the insecticide as coverage increases, reducing the number of mosquitoes that transmit the disease and its prevalence in both protected and unprotected populations. More personal protection is offered by bed nets when repellency is higher, but fewer mosquitoes meet the pesticide and perish. This causes the prevalence of infection to differ more between those who are infected who are protected and those who are not. More mosquitoes are also drawn to those who are not protected as coverage grows, raising the risk to those who are not protected.

In large-scale field trials and transmission models, Russell et al. (2010) and Govella et al. (2010) suggest that, in most settings, community-wide protection of non-users is expected to result from absolute coverage of 50% of effectively treated nets, and that, within these, additional gains are realized as coverage increases.

When the primary mosquito vector(s) for malaria bite primarily at night, after people have fallen asleep under their nets, that is when ITNs work best. ITNs are useful anywhere they can be appropriately hung, be it indoors or outdoors.

Since 2000, insecticidal vector control, including ITNs and IRS, has prevented 78% of

malaria cases. The WHO Global Malaria Program is reviewing evidence on the "community effect" of ITNs to understand its impact on different transmission settings and contextual factors.

2.3 Systematic review of ITNs

ITNs create a protective barrier for individuals sleeping under them, offering significantly enhanced protection compared to untreated nets.

High certainty evidence was generated by the Cochrane systematic review, which showed that ITNs play a crucial role in reducing all-cause child mortality, uncomplicated P. falciparum episodes, severe malaria episode incidence, and P. falciparum prevalence. Furthermore, they exhibit a capacity to lower the prevalence and frequency of simple episodes of P. falciparum when compared to untreated nets. Moreover, there exists moderate certainty evidence suggesting that ITNs contribute to a decrease in all-cause child mortality when compared to untreated nets (WHO, 2019).

The insecticides applied to treat bed nets not only eliminate mosquitoes but also target other insects. Moreover, these insecticides act as a deterrent to mosquitoes, reducing their population within homes where they might otherwise seek to feed on humans.

Furthermore, achieving high community coverage will result in fewer mosquitoes overall and a shorter lifespan. Whether or not a person is using a bed net, everyone in the community is safe when this occurs. A community needs more than half of its members to use an ITN to see such benefits.

2.4 Assessing the safety of ITNs

ITNs can vary in size, shape, color, material, and treatment. Most commonly, nets are crafted from polypropylene, polyethylene, or polyester. Authorized for ITN use, pyrethroids, and pyrroles are insecticide classes that prove lethal to insects while showing minimal evidence of posing health risks to humans and mammals. Historically, nets

required reapplication of insecticide every six to twelve months or more, contingent on cleaning frequency. The retreatment process involved immersing nets in an insecticide-water solution and allowing them to dry in a shaded area. Widespread ITN adoption faced challenges, primarily due to the need for frequent retreatment, compounded by low retreatment rates in African countries due to cost constraints and limited awareness. Recent research highlights potential compromises in net efficacy due to emerging pyrethroid resistance. Although some nets combine piperonyl butoxide (PBO) with a pyrethroid to address resistance, current evidence doesn't support enhanced effectiveness in areas with high pyrethroid resistance. The World Health Organization (WHO) does not presently endorse PBO-containing nets as tools for managing pyrethroid resistance.

2.5 Distribution and coverage of ITNs

Following the WHO-World Malaria Report 2022, manufacturers' delivery data for the years 2004–2021 indicate that nearly 2.5 billion ITNs were supplied globally during that time, with about 2.2 billion (87%) going to sub-Saharan Africa. In 2021, manufacturers delivered approximately 220 million ITNs to countries where malaria is endemic; of these, 46% were PBO nets and 9% were ITNs with dual active ingredients. By 2021, 68% of sub-Saharan African households had at least one ITN, up from roughly 5% in 2000.

From 1% in 2000 to 38% in 2021, the proportion of households with at least one ITN for every two persons rose. The proportion of people having access to an ITN at home rose from 3% to 54% during the same period.

Between 2000 and 2021, the percentage of people sleeping under an ITN rose significantly for all people (from 2% to 47%), children under the age of five (from 3% to 53%), and pregnant women (from 3% to 53%).

Sub-Saharan African nations are rapidly achieving high rates of LLIN ownership and getting closer to the WHO's goal of universal coverage, requiring one net for every two people at-risk individuals (WHO, 2022).

A recent study conducted in two DRC provinces revealed that LLIN durability played

a significant role in ITN use. This study also revealed that LLIN durability varies widely. Variations in net durability can also be attributed to the quality of the fabric that the LLIN brands use, although behavioral and environmental factors account for most of these differences.

In two health zones with comparable ecological profiles, in two neighboring provinces (South Ubangi and Mongala), two brands of LLIN—DuraNet in polyethylene and Dawa Plus 2.0 in polyester—with varying characteristics were distributed during the 2016 mass distribution campaign in the Democratic Republic of the Congo (DRC). (Mansiangi et al., 2020).

Given that neither net achieved the three-year median survival that the WHO had predicted, it is likely better to use a continuous distribution strategy in environments like the Democratic Republic of the Congo (DRC) or a distribution strategy that involves campaigns every two years.

Countries should use a combination of continuous distributions through various channels, such as ANC and the expanded immunization program concerning WHO recommendations for achieving universal coverage with LLIN in malaria control, and mass-free distributions through campaigns to maintain universal coverage of LLIN (Achieving, 2017).

Large-scale campaigns are the only tried-and-true, economical means of obtaining widespread and fair coverage quickly. But almost immediately after the campaign, population growth, net deterioration, and net loss caused coverage gaps to manifest. It is therefore necessary to have complementary continuous distribution channels. One LLIN should be given out for every two people who are at risk of malaria during mass campaigns (Mansiangi et al., 2020).

2.6 Mitigating malaria using the ITN approach

The guidelines from the development group emphasize that prioritizing the delivery of IRS or ITNs with high coverage and quality standards is crucial while introducing a

second intervention to address deficiencies in the implementation of the first intervention should be a subordinate consideration.

In most epidemiological and ecological contexts, it is advisable to attain widespread coverage with a fundamental vector control intervention (such as ITNs or IRS) for all populations susceptible to malaria. The conditional recommendation is to combine these fundamental interventions to reduce both morbidity and mortality.

Changes in the melanogenic potential of a specific geographical area can influence the population at risk of malaria, either increasing or decreasing it.

Programs may consider implementing a second core intervention to prevent, manage, and mitigate insecticide resistance after achieving high coverage with the first core intervention.

The choice to introduce a second core vector control intervention should follow a prioritization analysis encompassing all malaria interventions, rather than solely concentrating on vector control. This approach aims to optimize the impact of additional resources.

Decisions to reduce vector control efforts in areas with interrupted transmission should stem from a comprehensive analysis, considering factors such as case management, response capacity for vector control, active disease surveillance, and assessments of receptivity and vulnerability (Sochantha et al., 2006).

2.7 Factors associated with the use of ITNs

The factors that influence the use of ITNs in the prevention of malaria are multifaceted and interconnected; nonetheless, the most prevalent factors, referred to as underlying determinants of ITN use, include age, education level, household wealth, exposure to malaria messages, knowledge of the causes of malaria, knowledge of the effectiveness of ITNs, household size, area of residence, gender, marital status, poverty, type of ITN, and region. A few of these factors will be discussed in more detail below (Adedokun & Uthman, 2020)

The type of ITN and net care behavior: a recent study found that both the polyester

LLIN DawaPlus® 2 and the polyethylene LLIN DuraNet© performed significantly better in the northwest DRC, but both had a three-year median survival below that of the other. According to Mansiangi et al. (2020), this study emphasizes that adopting better net-care practices should increase their physical durability.

In the villages outside of Kinshasa, education was found to have the greatest influence on the utilization of ITNs, according to a study conducted in the Democratic Republic of the Congo (Ndjinga & Minakawa, 2010). The ownership of ITNs in households is affected by various risk factors, such as the region, household size, marital status of the household head, and level of education. However, among those who have access to ITNs, the factors associated with their use include the region, marital status, age, and wealth quintile, as identified in a study by Diallo et al. (2023).

Size of household members and residence area: according to (Njumkeng et al., 2019), the likelihood of using ITNs was found to be two times higher in homes with five to nine occupants and three times higher in homes with ten or more occupants, respectively, compared to homes with fewer than five occupants.

Furthermore, compared to semi-urban communities, ITN coverage was lower in rural areas.

Gender, age, awareness, and place of residence: Of the women who used ITNs, approximately 53% are between the ages of 25 and 34. Over 60% of low-income and illiterate women wore mosquito nets. Most people who know that mosquitoes are the source of malaria (59%) have used mosquito nets, as do those who have heard or seen messages about the disease (60%). Most people (61%) who assert that there is no difference in the risk of contracting malaria with or without mosquito net use also reported using one. Mosquito nets are used by most women (58%) who live in rural areas and areas like North Central (53%), Northeast (64%), and Northwest (62%). Women make up the majority in most poor communities (64%) and the state (67%) use mosquito nets (Adedokun & Uthman, 2020).

Misuse of ITNs: According to Larsen et al. (2021), there are several issues that

contribute to the misuse of ITNs in fisheries, including inadequate scientific research, poverty, and weak state institutions, which make sustainable fisheries management more difficult.

According to research conducted in Malawi (Berthe et al., 2019), people are forced to make difficult decisions like selling their ITNs or misusing them for fishing because of financial hardships brought on by food shortages, unemployment, and droughts (Larsen et al., 2021).

Concerns are expressed by McLean et al. (2014) that many people in the DRC fish near Lake Tanganyika using free malaria ITNs.

It is noted that Benin has a high frequency of improper ITN use in fishing practices (Hondo et al., 2023).

A study in the Northwest Region of Cameroon found that the majority of respondents owned LLINs (89.9%), with most of them obtained for free (87.3%). While the majority used the LLINs for sleeping (77.8%), a significant portion also used them for activities like fishing, nursing, and footfall nets (18.2%). Most respondents reported that their nets were in good condition (71.9%), but heat and a sense of suffocation were the main concerns (52.2%) (Ntonifor & Veyufambom, 2016a).

Misuse of ITNs for fishing is common worldwide, particularly in Sub-Saharan Africa, including the Democratic Republic of the Congo. Despite the increase in availability, fishing remains the primary misuse of these nets (Short et al., 2018).

A recent study in the Oromia Region of Ethiopia found that ITN use was significantly associated with being female, under 25 years old, having a higher income, and having more than three beds (Mekuria et al., 2022).

In Kano, Nigeria, a post-campaign survey revealed that women were more likely than men to use ITNs. Factors such as campaign wave, age, education, and the ratio of ITNs to household members were found to be significantly correlated with ITN use. Household wealth, residence, and polygamous households did not have a significant correlation with ITN use (Garley et al., 2013).

2.8 Conceptual framework of factors associated with the use of ITNs

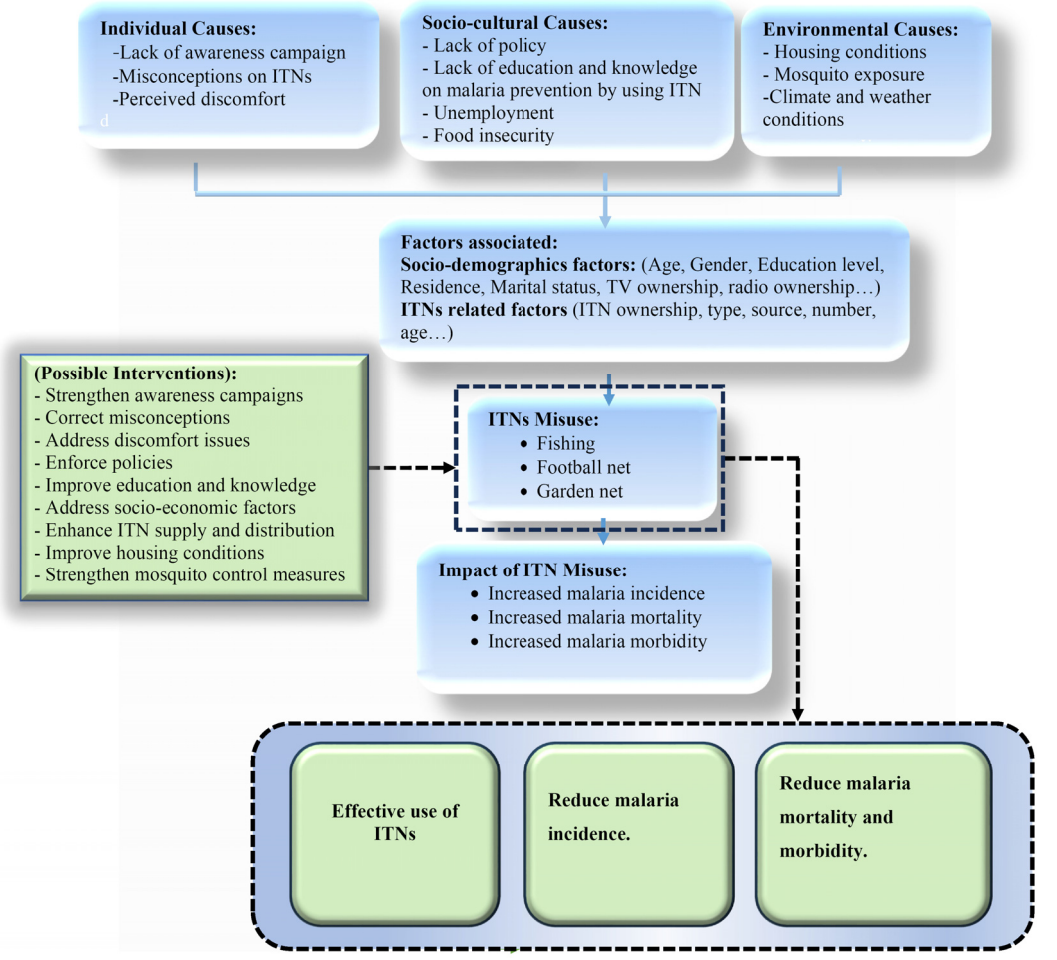

Figure 3. Conceptual framework of factors associated with the use of ITNs.

2.9 Hypothesis

The first hypothesis of this study is related to the use of ITN in the DRC: I believe that socio-demographic factors are associated to the use of ITN as well as lack of policy, behaviors, and lack of knowledge in malaria prevention can influence the use of ITN.

The second hypothesis concerns the factors related to the hh ITN ownership: I believe

that characteristics such as Net type, ITN brand, insecticide on the Net, source of the ITN depending on whether it comes from a mass distribution campaign or not, whether it's granted or paid for, place of distribution depending on whether it comes from a public, private health center, market, or school, can influence the use of ITN.

III. METHOD

3.1. Study Design

This study focused on a retrospective cross-sectional design using the data from the 2019 Multiple Indicator Cluster Surveys of DRC (Secondary data from the UNICEF website). This sectional descriptive study will compare several socio-demographic and ITN related characteristics variables.

3.2. Study site

The DRC, located in the heart of the African continent, with 103,262,808 people, is a vast and diverse country with nine neighboring nations. To the North, it shares borders with the Central African Republic and South Sudan. To the East, it is bordered by Uganda, Rwanda, Burundi, and Tanzania. Zambia lies to the Southeast, while Angola and the Republic of the Congo are situated to the West. Kinshasa, the capital city of the DRC, stands as a bustling metropolis situated along the banks of the Congo River.

The DRC's expansive geography encompasses dense rainforests, expansive savannas, and a network of rivers, including the Congo River, the second-longest river in Africa. This diverse landscape, however, contributes to the favorable conditions for mosquito proliferation, making malaria the predominant cause of mortality in the DRC.

Despite its rich natural resources, the DRC faces socio-economic challenges, including political instability and conflicts, which impact healthcare infrastructure and hinder the implementation of effective malaria control strategies. The complexity of these factors underscores the significance of studying the country as a unique context for understanding and addressing malaria and public health challenges in Africa.

3.3. Population and Setting of the Study

For this study, data was collected from a total of 21,724 adults between the ages of 15

and 49 who were eligible for the surveys. These individuals were part of 21,630 households that were interviewed across all 26 provinces of the Democratic Republic of the Congo.

3.4. Variables

The various dependent and independent variables are detailed in Tables 2 and 3.

3.4.1. Dependent variable:

The dependent variable in this study was to determine who slept under a net the previous night.

3.4.2. Independent variables:

The independent variables included socio-demographic characteristics of the adults of reproductive age within the households, as well as factors related to ITNs within the households.

Table 1. Description of the dependent variable

	Dependent variable	Remarks	Definition of variables
1	**Who sleeps under ITN?**	1=yes, 2=No	Determines the proportion of the hh members who used an ITN the previous night

Table 2. Description of independent variables

N°	Independent variables	Remarks	Definition of variables (Household and ITN factors)
1	hh head age group	<=25	Age of the head of the household
		26 to 35	
		>35	
2	Woman age group	No answer	
		<=25	Women's agesare divided into 3 subgroups
		26 to 35	

N°	Independent variables	Remarks	Definition of variables (Household and ITN factors)
		>35	
3	Gender	Male Female	Sex of the population study was divided into 2 subgroups(male and female)
4	Total number births	<=3 4 to 6 >6	Total number of birth events of the household woman
5	Husband's age group	<25 26 to 49 >50 No answer	Husband's age group
6	Alcohol consumption	Yes No No answer	Alcohol consumption by the household head
7	Residence	Urban Rural	place of residence
8	Global happiness	Very Happy Quite Happy Neither Happy Nor Unhappy Quite Unhappy Very unhappy No answer	The happiness index of the household
9	Region of origin	South-Western North-Western North-Eastern South-Eastern	The regional origin of household head is described into four sub-regions.
10	Marital status	Currently married/in union Formerly married Never married No answer	The marital situation of the head of the household
		Elementary or Less	household mother's education

N°	Independent variables	Remarks	Definition of variables (Household and ITN factors)
		Primary school	level
11	Women's education level	Middle school	
		High school	
		University and over	
		Elementary or less	household father's education level
		Primary school	
12	Head's education level	Middle school	
		High school	
		University or over	
		No answer	
		Yes	Presence or not of the disability
13	Disability	No	
		No answer	
		The poorest	Income level
		Poor	
14	Rural wealth index	Middle	
		Rich	
		Richest	
		No answer	
		<=3	Size of the household members
15	Size of the household	4 to 6	
		>6	
		Christianity	Religion of the head of the household
16	Religion of the head	Others religion	
		No answer	
		French	Language of the head of the household
17	Language of the head	National language	
		Dialect	
		No answer	
		Yes	Households owning at least one television
18	Television owning	No	

N°	Independent variables	Remarks	Definition of variables (Household and ITN factors)
		No answer	
		Not at all	Household head frequency of watching television
		Less than once a week	
19	Television watching frequency	At least once a week	
		Almost every day	
		No answer	
		Not at all	Household head frequency of reading newspapers or magazines
		Less than once a week	
20	Journal or magazine reading	At least once a week	
	frequency	Almost every day	
		No answer	
		Yes	Households owning at least one radio
21	Radio owning	No	
		No answer	
		Yes	Households owning at least one Cell phone
22	Cell phone owning	No	
		No answer	
	Internet access in the hh	Yes	Internet access in the household
23		No	
		No answer	
		Renter	Own ship of the home the family use
		Family lodging	
24	Home owning	Other	
		No answer	
		Yes	
25	Health insurance	No	Insurance coverage
		No answer	
		Bantu	Household head ethnic group
		Nilitic	

N°	Independent variables	Remarks	Definition of variables (Household and ITN factors)
26	Head's ethnic group	Soudanese Other group No answer	
27	Households owning at least one ITN	Yes No	This variable indicates whether a hh in the study owns at least one ITN. The options are 'Yes' or 'No'.
27	Number of ITN per household	<=2 3 to 4 >5	Determine the quantity of ITNs present in each household divided into 3 subgroups.
29	ITN Observed in the household	Yes No	This variable determines whether an ITN was observed in the household during the study. The options are 'Yes' or 'No'
30	ITN age	<12 12 to 24 24 to 36 >36	This variable categorizes the age of the ITNs present in the household in 4 subgroups.
31	ITN type or brand	LLIN Other type	This variable distinguishes between different types or brands of ITNs. The primary distinction is between LLINs and other types.
32	ITN Source	Net distribution campaign Antenatal consultation immunization campaign Other	This variable identifies the source from which the ITNs were obtained and divided into 4 subgroups.

3.5.Data collection

The data for this study were collected from the Multiple Indicator Cluster Survey with a malaria component in the DRC (MICS-PALU, DRC 2017-2018). The survey aimed to provide national-level estimates of the well-being of children and women in both urban

and rural areas of the country, as well as in each of the 26 provinces.

The sampling process involved stratifying the data by type of residence, creating three strata in each province: statutory cities, towns, and sectors. Resulting in a total of 76 defined strata. Sampling units were systematically selected based on size, with primary units being commune neighborhoods, cities, and sectors. Secondary units were city neighborhoods and villages. Clusters were formed by commune neighborhoods, including city neighborhoods and villages. In cases where a cluster was large, a random segment was selected as the secondary or tertiary unit.

From each of the 721 clusters/segments, a systematic sample of 30 households was drawn, resulting in a total sample of 21,630 households. Some clusters were not visited due to security reasons. In rural areas, clusters with fewer than 30 households were surveyed entirely without random selection.

Weights were applied to account for the non-self-weighting nature of the sample.

3.6. Survey questionnaires

The survey utilized diverse questionnaires to collect information:

1. A household questionnaire gathered fundamental demographic data on all de jure household members, the household, and accommodations.
2. A water quality analysis questionnaire was administered to four households in each cluster.
3. An individual female questionnaire was given to all women aged 15 to 49 in each household.
4. An individual male questionnaire was provided to all males aged 15 to 49 in every other household.
5. Children under five questionnaires were distributed to mothers (or guardians) of children under five residing in the household. This questionnaire included a module on anemia and malaria testing, conducted in two out of three households for all children aged 6 to 59 months.
6. A questionnaire for children aged 5 to 17 was given to one child per household,

randomly selected from among the 5-17-year-olds living there. The mother or main caregiver completed the questionnaire, except for the 'learning skills' module, which was completed by the children themselves.

3.7. Data Analysis

Jamovi version 2.4.7 will be used for data processing and analysis:

1. Descriptive Statistics: Descriptive statistics, including percentages and frequencies, provide an overview of socio-demographic and household ITN factors which aims to capture basic characteristics and distributions within the dataset.
2. Chi-Square Analysis: This will explore associations between variables, particularly useful for identifying relationships within categorical data. The analysis aims to uncover patterns and correlations among the considered variables.
3. Logistic Regression: Binomial and multinomial logistic regression will be employed.

- Offers a nuanced understanding of associations between individual ITN utilization and explanatory factors.
- Intends to identify key factors influencing the likelihood of ITN use in the study population by assessing coefficients and significance levels.

3.8. Ethical statement

The information for this research originates from surveys conducted by UNICEF and is accessible only with prior authorization, granted by specifying the study's intended purpose and date. All data is treated with confidentiality, encrypted, and exclusively employed for research objectives.

The study's outcomes will support health decision-makers in refining strategies for acquiring, distributing, and utilizing insecticide-treated nets (ITN). The objective is to diminish the occurrence and mortality rates linked to malaria in the DRC.

IV. RESULTS

4.1 General characteristics related to the household socio-demographic factors and ITN related characteristics.

4.1.1 General characteristics of the household's socio-demographics factors:

A total of 21,724 participants of reproductive age were included in this study, distributed between rural (66.5%) and urban (33.5%) areas of the DRC. The age distribution of the heads of households revealed that those over 35 years accounted for the largest proportion (38.4%), while those under 25 years accounted for the smallest proportion (8.7%). Among the women in the study, those under 25 years represented the largest group (45.8%), followed by those between 26-35 years (27.5%) and those over 35 years (26.7%). Males were more predominant in the study population, comprising 72.7% of the participants, with a higher representation in rural areas.

Most households had fewer than 3 children (63.9%), and a significant proportion (68.8%) of the population did not consume alcohol. In terms of well-being, 38.5% reported being quite happy, while 15% reported being unhappy. The North-Eastern region was the most represented region of origin (30.1%), followed by the South-Western (25.1%), South-Eastern (23%), and North-Western (21.7%) regions. Marital status showed that the majority were married (64.4%), while 28.1% had never been married.

Education levels varied, with 34.7% of women having attended primary school and 27.3% attending higher school. The largest proportion of household heads had attended higher school (38.4%). The study population had a low proportion of individuals with disabilities (3.7%), and the majority reported not having any disabilities (83.5%). In terms of wealth index, the poorest group represented the highest proportion (17%). Household size was predominantly small, with 91.5% having less than or equal to 3 people.

Christians represented the largest religious group among the heads of households (57.4%), with other religious groups accounting for the remaining 42.6%. The primary language spoken by the heads of households was the dialect (50%), followed by national languages (49.4%), and a small proportion speaking French (0.6%). Ownership of televisions and radios was relatively low, at 12% and 34.9%, respectively. Access to the internet was limited to 1.2% of households. A significant proportion of households (72.1%) owned their homes. Health insurance coverage was low, with only 2.4% of the population having coverage. The Bantu ethnic group represented the majority (87.8%), followed by Sudanese (8.8%), Nilotic (2.6%), and other ethnic groups (0.8%).

Table 3. General characteristics of the household's socio-demographic factors:

Variables	Characteristics	N=21724	Frequencies(%)
hh head age group	<=25	1885	8.7 %
	26 to 35	4178	19.2 %
	>35	8343	38.4 %
	No answer	7318	33.7 %
Woman age group	<=25	9943	45.8 %
	26 to 35	5971	27.5 %
	>35	5810	26.7 %
Gender	Male	15789	72.7 %
	Female	5935	27.3 %
Total number births	<=3	13882	63.9 %
	4 to 6	4062	18.7 %
	>6	3780	17.4 %
Husband age group	<25	949	4.4 %
	26 to 49	11124	51.2 %
	>50	1929	8.9 %
	No answer	7722	35.5 %
Alcohol consumption	Yes	5958	27.4 %
	No	14939	68.8 %
	No answer	827	0.038

Variables	Characteristics	N=21724	Frequencies(%)
Residence	Urban	7271	33.5 %
	Rural	14453	66.5 %
Global happiness	Very Happy	2122	9.8 %
	Quite Happy	8374	38.5 %
	Neither Happy Nor Unhappy	6279	28.9 %
	Quite Unhappy	3246	14.9 %
	Very unhappy	1680	7.7 %
	No answer	23	0.1 %
Region of origin	South-Western	5447	25.1 %
	North-Western	4722	21.7 %
	North-Eastern	6548	30.1 %
	South-Eastern	5007	23.0 %
Marital status	Currently married/in union	13999	64.4 %
	Formerly married	1628	7.5 %
	Never married	6094	28.1 %
	No answer	3	0.0 %
Women's education level	Elementary or Less	4192	19.3 %
	Primary school	7537	34.7 %
	Middle school	3385	15.6 %
	High school	5930	27.3 %
	University and over	680	3.1 %
Head's education level	Elementary or less	2964	13.6 %
	Primary school	5770	26.6 %
	Middle school	3035	14.0 %
	High school	8339	38.4 %
	University or over	1608	7.4 %
	No answer	8	0.0 %
Disability	Yes	802	3.7 %
	No	18145	83.5 %
	No answer	2777	12.8 %
Rural wealth index	The poorest	3702	17.0 %
	Poor	3033	14.0 %
	Middle	2975	13.7 %

Variables	Characteristics	N=21724	Frequencies(%)
	Rich	2568	11.8 %
	Richest	2175	10.0 %
	No answer	7271	33.5 %
Size of the household	<=3	19887	91.5 %
	4 to 6	1494	6.9 %
	>6	343	1.6 %
Religion of the head	Christianity	12472	57.4 %
	Others religion	9251	42.6 %
	No answer	1	0.0 %
Language of the head	French	136	0.6 %
	National language	10726	49.4 %
	Dialect	10861	50.0 %
	No answer	1	0.0 %
Television owning	Yes	2603	12.0 %
	No	1093	5.0 %
	No answer	18028	83.0 %
Television watching frequency	Not at all	17858	82.2 %
	Less than once a week	849	3.9 %
	At least once a week	769	3.5 %
	Almost every day	2112	9.7 %
	No answer	136	0.6 %
Journal or magazine reading frequency	Not at all	19798	91.1 %
	Less than once a week	1067	4.9 %
	At least once a week	542	2.5 %
	Almost every day	190	0.9 %
	No answer	127	0.6 %
Radio owning	Yes	7578	34.9 %
	No	14145	65.1 %
	No answer	1	0.0 %
Cell phone owning	Yes	8944	41.2 %
	No	12779	58.8 %
	No answer	1	0.0 %
Internet access in the	Yes	251	1.2 %

Variables	Characteristics	N=21724	Frequencies(%)
household	No	21472	98.8 %
	No answer	1	0.0 %
Home owning	Owner	15652	72.0 %
	Renter	3317	15.3 %
	Family lodging	2499	11.5 %
	Other	255	1.2 %
	No answer	1	0.0 %
Health insurance	Yes	527	2.4 %
	No	21133	97.3 %
	No answer	64	0.3 %
Head's ethnic group	Bantu	19070	87.8 %
	Nilitic	571	2.6 %
	Soudanese	1909	8.8 %
	Other group	173	0.8 %
	No answer	1	0.0 %

4.1.2 General characteristics of the household's insecticide treated net:

Table 4 determines the general characteristics related to the ITN within the household.

Regarding the variable of owning at least one-bed net, households owning at least one net were more numerous with 65.1%, compared to households not having ITN with 34.9%.

Regarding the number of ITNs, they were classified into three subgroups: the subgroup with less than or equal to two ITNs,3 to 4 ITNs, and finally a subgroup with more than 5 ITNs in the household. The subgroups with less than or equal to 2 ITNs had a high proportion of 42.3% followed by the subgroups with 3 to 4 ITNs with a proportion of 19.7% and finally the subgroup with more than 5 ITNs with 3.1%.

For the ITNs observed in the household, 90.8% of ITNs were observed, compared with 9.2% of households where ITNs have not been observed.

About the lifetime of the ITNs since the beginning of their use in the household,

divided into four specific subgroups, it is noteworthy that the ITNs less than were less than 12 months old had a high proportion of 37.5%, followed by the subgroup of 12 and 24 months with 26.7%, then the subgroup of more than 36 months with a proportion of 19.7 % and finally the ITNs in the subgroup between 24 and 36 months had a proportion of 16.1%.

In terms of net types, LLINs were the most common type in the households, comprising 96%, compared with 4% for nets other than LLINs.

Regarding which the mosquito nets were obtained, it is observed that most mosquito nets were obtained during the free mosquito net distribution campaign, accounting for 78%. This is followed by 5.2% of mosquito nets obtained during antenatal consultation, and the vaccination campaign provided a proportion of 1.1% of mosquito nets in the households. Other methods accounted for 14.9%.

Concerning the population sleeping under a mosquito net, a significant proportion of 84.9% of individuals had slept under a mosquito net the night before the survey, in contrast to 15.1% of the study population who reported not having slept under an ITN.

Table 4. shows the general characteristics related to the household's ITN:

Characteristics		**N=21724**	**Frequencies(%)**
household owning at least one ITN			
	Yes	14151	65.1 %
	No	7573	34.9 %
Number of ITN per household			
	<=2	9192	42.3 %
	3 to 4	4284	19.7 %
	>5	675	3.1 %
	No answer	7573	34.9 %
ITN Observed in the household			
	Yes	19736	90.8 %
	No	1988	9.2 %

Characteristics	N=21724	Frequencies(%)
Timelife of the ITN in the household		
<12	8151	37.5 %
12 to 24	5790	26.7 %
24 to 36	3499	16.1 %
>36	4284	19.7 %
ITN Type or brand		
LLIN	20852	96.0 %
Others type	872	4.0 %
The way the net was obtained		
Net distribution campaign	17108	78.8 %
Antenatal consultation	1127	5.2 %
Immunization campaign	246	1.1 %
Others	3243	14.9 %
People who slept under a mosquito		
Yes	18447	84.9 %
No	3277	15.1 %

4.2 Association between dependent variable, socio-demographics, and insecticide treated net explanatory factors:

4.2.1 Association between a dependent variable and socio-demographics explanatory factors:

Table 5 shows the association of socio-demographic factors and the individual of reproduction of age who slept under ITN last night:

- The value for the association between age groups of men and ITN use was found to be 0.036. This suggests a statistically significant association between age groups of men and ITN use. With a p-value is 0.036 at the chosen significance level of 0.05, the null hypothesis is rejected.
- The value for the association between the region of origin and ITN use was found to be 0.003. This suggests a statistically strong relationship between the region of

origin and ITN use.

- The p-value of 0.038 indicates a high correlation between the use of ITNs and the marital status.
- The value for the observed association between the head's household language and ITN use by chance alone is very low, with a p-value <0.001. This indicates a significant association between spoken language and ITN use.
- The association between watching television frequencies and using ITNs is strong, as indicated by the p-value of 0.012.
- The observed p-value of 0.002 between reading newspaper or magazine frequencies and the utilization of the ITN within the household suggests a strong correlation.
- The value for the association between the head's ethnic group and ITN use was found to be less than 0.001, This suggests that there is a significant relationship between the ethnic group and ITN use.
- This table also presents variables such as head's age group (p-value=0.051), women's age group (p-value=0.19), gender (p-value=0.504), Total number of births (p-value=0.569), alcohol consumption (p-value=0.75), Residence (p-value=0.552), Global happiness (p-value=0.263), Woman's Education level (p-value=0.988), head's Education level (p-value=0.247), Disability (p-value=0.831), Rural wealth index (p-value=0.877), Household size members (p-value=0.962), religion of the household's head (p-value=0.074), television owning (p-value=0.074), radio owning (p-value= 0.891), Owning at least one cell phone (p-value=0.214), Household with access to internet (p-value=0.784), The household owns its home (p-value=0.188) and Health insurance(p-value=0.855), the value of the association between these independents variables and the use of ITN was found to be greater to 0.05. Since this p-value is more than the chosen significance level of 0.05, we fail to reject the null hypothesis. This suggests that there is no association between these independent and dependent variables.

Table 5. shows the association between a dependent variable and socio-demographics explanatory factors:

		People who slept under ITN last night				*P*-value
		YES		NO		
		N	%	N	%	
Variables		18447	84.9	3277	15.1	
hh head age group						
	<=25	1609	85.4	276	14.6	
	26 to 35	3562	85.3	616	14.7	0.051
	>35	7131	85.5	1212	14.5	
	No answer	6145	84.0	1173	16.0	
	<=25	8420	84.7	1523	15.3	
Woman age group	26 to 35	5113	85.6	858	14.4	0.19
	>35	4914	84.6	896	15.4	
Gender						
	Male	13423	85.0	2366	15.0	
	Female	5024	84.7	911	15.3	0.504
Total number births						
	<=3	11764	84.7	2118	15.3	
	4 to 6	3454	85.0	608	15.0	0.569
	>6	3229	85.4	551	14.6	
	<25	816	86.0	133	14.0	
Husband's age group	26 to 49	9489	85.3	1635	14.7	
	>50	1656	85.8	273	14.2	0.036
	No answer	6486	84.0	1236	16.0	
Alcohol consumption						
	Yes	5079	85.2	879	14.8	
	No	12644	84.6	2295	15.4	0.075
	No answer	724	87.5	103	12.5	
Residence						
	Urban	6189	85.1	1082	14.9	
	Rural	12258	84.8	2195	15.2	0.552

	People who slept under ITN last night				*P*-value
	YES		NO		
	N	%	N	%	
Global happiness					
Very Happy	1826	86.1	296	13.9	
Quite Happy	7045	84.1	1329	15.9	
Neither Happy Nor Unhappy	5358	85.3	921	14.7	
Quite Unhappy	2763	85.1	483	14.9	0.263
Very unhappy	1435	85.4	245	14.6	
No answer	20	87.0	3	13.0	
Region of origin					
South-Western	4584	84.2	863	15.8	
North-Western	3966	84.0	756	16.0	
North-Eastern	5573	85.1	975	14.9	0.003
South-Eastern	4324	86.4	683	13.6	
Marital status					
Currently married/in union	11958	85.4	2041	14.6	
Formerly married	1367	84.0	261	16.0	
Never married	5119	84.0	975	16.0	0.038
No answer	3	100.0	0	0.0	
Women's education level					
Elementary or Less	3551	84.7	641	15.3	
Primary school	6408	85.0	1129	15.0	0.988
Middle school	2879	85.1	506	14.9	
High school	5034	84.9	896	15.1	
University and over	575	84.6	105	15.4	
Head's education level					
Elementary or less	2531	85.4	433	14.6	
Primary school	4876	84.5	894	15.5	
Middle school	2574	84.8	461	15.2	
High school	7065	84.7	1274	15.3	0.247
University or over	1393	86.6	215	13.4	

		People who slept under ITN last night				*P*-value
		YES		NO		
		N	%	N	%	
	No answer	8	100.0	0	0.0	
	Disability					
	Yes	684	85.3	118	14.7	
	No	15396	84.8	2749	15.2	
	No answer	2367	85.2	410	14.8	0.831
Rural wealth index						
	The poorest	3142	84.9	560	15.1	
	Poor	2571	84.8	462	15.2	
	Middle	2507	84.3	468	15.7	
	Rich	2179	84.9	389	15.1	0.877
	Richest	1859	85.5	316	14.5	
	No answer	6189	85.1	1082	14.9	
Size of the household						
	<=3	16883	84.9	3004	15.1	
	4 to 6	1272	85.1	222	14.9	
	>6	292	85.1	51	14.9	0.962
Religion of the head						
	Christianity	10532	84.4	1940	15.6	
	Others religion	7914	85.5	1337	14.5	0.074
	No answer	1	100.0	0	0.0	
Language of the head						
	French	119	87.5	17	12.5	
	National language	9230	86.1	1496	13.9	
	Dialect	9097	83.8	1764	16.2	< .001
	No answer	1	100.0	0	0.0	
Television owning						
	Yes	2249	86.4	354	13.6	
	No	930	85.1	163	14.9	
	No answer	15268	84.7	2760	15.3	0.074

	People who slept under ITN last night				*P*-value
	YES		NO		
	N	%	N	%	
Television watching frequency					
Not at all	15164	84.9	2694	15.1	
Less than once a week	698	82.2	151	17.8	
At least once a week	660	85.8	109	14.2	
Almost every day	1819	86.1	293	13.9	0.012
No answer	106	77.9	30	22.1	
Journal or magazine reading frequency					
Not at all	16792	84.8	3006	15.2	
Less than once a week	928	87.0	139	13.0	
At least once a week	471	86.9	71	13.1	
Almost every day	162	85.3	28	14.7	0.002
No answer	94	74.0	33	26.0	
Radio owning					
Yes	6429	84.8	1149	15.2	
No	12017	85.0	2128	15.0	
No answer	1	100.0	0	0.0	0.891
Cell phone owning					
Yes	7639	85.4	1305	14.6	
No	10807	84.6	1972	15.4	0.214
No answer	1	100.0	0	0.0	
Internet access in the household					
Yes	210	83.7	41	16.3	
No	18236	84.9	3236	15.1	0.784
No answer	1	100.0	0	0.0	
Home owning					
Owner	13291	84.9	2361	15.1	
Renter	2829	85.3	488	14.7	
Family lodging	2123	85.0	376	15.0	
Other	203	79.6	52	20.4	0.188

		People who slept under ITN last night				*P*-value
		YES		NO		
		N	%	N	%	
	No answer	1	100.0	0	0.0	
Health insurance						
	Yes	450	85.4	77	14.6	
	No	17944	84.9	3189	15.1	
	No answer	53	82.8	11	17.2	0.855
Head's ethnic group						
	Bantu	16205	85.0	2865	15.0	
	Nilotic	461	80.7	110	19.3	
	Soudanese	1653	86.6	256	13.4	
	Other group	127	73.4	46	26.6	< .001
	No answer	1	100.0	0	0.0	

4.2.2 Association between a dependent variable and ITN explanatory factors:

Table 6 shows the association between the ITN characteristics and its use:

- A p-value less than 0.001 is below the typical significance level of 0.05, indicating that the association between observed ITN and ITN utilization is statistically significant. This implies a significant relationship between observed and used ITNs. This suggests that observing an ITN is associated with an increased likelihood of using it.
- A p-value less than 0.001 indicates a strong relationship between ITN lifetime and its use. In other words, the two variables are not independent of each other, and the difference between what we could expect by chance and what we observe is highly significant.
- The p-value less than 0.001 indicates a statistically significant association between the ITN type and its use.
- The p-value of 0.002 indicates a statistically significant association between the

place where the ITN was obtained and its utilization.

- The household owning at least one ITN and the number of ITNs within the household, with p-values of 0.441 and 0.289 respectively, are not significantly associated with the utilization of the ITN since their p-values are greater than the fixed significance level of 0.05.

Table 6. shows the association between the ITN characteristics and its use:

Variables	People slept under ITN last night				*P*-value
	Yes		No		
	N	%	N	%	
Total	**18447**	**84.9**	**3277**	**15.1**	
ITN owning					
Yes	11997	84.8	2154	15.2	0.441
No	6450	85.2	1123	14.8	
Number of ITN per household					
<=2	7822	85.1	1370	14.9	0.378
3 to 4	3601	84.1	683	15.9	
>5	574	85.0	101	15.0	
No answer	6450	85.2	1123	14.8	
ITN Observed in the household					
Yes	16931	85.8	2805	14.2	< .001
No	1516	76.3	472	23.7	
ITN age					
<12	6602	81.0	1549	19.0	< .001
12 to 24	4905	84.7	885	15.3	
24 to 36	3064	87.6	435	12.4	
>36	3876	90.5	408	9.5	
ITN Type or brand					
LLIN	17752	85.1	3100	14.9	< .001
Others type	695	79.7	177	20.3	
ITN obtained source					

Variables	People slept under ITN last night				*P*-value
	Yes		No		
	N	%	N	%	
Net distribution campaign	14476	84.6	2632	15.4	0.002
Antenatal consultation	1002	88.9	125	11.1	
Immunization campaign	209	85.0	37	15.0	
Others	2760	85.1	483	14.9	

4.3 Logistic regression of factors associated with the use of insecticide bed net in DRC

The table below includes both unadjusted and adjusted odds ratios (OR) along with their 95% confidence intervals for various predictor variables:

The husbands aged 26-49 years have a significantly greater odds ratio (OR) influencing the use of ITN compared to the reference group (age group of less than 25 years).

The adjusted OR is 1.032 for the 26-49 years group, indicating a 0.32% increase in the odds of ITN use, and 0.983 for the group > 50 years, which means a decrease in the odds of using ITN of 1.7% compared to the < 25 years group, although these results are not statistically significant for 26-49 years group (p = 0.746) and > 50 years(p=0.88).The p-values for the 26-49 years and the greater than 50 years categories are all greater than the significance level of 0.05, indicating a not strong association between the independent and the dependent variable.

The region of origin of the South-Western serves as the reference group. The North-Eastern group has a significantly lower odds ratio of experiencing ITN utilization compared to the reference group.

The adjusted OR is 1.153 for the North-Western, 1.119 for the North-Eastern, and 1.04 for the South-Eastern, signifying a 15.3%, 11.9%, and 0.4% increase in the chance of using ITN compared with the South-Western group respectively.

The predictors have statistically significant results for the North-Western (p=0.022), and North-Eastern (0.046) groups but have a non-significant result for the South-Eastern group (p=0.506).

The marital status “currently married or in union” serves as the reference group.

People formerly married have the lowest odds ratio of influencing the use of ITN compared to the currently married.

The adjusted OR is 0.997, indicating a 0.3% decrease in the odds of using ITN when compared to the currently married group, although this result is not statistically significant (p = 0.972).

The dialect language of the head serves as the reference group. The household head who speaks French has the lowest odds ratio of 0.737. The adjusted OR of 0.739 and 0.813 suggests that for every one-unit decrease in French and national language, the odds of the outcome occurring decrease by approximately 73.9% and 81.3%, respectively, for the French language and national language. This means that the French and national language have a negative effect on the use of the ITN in DRC.

The French and national language, with respectively a p-values of 0.258 and p-value <0.001 indicates that there is sufficient evidence to suggest that the national language is associated with the use of ITN more than the French language, which has no sufficient relationship with the dependent variable.

Watching television at least once a week serves as the reference group.

The frequency of watching television almost every day has the greatest odds ratio, meaning the predictor influences the outcome approximatively 83.7% compared to the reference group.

The adjusted OR is 1.104 for the ‘not at all group’, indicating a 10.4% increase in the odds of ITN use. The OR is 1.332 for the group ‘less than once a week’. signifying a 33.2% increase in the odds of using ITN compared to the ‘almost everyday reference group. The odds ratio of 1.004 for the ‘almost every day’ group. The odds ratio of 0.04% influence on the outcome.

Although these results are not statistically significant for ‘Not at all group’(p=1.104), ‘Less than once a week group’ (p = 1.332) and ‘almost everyday group’(p=1.01),

The p-values for all groups are greater than the significance level of 0.05, indicating a not strong association between the independent and the dependent variables.

The frequency of reading magazines/journal in the “less than once a week” group has the greatest odds ratio of 1.195, meaning the predictor influences the occurrence of the outcome approximatively 19.5% times compared to the reference group (“Not at all group” serves as the reference group.)

The adjusted OR is 0.82 for the “less than once a week group”, which means an 82% decrease in the odds of using ITN, and 0.871 for the group “at least once a week” which means a decrease in the odds of using ITN of 87.1% compared to the reference group; and the odds ratio of 1.04 for the “almost every day” group that means 0.4% of influencing the outcome compare to the reference group.

Although these results are not statistically significant for the “at least once a week” (p=0.297) and “almost everyday group” with (p=0.852), except “less than once a week group” which has a strong association with the outcome (p = 0.04).

The ethnic group Bantu serves as a reference group with an odds ratio of 1. In this context, the “other group” has a significant odds ratio of 2.049, which means that other group individuals have 2.049 times higher odds of the event compared to Bantu individuals. This suggests a substantially increased risk for the event of using ITN among individuals in the "other group” compared to the Bantu reference group.

For the adjusted odds ratio, the Sudanese with an odds ratio of 0.908, have 0.908 times the odds of the event compared to Bantu individuals. This implies a reduced risk for the use of ITN among Sudanese individuals compared to the Bantu reference group.

The Nilotic group, with an odds ratio of 1.26, indicates that Nilotic individuals have 1.26 times higher odds of the event compared to Bantu individuals. This suggests a moderately increased likelihood of ITN use among Nilotic individuals relative to Bantu. For the “other Group” the decreased odds ratio of 1.831 compared to the unadjusted odds

ratio, indicates that they have 1.831 times higher odds of the event compared to Bantu individuals. The p-value less than the significance level indicates a strong association with the outcome for the Nilotic (p=0.043) and another group (p<0.001), except for the Soudanese (p=0.221).

The ITN observation in the household servers is the reference group.The unadjusted odds ratio for the "No" subgroup compared to the reference "Yes" subgroup is 1.879. This means the individuals in the “No group” have approximately 1.879 times the odds of not using ITNs compared to individuals in the “Yes group”.

The adjusted odds ratio for the “no observe ITN” group compared to the reference "observe ITN" group is 1.997. This adjusted odds ratio indicates that individuals in households where we do not observe ITNs have approximately 1.997 times the odds of not using ITNs compared to individuals in households where we observe the ITNs.

Furthermore, the p-value reported as less than 0.001 indicates that the observed associations between ITN observation and ITN use are statistically significant. This means that the differences in ITN use between the "ITN not observed" and "ITN observed" subgroups are unlikely to have occurred by chance.Overall, these results suggest that individuals in households where we do not observe ITNs have higher odds of not using ITNs compared to those where ITNs are observed, even after adjusting for other potential factors related to ITN use.

The less than 12 months’ time life of the ITN in the household is used as the reference group. in this context, the greater than 36 months group has the lowest odds ratio with 0.449. This suggests that individuals who have been using ITN for more than 36 months have 55.1% lower odds of using an ITN compared to those in the less than 12 months group.

For the adjusted odds ratio, individuals who have been using an ITN for 12 to 24 months (odds ratio of 0.724), have approximately 28% lower odds of using an ITN. For 24 to 36 months (odds ratio of 0.545) the odds are approximately 45.5% lower, and for greater than 36 months (odds ratio of 0.41), they have approximately 59% lower odds of

using an ITN compared to those who have been using ITN for less than 12 months.

These odds ratios suggest that as the time of ITN use increases beyond 12 months, the odds of using an ITN decrease.The p-values for the 12 to 24,24 to 36, and greater than 36 months categories are all less than 0.001, indicating a strong association with the outcome variable.

The type or brand of ITN, with a p-value <0.001, indicates there is sufficient evidence to suggest that the type of ITN is associated with the use of ITN.

The OR of 1.458 suggests that for every one-unit increase in the type of ITN, the odds of the outcome occurring increase by approximately 45.8%. This implies that the type/brand of ITN has a positive effect on the use of the ITN in DRC.

However, the adjusted OR of 1.403 suggests that for every one-unit increase in the type of ITN, the odds of the outcome occurring increase by approximately 40.3%.

The net distribution campaign way for obtaining ITN serves as the reference group.in this context, the immunization campaign has the lowest odds ratio of experiencing ITN utilization compared to the reference group.

The adjusted odds ratios for the “way the net was obtained”, compared to the reference group (campaign group), suggest the following: for the individuals who obtained an ITN through antenatal services (odds ratio of 0.588), they have approximately a 41.2% lower odds of using ITN, for individuals who obtained an ITN through immunization services (odds ratio of 0.803) they have approximately a 19.7% lower odds of using ITN: and for individuals who obtained an ITN through other means (odds ratio of 0.743), they have approximately a 25.7% lower odds of using ITN compared to those who obtained bed nets through distribution campaigns.These odds ratios suggest that individuals who obtained ITNs through antenatal services, immunization services, or other means have lower odds of using ITNs compared to those who obtained ITNs through distribution campaigns.

The p-value less than the significance level indicates a strong association with the outcome for the antenatal consultation group ($p<0.001$) and another group ($p<0.001$), except for the immunization campaign ($p=0.882$).

Table 7. Shows both unadjusted and adjusted odds ratios (OR) along with their 95% confidence intervals for various predictor variables:

Predictor		Unadjusted ODD Ratio				Adjusted ODD Ratio			
		95% CI				95% CI			
		Lower	Upper	OR	*P*-value	Lower	Upper	OR	*P*-value
Husband's age group	<25	1				1			
	26 to 49	0.874	1.279	1.057	0.568	0.851	1.252	1.032	0.746
	>50	0.809	1.265	1.011	0.921	0.783	1.233	0.983	0.88
	No answer	0.964	1.418	1.169	0.113	0.927	1.381	1.132	0.224
Region of origin	South-Western	1				1			
	North-Western	0.91	1.126	1.013	0.819	1.021	1.303	1.153	0.022
	North-Eastern	0.841	1.027	0.929	0.149	1.002	1.25	1.119	0.046
	South-Eastern	0.753	0.935	0.839	0.002	0.926	1.169	1.04	0.506
Marital status	Currently married/in union	1				1			
	Formerly married	0.972	1.287	1.119	0.118	0.857	1.161	0.997	0.972
	Never married	1.027	1.213	1.116	0.01	.	.	.	.
	No answer	8.84E-102	3.49E+92	5.56E-05	0.931	NaN	NaN	5.86E-05	0.931
Language of the head	Dialect	1				1			
	French	0.442	1.228	0.737	0.241	4.16E-100	8.26e0+90	0.739	0.258
	National language	0.776	0.901	0.836	<.001	0.438	1.248	0.813	<.001
	No answer	2.71E-106	6.53E+97	1.33E-04	0.94	0.749	0.882	1.28E-04	0.964
Television watching frequency	At least once a week	1				1			
	Not at all	0.968	1.256	1.103	0.14	2.82E-172	5.86E+163	1.104	0.182
	Less than once a week	1.083	1.665	1.343	0.007	0.955	1.277	1.332	0.012
	Almost every day	0.809	1.3	1.025	0.837	1.066	1.664	1.01	0.935
	No answer	1.15	2.684	1.757	0.009	0.792	1.288	1.004	0.991
Journal or	Not at all	1				1			
	Less than once a week	0.996	1.434	1.195	0.055	0.545	1.847	0.82	0.04
	At least once a	0.741	1.368	1.006	0.967	0.679	0.991	0.871	0.297

Predictor		Unadjusted ODD Ratio				Adjusted ODD Ratio			
		95% CI				95% CI			
		Lower	Upper	OR	*P*-value	Lower	Upper	OR	*P*-value
magazine reading frequency	week								
	Almost every day	0.744	1.79	1.154	0.523	0.673	1.129	1.04	0.852
	No answer	1.517	3.62	2.344	<.001	0.69	1.568	1.9	0.032
Head's ethnic group	Bantu	1				1			
	Nilitic	1.092	1.668	1.35	0.006	1.057	3.414	1.26	0.043
	Soudanese	0.763	1.005	0.876	0.059	1.007	1.577	0.908	0.221
	Other group	1.459	2.877	2.049	<.001	0.779	1.06	1.831	<.001
	No answer	2.97E-106	7.16E+97	1.46E-04	0.941	.	.	.	.
ITN Observed in the household (TN3)	Yes	1				1			
	No	1.682	2.099	1.879	<.001	1.291	2.596	1.997	<.001
Timelife of the ITN in the household (TN4)	<12	1				1			
	12 to 24	0.702	0.842	0.769	<.001	NaN	NaN	0.724	<.001
	24 to 36	0.54	0.679	0.605	<.001	1.778	2.243	0.545	<.001
	>36	0.399	0.504	0.449	<.001	0.657	0.797	0.41	<.001
ITN Type or brand(TN5)	LLIN	1				1			
	Others type	1.231	1.728	1.458	<.001	0.483	0.615	1.403	<.001
The way the net was obtained (ITN10)	Net distribution campaign	1				1			
	Antenatal consultation	0.567	0.83	0.686	<.001	0.363	0.463	0.588	<.001
	Immunization campaign	0.685	1.385	0.974	0.882	1.174	1.677	0.803	0.23
	Others	0.866	1.069	0.962	0.476	0.484	0.714	0.742	<.001

Note. Estimates represent the log odds of "TN13 = NO" vs. "TN13 = YES"

V. DISCUSSION

5.1. Overview

DRC is one of the countries in the World where malaria is endemic, posing a significant public health concern as the leading cause of death and morbidity. One of the primary strategies for combating malaria is the use of ITNs. This study will analyze the factors associated with the use of ITNs in the DRC.

This chapter presents the main results of this study and examines the factors associated with the use of ITNs in DRC. The research has highlighted factors associated with the use of ITNs among adults of reproductive age in the DR Congo.

These findings underscore the need to strengthen policies, strategies, and interventions for the supply and distribution of ITNs. This enhancement is crucial to facilitate accessibility and promote the effective use of ITNs at the individual level to combat malaria in the country.

Interventions should also take into consideration key factors that can influence the effective use of ITNs. This includes implementing awareness-raising campaigns in local languages and involving the most vulnerable populations. Efforts should be directed towards clarifying misconceptions about the insecticide used in impregnating mosquito nets. Additionally, procurement, distribution, and use policies that take account of local contexts. Education and knowledge dissemination about malaria prevention using mosquito nets are also vital components of effective intervention strategies.

5.2. Study finding discussions

The results from this study show that men's age is strongly significant in influencing the use of ITNs among the study population, with a p-value <.036. Men in the age group 26-49 years had the highest percentage 51.2%, while the age group less than 25 years had

the lowest percentage of 4.4% in this study. In a similar study conducted in Ethiopia by Graves, P. M., and Ngondi (2007), increased net use was associated with age between 25-49 (aOR = 1.4, 95% CI 1.2-1.5) and age 50 and over (OR = 1.3, 95% CI 1.0-1.7) while reduced net use was associated with age 5-24 (aOR = 0.3; 95% CI 0.2-0.4) ;

The age factor may contribute to the observation that young men and adults between 26-49 years, with a proportion of 51.2% have used ITNs compared to groups under 25 years and over 50 years. This could be attributed to their mobility, social activity during awareness, and participation in the free distribution campaign of ITNs.

In the same study, Graves, P. M., and Ngondi (2007), female sex was associated with increased net use (aOR = 1.3; 95% CI 1.1-1.6), attributed to women's greater knowledge of malaria (P-value < 0.001). Additionally, living in an urban area (aOR = 2.5; 95% CI 1.5-4.1) was associated with increased ITN use.

In contrast to Graves, P. M., and Ngondi (2007), for this study, gender (p-value=0.504) was not found to be associated with ITN use.

The proportion of people in the DRC who live in rural areas is 66.5%, while the proportion of people who live in urban areas is 33.5%. However, this study's findings are unrelated to the use of ITNs. In contrast, a study by Baume, C. A. et al. (2011) in Ghana found that people are significantly more likely to use nets if the household is a located in a rural rather than an urban area (OR = 1.92 [95% C.I. 1.49-2.47]; p = 0.000). Graves, P. M., and Ngondi (2007) in Ethiopia also found that people living in urban areas (aOR = 2.5; 95% CI 1.5-4.1) are associated with higher net use. These findings differ from the current study in both instances, where neither urban nor rural settings were linked to net use.

In Ghana, Baume, C. A., et al. (2011) discovered that people who were aware that mosquitoes transmit malaria (OR = 1.38 [95% C.I. 1.03-1.86]; p < 0.05) and had higher levels of education (OR = 2.32 [95% C.I. 1.58-3.40]; p = 0.000) were significantly more likely to have used a mosquito net the night before. A mother who was aware that mosquitoes transmit malaria had a 1.4 times higher probability of using a net compared to

a mother who was not informed about the malaria transmission vector. According to research conducted in two villages close to Kinshasa, found a correlation between the use of mosquito nets and the educational level of the household head (Ndjinga & Minakawa, 2010).

However, in this current study, no association was found between the educational level of the woman (p-value=0.988), the head of household (p-value=0.247), and the use of ITNs.

On the other hand, factors such as television viewing frequency (p-value=0.012) and newspaper or magazine reading (p-value=0.002) were statistically related to net use, Television and newspapers can play a crucial role in raising awareness and educating people about the use of ITNs in the fight against malaria. Media campaigns, such as TV commercials and newspaper articles, can inform people about the importance of using ITNs to prevent malaria.

By watching television or reading newspapers or magazines, individuals can be exposed to educational messages, testimonials, or ITN distribution campaigns, which can positively influence their behavior in favor of net use, thus contributing to greater adherence to malaria prevention measures.

According to this survey, the percentage of people who used ITNs increased with their recentness: less than 12 months (37.5%), 12 to 24 months (26.7%), 24 to 36 months (16.1.5%), and more than 36 months (19.7%). With a p-value of less than 0.001, they were used less frequently in the home regardless of how old they were.

This version is supported by a study done in Ghana by Baume, C. A., et el., (2011), which discovered that if a mosquito net was less than a year old, it was significantly more likely to have been used (OR=2.44 [95% C.I. 1.46-4.05]; p=0.001). This is attributed to the fact that older nets lose their effectiveness, leading users to lose faith in their ability to prevent mosquito bites.

Furthermore, compared to households with three or more nets, those with fewer nets had higher odds of using ITN, one net (OR = 7.47 [95% C. I. 4.87-11.43]; p = 0.000), and

two nets (OR = 1.93 [95% C. I. 1.23-3.02]; p < 0.01). This aligns with the current study, which discovered that a higher percentage of people with ITNs (42.3%) had less or equal to two nets, even though this variable was not statistically associated with net use (p-value 0.378). A comparable study was conducted in Kenya (Githinji, S. et al.,2010). indicated that those who had extra nets reserved it and had a lower likelihood of sleeping under damaged nets than those who didn't (odds ratio 0.67; p = 0.000).

In the present study, around 65% of households owned at least one ITN, while approximately 35% did not own one. However, the ownership of ITNs was not statistically associated with their use (p-value of 0.441). A similar study conducted by (Githinji, S. et al, 2010) in Kenya, showed that 95% of households surveyed owned at least one net, with 78% of nets in households being either ITNs or LLINs.

In this study, 96% of nets were LLINs, while 4% were of other types. There was a statistically strong association between net type and use (aOR 1.403 [0.483-0.615] CI and p-value <0.0010).

Results from this study show that the majority of nets were obtained from a free distribution campaign (78.8%) and that free distribution was statistically associated with ITNs utilization, with a p-value less than 0.001.

A similar study conducted by (Githinji, S. et al,2010) in Kenya, showed that the main source of net ownership was the free mass distribution campaign, with around 47% of households obtaining their nets from this source.

According to the study's findings, 17% of the poorest people had more mosquito nets than the less poor, although this difference was unrelated to their use (p-value of 0.877). According to a related study conducted in Malawi by (Berthe et al., 2019), food insecurity and poverty were identified as the primary reasons for some Malawians deciding to use their ITNs for fishing as a source of income. Alawode, O. A., et al., (2019) in Nigeria discovered that the probability of owning a mosquito net was 5% higher for poor urban households than for wealthier households. Additionally, (Githinji, S. et al.,2010) found that people from the poorest households were more likely to sleep

under ITNs than the least poor (odds ratio 1.41; p = 0.005).

Based on research conducted in Nigeria by Alawode, O. A., et al. (2019), impoverished urban families had a 5% higher probability of possessing a mosquito net than the poorest households (OR = 1.05). Furthermore, a study carried out in China by Xu, J. W., et al. (2014) showed that the richest groups were more likely to utilize mosquito nets than the lowest, with (a p-value 0.0001). These findings contrast with the results of Alawode, O. A., et al. (2019).

According to this study, the Bantu ethnic group had the largest percentage of mosquito nets, at about 87.8%. Other minority ethnic groups with similar percentages were the Nilotic (2.6%) and Sudanese (8.8%). As reported by Xu, J. W., et al. (2014), a comparable study examining mosquito net ownership and use in the Jinuo area of China revealed that net ownership is lower among the Jinuo ethnic minority than the average for the rest of Yunnan. The study's findings also show that Jinuo people do not have equal access to nets because only 23.5% of LLINs were given out for free by the Yunnan government, while 76.1% of the nets used were bought commercially by the villagers. The study's findings additionally reveal that Jinuo people do not have equal access to nets because only 23.5% of LLINs were given out for free by the Yunnan government, while 76.1% of the nets used were bought commercially by the villagers. Belonging to a minority ethnic group can influence the access and use of mosquito nets due to cultural and linguistic barriers, economic disparities, geographical accessibility, and variations in levels of education and health awareness among ethnic groups. These factors can impact the understanding of the importance of mosquito nets and their correct use.

This present study reveals that the probability of owning a mosquito net differs according to region. Households in the North-western region (OR = 1.153), North-eastern region (OR = 1.119), and South-eastern region (OR = 1.169) were more likely to use mosquito nets than the South-western region with a (p-value=0.003). A similar study conducted by Alawode, O. A., et al. (2019) in Nigeria shows that the probability of owning a mosquito net was more than doubled in the North-East and South-East regions

compared with households in the north-central region of the country (OR = 2.35 and 2.23, respectively). The probability of owning a mosquito net was the same in the North-West and South-South regions (1.01), while households in the South-West region were 13% more likely to own a mosquito net than those in the North-Central region (OR = 1.13). This shows that factors such as logistical challenges, variations in malaria prevention awareness, differences in net accessibility, and economic disparities between regions can influence the unequal distribution of nets and their effective use in malaria prevention.

The research undertaken by Kimbi, H. K., et al. (2014) in Buea Health District, Cameroon, revealed that 65.2% of respondents were married, while 30.9% were single, and that most of them were Christians (99%).

This pattern is similar in this current study, where Christians account for around 57%. Even though it does not have a significant relationship with net use (p-value of 0.074), married women account for a considerable proportion (64%) and are statistically significant with a p-value of 0.038.

This study shows that the most widely used sources of information were television (p-value = 0.012) and newspapers or magazines (p-value = 0.002), with statistically significant results. Other sources included cell phone messages (p-value=0.214), radio (p-value=0.891), and internet messages (p-value=0.784), although these results were not statistically associated with net use.

A related study carried out in Cameroon by Kimbi, H. K., et al. (2014) found that 98.6% of participants were aware of malaria, while 1.4% did not. The healthcare facility was the primary source of information (74%), followed by the radio (55%), television (46%), posters and brochures (8%), and other sources like family and the mobile phone network. Radio (55%), TV (46%), flyers and posters (8%), and additional sources including family and cell phone messages. The health facility was the only information source that was more popular in rural areas (78%) compared to urban areas (72%), however, the difference was not statistically significant (P = 0.13).

The findings of this study revealed that the language spoken by the head of household varied with approximately 50% for dialect, around 49% for national languages, and only around 1% for French, which is the official language. Compared with dialect as the reference language, French and the national language had odds ratios of 0.739 and 0.813, respectively, with p-values of less than 0.001, indicating a statistically significant association with ITN use. The high proportion of dialects and national languages compared with French shows that the dissemination of awareness-raising messages in local languages can facilitate local community participation. However, the exclusive use of a local language may limit the visibility and accessibility of the research on an international scale.

5.3. Limitations of the study

1. Dependence on the quality of source data, the absence of key variables, contextual and methodological variations with the primary study, as well as time constraints affected this study.
2. The lack of direct control over data collection may restrict clarification of specific questions and lead to missing data as well as biased information.

5.4. Suggests for further research

1. Advocacy of ITN as a Medical Device
2. Innovative ITNs Distribution Strategies
3. Perceptions of ITNs Across Different Age Groups
4. Impact of Cultural and Religious Beliefs
5. Longitudinal Studies in ITN Use Over Time
6. Cross-Country Comparisons on ITN Use

VI. CONCLUSION AND RECOMMANDATIONS

6.1 Conclusions

In summary, 21724 participants attended this study. Of them, 84. 9% were sleeping under ITNs, and 15.1% of the participants responded that they did not use a mosquito net, with 66.5% in rural areas and 33.5% in urban areas of the DRC.

This study highlighted several important factors associated with net use among DRC adults of reproductive age. This study highlighted several underlying factors associated with ITNs use in DRC, including the household's husband age, religion of the head of household, region of origin of the head of household, marital status of the head of household, language of the head of household, frequency of watching television, frequency of reading newspapers and magazines, ethnic group of the head of household, ownership at least one ITNs in the household, age of ITNs, type of ITNs and source of ITNs.

These factors were identified as influencing ITN use among adults aged between 19-49 in the DRC.

6.2 Recommendations

The results of this research will be suggested for the Ministry of Health, health institutions, policymakers and researchers, and technical cooperation and donor institutions:

1. Recommendations to the Minister of Health:
   - Strengthen awareness campaigns on the importance of using ITNs.
   - Invest in free or low-cost ITNs distribution programs.
   - Establish partnerships with other sectors to promote integrated actions to fight against malaria.

2. Recommendations to health institutions:

- Set up regular training courses for health personnel on malaria prevention and treatment.
- Integrate the distribution of mosquito ITNs into maternal and child health services.
- Ensure rigorous monitoring of malaria cases and ITNs usage rates to assess the effectiveness of interventions.

3. Recommendations to policymakers and researchers:

- Support research to identify barriers to ITNs use and propose appropriate solutions.
- Integrate research findings into the development of public health policies.
- Promote collaboration between researchers and decision-makers to ensure the effective implementation of recommendations.

4. Recommendations to technical cooperation and donor institutions

- Allocate financial resources for large-scale ITNs distribution programs.
- Support initiatives to strengthen health systems to improve ITNs availability and accessibility.
- Encourage coordination between different organizations to maximize the impact of ITNs interventions.

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APPENDIX

Appendix 1. DR Congo 26 provinces in 4 regions

North Western: 1. Nord-Ubangi; 2. Sud-Ubangi; 3. Mongala; 4. Equateur; 5. Tshuapa; 6. Maindombe.
North Eastern: 1. Bas-Uele; 2. Haut-Uele; 3. Ituri; 4. Tshopo; 5. Nord-Kivu; 6. Sud-Kivu; 7. Maniema; 8. Sankuru.
South western: 1. Kinshasa; 2. Kwilu; 3. Kasai; 4. Kwango; 5. Kongo Central; 6. Kasai.
South eastern: 1. Kasai Central; 2. Lomami; 3. Tanganyika; 4. Haut-Lomami; 5. Lualaba; 6. Haut-Katanga.

Appendix 2. Access to United Nations Children's Fund approval

Access to MICS datasets approved

1 message

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no-reply@unicef.org <no-reply@unicef.org> 4 janvier 2023 à 06:26
À : pascalmuza86@gmail.com

Dear Pascal MULOLWA,

Thank you for requesting to use the MICS dataset(s). You have been granted access.

The data may not be used for purposes other than those expressed in the application form and may not be redistributed or passed on to others in any form.

Please log into the MICS website using the email and password you provided during registration and download the dataset(s) on survey page.

We would appreciate if you would share your research findings with us – please email us at mics@unicef.org.

Best regards,

UNICEF MICS Team