EFFECTS OF HEALTH EDUCATION INTERVENTION ON THE USE OF INSECTICIDE-TREATED NETS AMONG ANTENATAL WOMEN IN A TEACHING HOSPITAL IN NIGERIA

By

OPARA MONICA ONYINYECHI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

February 2024

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February 2024

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Malaria poses a public health challenge in endemic African countries. Global estimates of malaria indicate at least 3.3 billion people are at risk of being infected with malaria and developing disease, and 1.2 billion are at high risk. According to the latest World Malaria Report, released in November 2017, there were 216 million cases of malaria in 2017, up from 211 million cases in 2016. Malaria causes a variety of adverse consequences in pregnant women due to the invasion of the placenta by Plasmodium. It increases the risk of adverse pregnancy outcome for the mother, the factors and the new born, such as maternal anaemia, Intrauterine Growth Retardation (IUGR) and the delivery of low-birth-weight infants. The objective of this study is to develop, implement, and assess the effects of health education interventions on the use of insecticide-treated nets among antenatal women in a teaching hospital in Nigeria. The study was a two-arm double-blind parallel randomized controlled trial involving pregnant women who have been enrolled into Antenatal Clinic at UNTH, Enugu state, Nigeria. Research and review existing literature on effective health education

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interventions targeting malaria prevention and ITN usage among pregnant women was done by collecting ethical approval from health authorities. Design culturally appropriate health education materials and sessions that emphasize the importance of ITNs in preventing malaria during pregnancy, addressing misconceptions, and providing practical guidance on ITN acquisition, maintenance, and proper use. A training module was developed using health belief model as the theory and the Information was on health care seeking behaviour, patients' illness responses. The validation of the module was conducted among 2 nurses in the clinic who were not part of the study. A two-day training was done for the selected nurses (who was served as research assistants), using the developed health education intervention Training Module. Training on each day lasted for three hours. Health education intervention in addition to routine clinic care were used in this RCT as a means for improving ITNs use among pregnant women in the intervention group, while the control group were left to receive their normal routine clinic care only.

The pregnant women were selected based on the inclusion criteria of the study. Among the eligible respondents, a total of 350 pregnant women were randomly selected and 283 were eligible for participation (141 in the intervention group and 142 in the control group at baseline) using opaque sealed envelopes. Data were collected at baseline, at three- and six-months post-intervention and follow up using a questionnaire. There was no significant difference in sociodemographic characteristics, knowledge, attitude and practice between the intervention and control group at baseline. Respondents at post-intervention and follow up were more likely to have good Practice compared to respondents at baseline respectively (AOR = 4.164, 95% CI: 6.273 – 3.165, p <0.001; AOR = 4.164, 95% CI: 6.273 – 3.165, p <0.001). Respondents at intervention group

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and control group at follow-up were more likely had a high knowledge compared to respondents at baseline (AOR = 2.555, 95% CI: 1.511 – 4.322, p <0.001) and at attitude score, the (AOR = 0.127, 95% CI: 0.076 – 0.212, p <0.001) and there was a significant interaction at post-intervention and follow up, respondents at post intervention and follow up were more likely to have good Practice compared to respondents in the control group at baseline respectively (AOR = 0.002, 95% CI: 3.088 – 9.034, p < 0.001; AOR = 0.002, 95% CI: 3.985 – 22.471, p < 0.001). The findings from this study provide evidence for the effectiveness of Health Education Intervention in improving knowledge, attitude and practice, health seeking behaviour among pregnant women in Enugu state, Nigeria. In conclusion, the study demonstrates that Health Education Interventions significantly enhance knowledge, attitudes, and practices, as well as health-seeking behaviors among pregnant women in Enugu State, Nigeria. These improvements highlight the critical role of targeted educational programs in promoting the adoption and effective use of ITNs, ultimately contributing to better maternal health outcomes.

Keywords: Attitude, Health Education, Health Seeking Behaviour, Knowledge, Practices.

SDG: GOAL 3: Good Health and Well-Being

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN INTERVENSI PENDIDIKAN KESIHATAN TERHADAP PENGGUNAAN JARING YANG DIRAWAT RAKYAT DALAM KALANGAN WANITA ANTENATAL DI HOSPITAL PENGAJARAN DI NIGERIA

Oleh

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Malaria merupakan cabaran endemik bagi kesihatan awam di negera-negara Afrika. Jangkaan global malaria menunjukkan sekurang-kurangnya 3.3 bilion orang berisiko mendapat jangkitan malaria dan penyakit lain, dan seramai 1.2 bilion berisiko tinggi. Sebanyak 216 juta kes malaria dilaporkan dalam World Malaria Report yang dikeluarkan pada November 2017, melebihi kes yang dilaporkan pada tahun 2016 iaitu sebanyak 211 juta kes. Malaria memberi kesan buruk kepada wanita hamil disebabkan oleh pencerobohan plasenta oleh Plasmodium. Hal ini meningkatkan risiko bahaya seperti anemia, Intrauterine Growth Retardation (IUGR) dan kelahiran bayi tidak cukup berat kepada kehamilan ibu dan bayi baru lahir. Objektif kajian ini adalah untuk membangunkan, melaksanakan, dan menilai kesan intervensi Pendidikan kesihatan terhadap penggunaan kelambu dirawat racun serangga dalam kalangan wanita hamil di hospital pengajar di Nigeria. Kajian ini adalah uji kaji terkawal rawak two-arm double-blind yang melibatkan wanita hamil yang telah didaftarkan di Klinik Antenatal di UNTH, daerah Enugu, Nigeria. Kajian dan sorotan literatur sedia ada mengenai

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keberkesanan intervensi pendidikan kesihatan yang tertumpu kepada pencegahan malaria dan penggunaan ITN dalam kalangan wanita hamil dilakukan dengan mendapatakan kelulusan etika dari jabatan kesihatan. Merancang bahan pendidikan yang bersesuaian dengan budaya dan sesi yang menekankan kepentingan ITN dalam mencegah malaria bagi wanita ketika hamil, menangani salah tanggapan, dan menyediakan panduan praktikal tentang pemerolehan, penyelenggaraan dan penggunaan ITN yang betul. Sebuah modul latihan dibangunkan dengan menggunakan model kepercayaan kesihatan sebagai teori dan maklumat mengenai tingkah laku kesihatan dan tindak balas penyakit pesakit. Pengesahan modul dilaksanakan bersama 2 orang jururawat di klinik yang tidak terlibat dalam kajian ini. Jururawat (yang berkhidmat sebagai pembantu penyelidik) yang terpilih perlu menjalani latihan selama dua hari menggunakan Modul Latihan intervensi pendidikan kesihatan yang telah dibangunkan. Latihan berjalan selama tiga jam pada setiap hari. Disamping penjagaan rutin klinik, Intervensi pendidikan kesihatan digunakan dalam RCT ini sebagai langkah untuk meningkatkan penggunaan ITN dalam kalangan wanita hamil bagi kumpulan intervensi, manakala kumpulan kawalan dibiarkan untuk menerima penjagaan klinik rutin seperti biasa.

Wanita hamil dipilih berdasarkan kepada kriteria inklusif kajian. Antara responden yang layak, sebanyak 350 wanita hamil dipilih secara rawak dan sebanyak 283 orang yang layak (141 orang dalam kumpulan intervensi dan 142 dalam kumpulan kawalan di peringkat awal) menggunakan sampul surat bertutup. Data dikumpulkan pada peringkat awal, pada tiga-dan enam bulan selepas intervensi dan susulan menggunakan soal selidik. Tidak terdapat perbezaan ketara dalam ciri sosiodemografi, pengetahuan, sikap dan amalan antara kumpulan intervensi dan kawalan di peringkat awal.

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Responden pada di pasca intervensi dan susulan didapati mempunyai amalan yang baik berbanding responden di peringkat awal dengan masing-masing (AOR = 4.164, 95% CI: 6.273 – 3.165, p <0.001; AOR = 4.164, 95% CI: 6.273 – 3.165, p <0.001). Responden dalam kalangan kumpulan intervensi dan kumpulan kawalan di tahap susulan didapati mempunyai pengetahuan tinggi berbanding responden di peringkat awal (AOR = 2.555, 95% CI: 1.511 – 4.322, p <0.001) dan skor sikap, (AOR = 0.127, 95% CI: 0.076 – 0.212, p <0.001) dan terdapat interaksi signifikan pada pasca intervensi dan susulan, responden di tahap pasca intervensi dan susulan didapati mempunyai amalan bagus berbanding responden dalam kumpulan kawalan di peringkat awal, masing-masing (AOR = 0.002, 95% CI: 3.088 – 9.034, p < 0.001; AOR = 0.002, 95% CI: 3.985 – 22.471, p < 0.001). Dapatan kajian ini membuktikan keberkesanan Intervensi Pendidikan Kesihatan dalam meningkatkan pengetahuan, sikap dan amalan, tingkah laku kesihatan dalam kalangan wanita hamil di daerah Enugu, Nigeria. Kesimpulannya, kajian ini menunjukkan bahawa Intervensi Pendidikan Kesihatan dengan ketara meningkatkan pengetahuan sikap, dan amalan serta tingkah laku kesihatan dalam kalangan wanita hamil di daerah Enugu, Nigeria. Kemajuan ini memberi penekanan kepada peranan penting program pendidikan tersasar dalam menggalakan amalan dan keberkesanan penggunaan ITN, justeru menyumbang kepada kesihatan ibu.

Kata kunci: Amalan, Pendidikan Kesihatan, Pengetahuan, Sikap, Tingkah Laku Kesihatan.

SDG: MATLAMAT 3: Kesihatan dan Kesejahteraan yang Baik

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LIST OF ABBREVIATIONS

ACTS	Artemisimium-based Combination Therapies
AMNS	Any Mosquitoes Nets
ANC	Antenatal Care
DOT	Directly Observed Therapy
FMOH	Federal Ministry of Health
GFATM	Global Fund to Fight Aids, Tuberculosis and Malaria
IRS	Residual-House Spray
IRS	Internal Revenue System
IUCN	International Union for Conservation of Nature
IPTP	Intermittent Preventive Treatment of Malaria in Pregnancy
IPT	Intermittent Presumptive Therapy
ITN	Insecticide Treated Nets
LLIN	Long-Lasting Insecticide Nets
NDHS	Nigeria Demographic and Health Survey
NGO	Non-Government Organization
NMCSP	National Malaria Control Strategies Plan
PAS	Protected Areas
PF	Plasmodium Falciparum
RBM	Roll Back Malaria
SMS	Short Message Service
SP	Sulphadoxine-Pyrimethamine
USAID	United States Agency for International Development
UNICEF	United Nations Children Fund
UN	United Nation
WHO	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background of the study

Malaria remains a significant public health challenge in many endemic African countries, as recognized by the World Health Organization (WHO). Despite ongoing efforts to control and eliminate the disease, factors such as limited access to healthcare, inadequate resources, climate change, and the emergence of drug-resistant strains contribute to its persistence (WHO, 2023).

By 2022, the WHO continued its efforts to combat malaria through various strategies, including distributing insecticide-treated bed nets, improving access to diagnostic testing and treatment, conducting indoor residual spraying, and advancing research on new prevention and treatment methods (WHO, 2023). Partnerships between governments, non-governmental organizations, and international agencies are crucial in addressing malaria comprehensively. These partnerships work towards strengthening healthcare systems, raising awareness, and implementing sustainable interventions to reduce the burden of malaria in affected communities.

Global estimates indicate that 36.36% of the population is at risk of malaria infection, with 13.64% at high risk. According to the latest World Malaria Report released on December 8, 2022, there were an estimated 247 million malaria cases in 2021 across 84 malaria-endemic countries, including French Guiana. This figure represents a

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0.82% increase from 245 million cases in 2020, with most of the rise occurring in countries within the WHO African Region. In the baseline year of 2015 for the Global Technical Strategy for Malaria 2016–2030 (GTS), there were approximately 230 million malaria cases (WHO, 2022).

The incidence of malaria cases (cases per 1000 population at risk) decreased from 82 in 2000 to 57 in 2019, before increasing slightly to 59 in 2020. The proportion of malaria cases attributed to Plasmodium vivax declined from about 8% (20.5 million cases) in 2000 to 2% (4.9 million cases) in 2021, indicating progress in combating P. vivax malaria through targeted interventions and improved healthcare strategies over the past two decades. The incidence of malaria cases remained stable from 2020 to 2021, reflecting efforts to maintain control measures despite challenges.

The increase in malaria cases in 2020 was primarily linked to disruptions in healthcare services caused by the COVID-19 pandemic. Between 2019 and 2021, An estimated 5.4% of malaria cases were directly linked to disruptions in healthcare services during the COVID-19 pandemic, highlighting the significant impact of the pandemic on malaria control efforts (WHO, 2022).

Globally, twenty-nine countries accounted for 96% of malaria cases, with Nigeria (27%), the Democratic Republic of the Congo (12%), Uganda (5%), and Mozambique (4%) collectively representing nearly half of all cases. The WHO African Region reported an estimated 234 million malaria cases in 2021, accounting for approximately 95% of global cases. From 2000 to 2019, the incidence of cases in this region decreased from 37.3% to 22.5% per 1000 population at risk, but rose to 23.4% in 2020 due to

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service disruptions during the COVID-19 pandemic. However, the incidence declined to 22.9% per 1000 population in 2021 (WHO, 2022).

The WHO South-East Asia Region accounted for about 2% of the global malaria burden. Malaria cases in this region decreased by 76%, from 23 million in 2000 to approximately 5 million in 2021. Malaria case incidence also dropped by 82%, from about 18 cases per 1000 population at risk in 2000 to approximately three cases per 1000 population at risk in 2021. India represented 79% of cases in the region. Sri Lanka was certified malaria-free in 2016 and remains free from the disease.

Between 2020 and 2021, the WHO Eastern Mediterranean Region reported an increase of 400,000 malaria cases, with over half occurring in Myanmar. Malaria cases in this region declined by 38%, from about 7 million cases in 2000 to approximately 4 million in 2015. However, cases rose by 44% from 2016 to 2021, reaching 6.2 million. Over the period 2000–2020, malaria case incidence in this region decreased from 20 to 12 cases per 1000 population at risk. Sudan accounted for about 54% of cases in the region. In 2021, the Islamic Republic of Iran reported no indigenous malaria cases for four consecutive years, and Saudi Arabia reported zero indigenous cases for the first time (WHO, 2022).

Globally, malaria deaths decreased steadily by 35.6% from 897,000 in 2000 to 577,000 in 2015, and by a further 1.6% to 568,000 in 2019. However, in 2020, malaria deaths increased by 10%, reaching an estimated 625,000. In 2021, estimated deaths slightly declined by 1% to 619,000. Between 2019 and 2021, approximately 63,000 deaths (around 10%) were attributed to disruptions in essential malaria services during the

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COVID-19 pandemic. The percentage of total malaria deaths in children under 5 years and pregnant women decreased from 87% to 76% between 2000 and 2015 and has remained unchanged since then. Globally, between 2000 and 2021, an estimated 2 billion malaria cases and 11.7 million malaria deaths were averted. Most of the cases (82%) and deaths (95%) averted were in the WHO African Region, followed by the WHO South-East Asia Region (cases 10% and deaths 3%) (WHO, 2022).

Malaria poses significant risks to pregnant women due to Plasmodium invasion of the placenta. It increases the likelihood of adverse pregnancy outcomes such as maternal anemia, intrauterine growth retardation (IUGR), and the delivery of low-birth-weight infants. In 2010 alone, malaria caused an estimated 216 million cases and 655,000 deaths worldwide.

In 2021, moderate to high transmission countries in the WHO African Region reported an estimated 40 million pregnancies, with 13.3 million (32%) exposed to malaria infection during pregnancy (WHO, 2022). West Africa had the highest prevalence of malaria exposure during pregnancy at approximately 40.7%, followed closely by Central Africa at 39.8%, while East and Southern Africa had a prevalence of 20% according to WHO sub-regional data (WHO, 2022).

The Roll Back Malaria (RBM)

The Roll Back Malaria (RBM) Partnership is a global initiative established in 1998 to coordinate international efforts to combat malaria. The partnership brings together governments, international organizations, civil society, the private sector, and affected communities to accelerate progress towards malaria control and elimination.

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The RBM Partnership aims to reduce the global burden of malaria by advocating for increased political commitment, mobilizing resources, fostering innovation, and promoting collaboration among stakeholders. Its strategies include scaling up access to effective malaria prevention, diagnosis, and treatment interventions, as well as strengthening health systems in malaria-endemic countries.

Key activities of the RBM Partnership include:

1. Advocacy and resource mobilization: The partnership advocates for increased funding and political commitment to malaria control and elimination efforts, both globally and within affected countries.
2. Technical support and capacity building: RBM provides technical expertise and support to countries in developing and implementing malaria control strategies, as well as building the capacity of health systems and health workers.
3. Monitoring and evaluation: RBM monitor progress towards malaria control and elimination goals, collects and analyzes data on malaria burden and intervention coverage, and provides evidence to inform decision-making.
4. Innovation and research: The partnership promotes research and innovation to develop new tools, strategies, and approaches for malaria prevention, diagnosis, and treatment.

Overall, the Roll Back Malaria Partnership plays a critical role in driving collective action and coordination to accelerate progress towards the global goal of ending malaria as a public health threat.

1. Malaria Prevention:

a. Insecticide-Treated Bed Nets (ITNs) Distribution: One of the cornerstone interventions for malaria prevention among children under five and pregnant women is the distribution of insecticide-treated bed nets (ITNs). ITNs create a physical barrier against mosquito bites and reduce malaria transmission. The RBM Partnership, in collaboration with governments and other partners,

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facilitates the distribution of ITNs to households in malaria-endemic regions (RBM, 2020).

b. **Intermittent Preventive Treatment in Pregnancy (IPTp):** IPTp involves the administration of antimalarial medication to pregnant women during scheduled antenatal care visits, regardless of whether they have malaria symptoms. Sulfadoxine-pyrimethamine (SP) is the recommended drug for IPTp. This intervention helps prevent malaria-related complications in pregnant women and reduces the risk of low birth weight and other adverse outcomes in new born (WHO, 2020).

2. Malaria Diagnosis and Treatment:

a. **Rapid Diagnostic Tests (RDTs):** Rapid diagnostic tests are crucial for the prompt diagnosis of malaria, particularly in resource-limited settings where laboratory infrastructure may be lacking. RDTs detect specific malaria antigens in blood samples within minutes, allowing healthcare providers to initiate appropriate treatment promptly (WHO, 2021).

b. **Artemisinin-based Combination Therapy (ACT):** Artemisinin-based combination therapy (ACT) is the first-line treatment for uncomplicated malaria caused by Plasmodium falciparum, the most prevalent malaria parasite species. ACT is highly effective in clearing malaria parasites from the bloodstream and preventing disease recurrence (WHO, 2021).

3. Health System Strengthening:

The RBM Partnership advocates for the strengthening of health systems to ensure the effective delivery of malaria prevention and treatment services to children under five and pregnant women. This includes capacity building for healthcare workers, improving access to essential medicines and diagnostics, and integrating malaria services into maternal and child health programs (RBM, 2020).

4. Community Engagement and Empowerment:

Community engagement is essential for the success of malaria control efforts targeting children under five and pregnant women. The RBM Partnership supports community-

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based initiatives such as malaria education campaigns, community health worker programs, and community-led distribution of ITNs to enhance awareness and promote uptake of malaria interventions at the grassroots level (RBM, 2020).

The Health Seeking Behaviour (HSB)

Health-seeking behavior greatly influences the use and practices surrounding insecticide-treated nets (ITNs) among pregnant women. At the University of Nigeria Teaching Hospital (UNTH) in Enugu, health education interventions have shown a significant impact on enhancing ITN utilization among pregnant women attending antenatal clinic.

Prior to these interventions, the knowledge and proper use of ITNs were suboptimal, largely due to limited awareness about malaria prevention and ITN benefits. Health education programs at UNTH aim to bridge this gap by integrating comprehensive education sessions into routine antenatal care. These sessions inform pregnant women about the critical role of ITNs in preventing malaria, which is a leading cause of maternal and neonatal morbidity and mortality in Nigeria (Nwonwu et al., 2016). Interventions include practical demonstrations on the correct use and maintenance of ITNs, addressing misconceptions, and emphasizing the importance of consistent usage. As a result, studies have shown a marked improvement in ITN usage post-intervention. For instance, Ntonifor et al. (2013) reported that pregnant women who participated in these education sessions exhibited higher ITN utilization rates and better practices in ITN maintenance.

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This enhancement in health-seeking behavior underscores the effectiveness of targeted health education in promoting preventive health measures among pregnant women. By improving ITN usage and practices, these interventions contribute significantly to reducing the incidence of malaria, thus improving maternal and neonatal health outcomes.

Manufacturers' delivery data for 2004–2021 show that almost 2.5 billion ITNs were supplied globally in that period, of which 2.2 billion (87%) were supplied to sub-Saharan Africa. Manufacturers delivered about 220 million ITNs to malaria endemic countries in 2021. Of these, 46% were pyrethroid–piperonyl butoxide (PBO) nets and 9% were dual active ingredient ITNs. By 2021, 68% of households in sub-Saharan Africa had at least one ITN, an increase from about 5% in 2000. The percentage of households owning at least one ITN for every two people increased from 1% in 2000 to 38% in 2021. In the same period, the percentage of the population with access to an ITN within their household increased from 3% to 54%. The percentage of the population sleeping under an ITN also increased considerably between 2000 and 2021, for the whole population (from 2% to 47%), for children aged under 5 years (from 3% to 53%) and for pregnant women (from 3% to 53%). Generally, the overall access to and use of ITNs remains below the levels that were observed in 2017.

However, in Nigeria, there has been an increase in malaria incidence and mortality, despite the wide distribution of ITNs (Israel et al., 2018). Despite numerous studies on ITN ownership in Nigeria, there is still limited evidence on barriers and difficulties with ITN usage. Additionally, several studies have examined the effectiveness of ITNs in preventing malaria, with some data reporting poor compliance with their use (Bisi-

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Onyemaechi et al., 2017; Amoran et al., 2011; Aribodor et al., 2011; Uzoamaka et al., 2016). While ITNs have been identified as a cost-effective and acceptable method of reducing morbidity and mortality caused by malaria, factors influencing compliance with their use must be carefully considered. Therefore, it is important to review and understand why people are not using ITNs. Pulford et al. reviewed 22 available studies in 2011 on reasons why nets went unused, citing discomfort due to heat and perceived low risk of malaria due to low mosquito density as primary reasons, but noted the tentative nature of findings due to the scarcity of published studies. Since then, large national household surveys, including Malaria Indicator Surveys (MIS) and Demographic and Health Surveys (DHS), have in several cases added questions about reasons for not using nets.

Using insecticide-treated nets by pregnant women is essential for combating malaria and protecting both mother and unborn child. Malaria, caused by the Plasmodium parasite transmitted through the bite of infected female Anopheles mosquitoes, poses significant risks to pregnant women and their babies.

Insecticide-treated nets (ITNs) act as physical barriers that prevent mosquitoes from biting pregnant women during sleep when they are most vulnerable. These nets are treated with insecticides that kill or repel mosquitoes, significantly reducing malaria transmission. A study in The Lancet Global Health found that ITNs use significantly reduced malaria infections among pregnant women in sub-Saharan Africa (Desai et al., 2018). Malaria during pregnancy can lead to severe complications, including anemia, spontaneous abortion, stillbirth, and maternal death. Pregnant women are more susceptible to malaria due to changes in their immune system and increased

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blood volume, making them more attractive to mosquitoes. The World Health Organization (WHO) recommends ITNs for pregnant women to prevent these complications (WHO, 2019). Malaria infection during pregnancy is associated with adverse outcomes such as low birth weight, preterm birth, and intrauterine growth restriction. These complications can have long-term consequences for the child's health and development. A systematic review in PLOS Medicine found that ITNs use during pregnancy reduced the risk of low birth weight and stillbirth (Eisele et al., 2012). ITNs are cost-effective interventions for malaria prevention. Investing in mosquito nets for pregnant women can yield significant health benefits and reduce healthcare costs associated with treating malaria-related complications. A study in Malaria Journal evaluated the cost-effectiveness of ITNs distribution to pregnant women in Nigeria and found it to be highly cost-effective compared to no intervention (Friedman et al., 2016).

Using mosquito nets, particularly ITNs, by pregnant women is a crucial strategy for preventing malaria and its negative effects on pregnancy outcomes. This evidence-based intervention not only protects the health of pregnant women but also improves maternal and child health outcomes.

There is no widely recognized study explicitly stating the use of insecticide-treated nets (ITNs) among pregnant mothers as hazardous due to chemical exposure. However, discussions and studies have raised concerns about potential chemical exposure from ITNs and its impact on human health.

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A study in Environmental Health Perspectives in 2012 assessed the risk of pyrethroid exposure through ITNs and concluded that the levels of exposure were well below thresholds considered harmful to humans.

Additionally, a systematic review published in the International Journal of Environmental Research and Public Health in 2018, titled "Human Health Effects of Pyrethroids," evaluated the health effects of pyrethroid insecticides, which are commonly used in ITNs. The review highlighted potential adverse effects such as neurotoxicity, respiratory effects, and reproductive toxicity. While the review discusses the health effects of pyrethroids in general, it does not specifically focus on pregnant women using ITNs.

Furthermore, a study published in the journal Environmental Health Perspectives in 2015, titled "Association of Prenatal Exposure to Permethrin with Prenatal Cytokine Responses," examined the association between prenatal exposure to permethrin and cytokine responses in umbilical cord blood. Although this study did not directly investigate the use of ITNs among pregnant women, it suggests the need for further research into the potential immunological effects of insecticide exposure during pregnancy.

These studies provide insights into the potential risks associated with chemical exposure from ITNs, but more research is needed to fully understand the health implications, especially among pregnant women. Pregnant women should consider the potential benefits of ITN use in preventing malaria against any possible risks of chemical exposure and consult healthcare professionals for personalized advice.

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1.2 Problem Statement

Malaria is a deadly infectious disease transmitted by protozoan parasites, posing significant public health crises in impoverished countries (CDC, 2014). It ranks among the major causes of preventable death and is the third leading cause of death among infectious diseases (Uguru et al., 2010). Malaria is widespread in tropical regions, particularly affecting Sub-Saharan African countries where it infects approximately 515 million people annually and causes 1.5 to 2 million deaths per year among children under age 5 (WHO, 2011). The disease is closely linked to poverty, primarily affecting regions and populations unable to afford malaria treatment (WHO, 2015). Malaria deaths peaked at 182 million in 2004 and declined to 124 million in 2010, with over 80% occurring in Sub-Saharan Africa (WHO, 2011). In 2015, the World Health Organization (WHO) reported 214 million malaria cases globally, resulting in an estimated 438,000 deaths (WHO & UNICEF, 2015).

Pregnancy reduces a woman's immunity to malaria, increasing susceptibility to infection and the risk of severe illness, anemia, and death. Maternal malaria also hinders fetal growth, elevating the risk of premature delivery and low birth weight, which is a leading cause of child mortality (WHO, 2019). Pregnant women and children are the most vulnerable to malaria, emphasizing the critical need for targeted interventions in these groups. The Malaria Atlas Project assesses the population at risk of Plasmodium falciparum and P. vivax transmission, using country-specific demographic data on women of reproductive age, fertility rates, induced abortions, and stillbirths to estimate annual pregnancies from 2007 to 2020. Reddy et al. (2023) focused extensively on endemic areas in Sub-Saharan Africa.

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In 2020, an estimated 121.9 million pregnancies occurred in malaria transmission areas, resulting in 70.9 million (58.1%) live births. Globally, 52.9 million pregnancies were at risk of malaria in the WHO South-East Asia (SEARO) region, 5.1 million in the Western Pacific (WPRO) region, 46.1 million in the Africa (AFRO) region, 11.1 million in the Eastern Mediterranean (EMRO) region, and 6.7 million in the Americas (AMRO) region. From 2007 to 2020, pregnancies in P. falciparum transmission areas decreased globally by 11.4%, with specific declines of 100.0% in the WHO Europe (EURO) region, 52.6% in WPRO, 51.5% in AMRO, 23.9% in EMRO, and 17.2% in SEARO. Conversely, pregnancies in P. vivax transmission areas declined by 42.8%, with reductions of 100.0% in EURO, 89.8% in WPRO, 48.4% in AMRO, 32.4% in EMRO, and 10.0% in SEARO, while AFRO saw a 25.8% increase. Reddy et al. (2023) conducted a sensitivity analysis suggesting that if Sub-Saharan Africa were considered entirely endemic for P. vivax, the number of pregnancies at risk could increase seven-fold.

Global estimates indicate a significant decline in pregnancies at risk of malaria from 2007 to 2020, though in Africa, 25.4% more pregnancies were at risk of P. falciparum or P. vivax malaria than in 2007. This increase is attributed to rising population numbers and corresponding pregnancies in endemic areas, despite declining malaria rates. These findings are crucial for prioritizing resource allocation to control malaria in pregnancy. Recent evidence indicates Nigeria is among countries not on track to halve malaria incidence and deaths by 2023, aligned with targets set by Commonwealth member nations (WHO, 2022).

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The Commonwealth's target likely refers to objectives outlined in the World Health Organization's (WHO) Global Technical Strategy for Malaria 2016-2030. This strategy, adopted by WHO member states including Nigeria, aims to reduce the global burden of malaria. A key target is halving malaria incidence and deaths by 2023, aligning with Sustainable Development Goal (SDG) 3, which promotes healthy lives and well-being for all ages.

Reducing malaria incidence involves decreasing new cases within a specified population over time, typically measured per 1,000 or 100,000 people annually. Reducing malaria deaths entails lowering deaths attributed to malaria within a population over time, typically measured per 100,000 people or as a percentage of total deaths annually within a population.

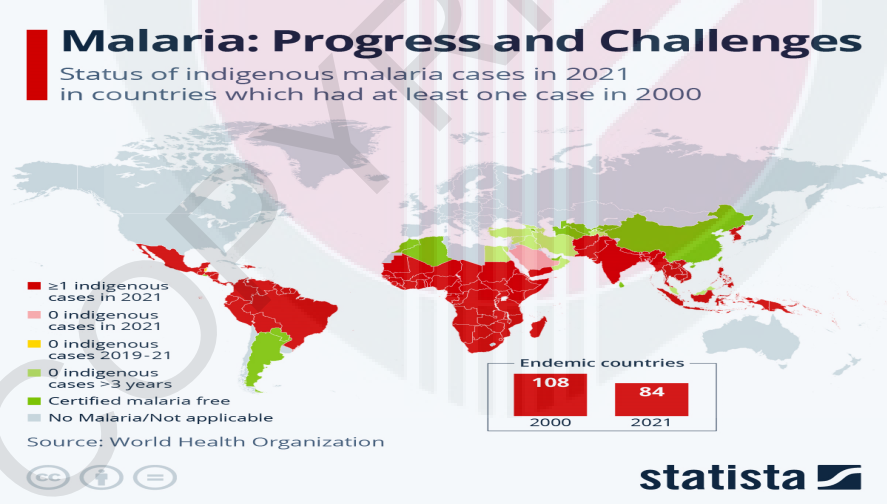


Figure 1.1: Statistics of Malaria Cases, Progress and their Challenges in Different Countries
(Source: Who, 2022)

In Nigeria, malaria remains a highly morbid and fatal infectious disease (Mbachu et al., 2013). Among pregnant women, the morbidity and mortality rates are alarmingly

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high, reaching up to 89% (Iwuafor et al., 2016). Pregnant women are three times more likely to develop severe malaria compared to their non-pregnant counterparts, with a mortality rate approaching 50% (WHO, 2016). Approximately 11% of maternal deaths in the country are attributed to malaria (FMH, 2014). Malaria is the leading cause of outpatient visits, particularly in rural Nigerian towns where high transmission rates prevail. In 2016, an estimated 990,000 people died from malaria, equating to more than 2,700 deaths per day or 2 deaths per minute (Uguru et al., 2017).

Current estimates of malaria parasitaemia among pregnant Nigerian women vary significantly by geographic region. Hospital-based prevalence ranges from 5% in the North-western region (Isah et al., 2011) to 17% in the South-western region and as high as 95% in the South-eastern region (Agan et al., 2010). Only approximately 35% of pregnant women deliver in healthcare facilities in Nigeria (Adebami et al., 2014), suggesting that health facility-based estimates may not fully capture the true extent of the malaria burden in this population.

Preventing and treating malaria during pregnancy is a core focus of the 2009–2013 National Malaria Control Strategic Plan (NMCSP) (FMH, 2014). Key interventions include the use of insecticide-treated bed nets (ITNs), intermittent preventive therapy with sulfadoxine-pyrimethamine (IPTp-SP), and early case detection (Cohee et al., 2016). The updated NMCSP emphasizes achieving household ownership of at least two ITNs, with a target of increasing ITN use to 80%. Strong evidence supports the efficacy of ITNs in preventing malaria infections and related complications during pregnancy (Gamble et al., 2021). However, despite these benefits, ITN usage remains low, with reported rates of 16.4% and 16.0% for ITNs and long-lasting insecticidal

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nets (LLINs), respectively (NPC, 2013), showing considerable variation across geopolitical zones.

The low uptake of insecticide-treated nets (ITNs) in pregnancy, despite their proven health benefits, can be attributed to several factors:

1. **Accessibility and Availability**: Limited access to ITNs due to factors such as cost, distribution channels, and stock-outs at health facilities can hinder pregnant women from obtaining these preventive measures (Mbonye A.K et al., 2006).

2. **Awareness and Knowledge Gaps**: Lack of awareness about the importance of using ITNs during pregnancy and insufficient knowledge about the risks of malaria transmission can contribute to low uptake. Health education programs targeting pregnant women and their communities are essential for improving awareness (Sangaré LR et al., 2011).

3. **Perceived Risk Perception**: Some pregnant women may underestimate their risk of contracting malaria or believe that they can avoid mosquito bites through other means, leading to a reluctance to use ITNs (Hill J et al., 2013).

4. **Perceptions of ITNs**: Negative perceptions about the effectiveness, comfort, and durability of ITNs may deter pregnant women from using them consistently. Addressing misconceptions and promoting positive experiences with ITNs can help improve uptake (Ahmed S.M et al., 2011).

5. **Socioeconomic Factors**: Socioeconomic status, including factors such as education level, household income, and access to healthcare, can influence the uptake of ITNs. Pregnant women from disadvantaged backgrounds may face greater barriers to obtaining and using these interventions (Ricotta E.E et al., 2014).

6. **Cultural and Social Norms**: Cultural beliefs and social norms within communities may affect the acceptability of ITNs. Engaging with community leaders and influencers to promote the adoption of ITNs can be effective in overcoming cultural barriers (Mubyazi G.M et al., 2018).

Addressing these barriers requires a multifaceted approach involving government agencies, non-governmental organizations, healthcare providers, and communities to ensure that ITNs are accessible, affordable, and accepted by pregnant women and their families.

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The highlighted knowledge gap in the study "Effects of Health Education Intervention on the Use of Insecticide-Treated Nets among Antenatal Women in a Teaching Hospital, Nigeria" revolves around the insufficient understanding of the effectiveness of health education interventions in promoting the proper utilization of insecticide-treated nets (ITNs) among pregnant women in Nigeria. This knowledge gap has become a priority for several reasons:

1. **Perceived Susceptibility and Severity**: Pregnant women in Nigeria are at increased risk of malaria and its associated complications, including maternal anemia and adverse birth outcomes. However, there is often a lack of awareness among pregnant women regarding the severity of malaria and the potential risks it poses to both maternal and fetal health (Rahman et al., 2019).
2. **Perceived Benefits and Barriers**: While ITNs are a proven tool for malaria prevention, pregnant women may have limited knowledge about their effectiveness or may perceive barriers to their use, such as discomfort or concerns about adverse effects from insecticide exposure. Without accurate information and support, pregnant women may be less likely to adopt ITN use as a preventive measure (Oyeyemi et al., 2018).
3. **Cues to Action**: Health education interventions can serve as critical cues to action by providing pregnant women with the knowledge and motivation needed to overcome barriers and adopt ITN use as a protective behavior. However, the effectiveness of such interventions in the Nigerian context remains uncertain due to a lack of empirical evidence (Nyarko et al., 2014).

Utilizing the Health Belief Model (HBM) as the theoretical framework for the study will help address these knowledge gaps and inform the design of effective health education interventions. The HBM emphasizes several key constructs that influence health-related behaviors, including:

- Perceived Susceptibility: Pregnant women's beliefs about their vulnerability to malaria infection during pregnancy.
- Perceived Severity: Their perceptions of the seriousness of malaria and its potential consequences for maternal and fetal health.
- Perceived Benefits: The perceived effectiveness of ITN use in preventing malaria and reducing the risk of adverse outcomes.

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- Perceived Barriers: The perceived obstacles or concerns associated with ITN use, such as discomfort or safety concerns.
- Cues to Action: External factors or stimuli that prompt pregnant women to adopt ITN use, such as health education messages or advice from healthcare providers (Champion & Skinner, 2018).

By addressing these constructs through targeted health education interventions grounded in the HBM, the study aims to promote positive behavior change and improve ITN utilization among antenatal pregnant women in Enugu State, Nigeria. By providing pregnant women in Enugu State with accurate information, addressing misconceptions, and overcoming barriers to ITN use, the intervention can empower women to make informed decisions about malaria prevention and enhance their likelihood of adopting ITN use as a protective behaviour.

While previous research provides a foundation for further exploration, there are still many reasons to conduct new studies, ranging from advancing knowledge and improving techniques to addressing emerging challenges and fostering interdisciplinary collaboration. In this case, there is no study that has been conducted on knowledge, attitude and practice using health belief model as the study theory among pregnant women in this location.

1.3 Significance of the study

This study could provide valuable information on health education and attitudes towards the use of Insecticide-Treated Nets (ITNs) among pregnant women in Nigeria. Information from the Enugu State Health Directorate indicates that no known study has been conducted on health education interventions addressing knowledge, attitudes, and practices related to ITN use among pregnant women in the region.

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The findings and recommendations of this study could inform policymakers at the district, regional, and national levels in developing pragmatic policies for malaria prevention and control programs. Additionally, the Enugu State Health Directorate could use these insights to plan and implement effective health education programs on ITNs to raise awareness and promote their practice in the region. Increasing public awareness of ITNs for malaria prevention in the Enugu region is essential to enhance uptake and utilization, ultimately reducing malaria incidence among pregnant women. Furthermore, the findings of this study could contribute to reviewing the national malaria strategic plan to incorporate targeted educational programs for reproductive-age women in Enugu. Health education has a positive influence on knowledge and practice regarding ITN use among pregnant women. Programmatic efforts should focus on expanding community-level distribution campaigns and intensifying behavior change interventions that highlight the effectiveness of ITNs in malaria prevention. This approach aims to increase the proportion of pregnant women using insecticide-treated nets.

How Antenatal Care is conducted in Nigeria

Antenatal care in Nigeria typically involves a series of medical check-ups and interventions provided to pregnant women to ensure the well-being of both the mother and the unborn child. It usually starts in the first trimester and continues throughout the pregnancy.

Antenatal care often begins with the confirmation of pregnancy through urine or blood tests. Women then receive regular check-ups at healthcare facilities such as primary health centers, hospitals, or maternal health clinics. During these visits, healthcare

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providers monitor the mother's health and the baby's development, including checking blood pressure, weight, and fetal heartbeat.

Additionally, pregnant women in Nigeria receive essential vaccinations, such as tetanus toxoid, to prevent infections that could harm them or their babies. They also receive education on nutrition, hygiene, and birth preparedness, including information on danger signs during pregnancy and childbirth.

Antenatal care in Nigeria aims to detect and manage any pregnancy-related complications early, reducing the risk of maternal and neonatal mortality. However, access to quality antenatal care can vary depending on factors like geographic location, socioeconomic status, and availability of healthcare resources.

1.4 Research Question

What are the effects of health education intervention on the use of insecticide-treated nets among antenatal women in a teaching hospital in Nigeria?

1.5 Objectives

1.5.1 General Objective

The general objective is to develop, implement, and assess the effects of health education interventions on the use of insecticide-treated nets among antenatal women in a teaching hospital in Nigeria.

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1.5.2 Specific objectives

To describe and compare between the respondents in the intervention group and control group at baseline according to the following characteristics:

i. Socio-demography (age, ethnicity, residence- rural/urban, marital status, educational level, household monthly income and employment status)

ii. ITNs use (practices)

iii. Knowledge and attitudes regarding insecticide-treated net (ITN) use and health-seeking behaviour

iv. Health Belief Model factors (such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy)

To determine the changes within intervention group from baseline to 3 and 6 months post intervention for the following characteristics:

i. ITNs use (practice)

ii. Knowledge and attitudes regarding ITN use and health-seeking behavior iii.

iii. Health Belief Model factors (such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy)

To compare the changes between intervention group and control group at 3 and 6 months post intervention for the following characteristics:

i. ITNs use (practice)

ii. Knowledge and attitudes regarding ITN use and health-seeking behavior

iii. Health Belief Model factors (such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy)

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To compare the differences between the intervention group and control group at 3 and 6 months post-intervention after controlling for covariates for the following characteristics:

i. ITN use (practices)

ii. Knowledge and attitudes regarding ITN use and health-seeking behavior

iii. Health Belief Model factors (such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy)

To develop, implement, and evaluate the effects of a health education intervention on:

i. ITN use (practices)

ii. Knowledge and attitudes regarding ITN use and health-seeking behavior

iii. Health Belief Model factors (such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy)

1.6 Research Hypotheses

There are observed significant differences in the health education intervention on the increase of ITN use, knowledge, attitudes, practices, health-seeking behavior, and Health Belief Model factors within the intervention group at 3 and 6 months post-intervention.

There are observed significant differences in the health education intervention on the increase of ITN use, knowledge, attitudes, practices, health-seeking behavior, and Health Belief Model factors between the intervention and control groups at 3 and 6 months post-intervention.

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CHAPTER 2

LITERATURE REVIEW

2.1 History of Malaria

Malaria occupies a unique place in the annals of history. Over millennia, its victims have included Neolithic dwellers, early Chinese and Greeks, princes, and paupers. In the 20th century alone, malaria claimed between 150 million and 300 million lives, accounting for 2 to 5 percent of all deaths (WHO, 2023). Although its chief sufferers today are the poor of sub-Saharan Africa, Asia, the Amazon basin, and other tropical regions, 40 percent of the world's population still lives in areas where malaria is transmitted.

Despite significant progress, malaria remains a major global health challenge. According to the WHO's World Malaria Report 2021, there were an estimated 241 million malaria cases and 627,000 deaths in 2020, with the vast majority occurring in sub-Saharan Africa. The COVID-19 pandemic posed additional challenges, disrupting malaria control efforts and leading to an increase in malaria cases and deaths in some regions (WHO, 2022).

Advances in Vaccine Development

One of the most significant recent developments in the fight against malaria is the approval of the first malaria vaccine, RTS,S/AS01 (commonly known as Mosquirix). Developed by GlaxoSmithKline and PATH, and supported by the Bill & Melinda

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Gates Foundation, the vaccine received a positive recommendation from the WHO in October 2021 for use in children in sub-Saharan Africa and other regions with moderate to high P. falciparum malaria transmission. While the vaccine provides partial protection, it represents a significant milestone in malaria prevention (WHO, 2022).

Innovations in Vector Control

Innovations in vector control have also shown promise in recent years. The development of new insecticides and insecticide-treated nets that target insecticide-resistant mosquito populations is crucial in maintaining the efficacy of malaria prevention strategies. Additionally, research into the genetic modification of mosquitoes to reduce their ability to transmit malaria parasites has made significant strides, though it remains a topic of ethical and ecological debate.

Drug Resistance and New Treatments

The emergence of drug-resistant malaria strains continues to pose a significant challenge. Resistance to artemisinin, the cornerstone of current malaria treatment, has been reported in Southeast Asia and parts of Africa. In response, researchers are investigating new antimalarial compounds and combination therapies to address this threat. One promising development is the identification of new drug targets and the repurposing of existing medications to treat malaria (WHO, 2023).

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Integrated Approaches and Community Engagement

Effective malaria control requires integrated approaches that combine medical, environmental, and social interventions. Community engagement and education are critical components of successful malaria programs, ensuring that interventions are culturally appropriate and widely accepted. Programs that involve local communities in decision-making and implementation have shown higher success rates in reducing malaria transmission (WHO, 2023).

The history of malaria is a testament to the enduring struggle between humans and disease. From ancient civilizations to modern scientific breakthroughs, malaria has shaped human history in profound ways. Recent advancements, particularly in vaccine development and vector control, offer hope for reducing the global burden of malaria. However, challenges such as drug resistance, climate change, and socio-political instability continue to hinder progress. Sustained global commitment and innovative approaches are essential to achieving the ultimate goal of malaria eradication.

2.1.1 Discovering the Malaria Parasite

The discovery of the malaria parasite was a pivotal moment in medical science, fundamentally altering our understanding and management of the disease. While this discovery dates back to the late 19th century, ongoing advancements in research up to 2021 have significantly deepened our comprehension of malaria's biology, transmission, and treatment. This section delves into the historical discovery of the malaria parasite, with a focus on contemporary perspectives and research insights from 2019 to 2021.

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Historical Background

The malaria parasite's discovery is credited primarily to two scientists: Alphonse Laveran and Ronald Ross.

1. Alphonse Laveran's Discovery (1880):

French army surgeon Alphonse Laveran first identified the malaria parasite in 1880 while working in Algeria. Observing pigmented bodies in the blood of malaria patients, he correctly identified these as parasites causing the disease. His groundbreaking work earned him the Nobel Prize in Physiology or Medicine in 1907 (Cox, 2010).

2. Ronald Ross's Contribution (1897):

Building on Laveran's findings, British physician Ronald Ross demonstrated in 1897 that malaria parasites were transmitted by mosquitoes, specifically Anopheles mosquitoes. He elucidated the parasite's lifecycle within the mosquito, a discovery that earned him the Nobel Prize in Physiology or Medicine in 1902 (Bruce-Chwatt, 1988).

Advances in Malaria Research (2019-2021)

The period from 2019 to 2021 saw significant advancements in malaria research, enhancing our understanding of the parasite and improving control measures.

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1. **Genomic and Molecular Insights:**

Advances in genomic technologies have allowed for detailed sequencing of Plasmodium species, revealing insights into genetic diversity and evolution. This understanding is crucial for identifying drug resistance markers and developing new therapeutic targets (Cowell et al., 2021).

2. **Drug Resistance and New Treatments:**

Drug resistance, particularly to artemisinin-based combination therapies (ACTs), remains a significant challenge. Research has focused on identifying novel drug targets and developing alternative treatments. New compounds, such as KAF156 (ganaplacide), are in development to address resistance (Haldar et al., 2021).

3. **Vaccine Development:**

A landmark achievement during this period was the approval of the RTS,S/AS01 (Mosquirix) vaccine by the World Health Organization (WHO) in October 2021. This vaccine, targeting P. falciparum, provides partial protection and is a critical tool in the fight against malaria, especially in children in sub-Saharan Africa (WHO, 2021).

4. **Vector Control Innovations:**

Innovations in vector control include new insecticides and insecticide-treated bed nets designed to combat insecticide-resistant mosquito populations. Additionally, research into genetically modified mosquitoes, such as those engineered to reduce their ability to transmit malaria, shows promise (Killeen et al., 2021).

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5. Impact of COVID-19:

The COVID-19 pandemic disrupted malaria control efforts, affecting healthcare delivery and intervention programs. The WHO reported an increase in malaria cases and deaths in 2020 due to these disruptions, emphasizing the need for resilient healthcare systems (WHO, 2020).

Contemporary Challenges and Future Directions

Despite progress, several challenges remain in the fight against malaria:

1. Sustained Funding and Global Collaboration:

Continued investment in research and control programs is essential. International collaboration and sustained funding are critical to developing and deploying new interventions effectively (D'Acremont et al., 2021).

2. Integrated Control Strategies:

Effective malaria control requires integrated approaches that combine medical, environmental, and social interventions. Community engagement and education are crucial for the success of these strategies (Sherrard-Smith et al., 2020).

3. Climate Change:

Climate change poses new challenges to malaria control by altering the distribution and breeding patterns of Anopheles mosquitoes. Research into the impact of climate change on malaria transmission is vital for future control efforts (Caminade et al., 2021).

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The discovery of the malaria parasite by Alphonse Laveran and the elucidation of its transmission by Ronald Ross were monumental achievements in medical science. Building on these foundational discoveries, contemporary research from 2019 to 2021 has advanced our understanding of the parasite's biology, drug resistance, and control strategies. Despite significant progress, challenges such as drug resistance, climate change, and the impact of the COVID-19 pandemic underscore the need for sustained commitment and innovative approaches to achieve malaria eradication.

2.2 Prevalence of malaria

2.2.1 Globally

Globally, in the most recent year of 2013, an estimated 3.3 billion people lived in areas at high risk of Plasmodium falciparum (Pf) malaria, with more than 500,000 deaths attributable to the disease. However, over 90% of malaria cases occurred in Africa (Gething et al., 2011). Recent estimates from the WHO's 2015 World Malaria Report indicate that Plasmodium vivax cases accounted for 95% of all malaria cases reported in 2014, corresponding to 6% of all malaria cases globally (Rosalind et al., 2016). Malaria was estimated to occur in about 51% of the 24 million cases outside the African continent.

Despite sustained efforts and billions of dollars provided by the World Health Organization (WHO) to prevent and control malaria, it remains one of the most significant vector-borne disease problems globally (Gallup & Sachs, 2010). Three factors affect malaria prevalence to varying degrees: a) Ecological factors, including

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the presence, abundance, and behavior (e.g., biting rates) of vectors. b) Biophysical factors, such as temperature, precipitation, and land cover. c) Socio-economic factors, including education and development status (Gosoniu et al., 2012).

Although we now have a greater understanding of the socio-ecological factors influencing malaria and have made significant strides towards eradicating the disease, substantial knowledge gaps persist (WHO, 2014). The International Union for Conservation of Nature (IUCN) has established a definition and classification system for protected areas (PAs) since 1948. This system includes management theory, strategic management considerations, planning frameworks, and various support tools to assist practitioners in improving management effectiveness and inspiring innovation. Management for national systems of protected areas is considered, including government and private protected areas and Indigenous and Community Conserved Areas (ICCAs). For individual protected areas, management guidance is provided for each of the six IUCN protected area management categories. The varied nature of current PA classification reflects the diverse motivating factors for PA establishment and management.

A variety of research on the risk factors, determinants, and correlates of malaria prevalence suggests that the existence and management of PAs may influence malaria prevalence in surrounding areas. However, there is a lack of direct empirical evidence linking this relationship, and conflicting reports necessitate further research. Valle & Clark (2013) found higher malaria prevalence in areas closer to forested PAs, while Olson et al. (2010) reported higher prevalence in recently deforested and unprotected areas. These studies, conducted in the Amazon, limit their generalizability to other

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regions. We aim to resolve discrepancies introduced by these studies while testing for relationships in a different geographic area. Specifically, we ask whether protected areas (PAs) shape malaria prevalence in nearby human populations in Sub-Saharan Africa. We hypothesize that:

a. Malaria prevalence differs by the IUCN status of the nearest PAs, with higher malaria prevalence in surrounding communities near PAs with greater human interaction. b. Malaria prevalence is lower in areas near PAs and higher in areas further away.

Previous studies have used logistic regression and Random Forest models to explore the relationships between malaria prevalence and PAs. These studies suggest that protected areas influence many biophysical, ecological, and social determinants of malaria, such as land-use/land-cover, biodiversity, socio-economic conditions, and human behavior (Worboys et al., 2010). However, the role of PAs in malaria dynamics remains unclear and largely unexamined. With exponential growth in the number and extent of PAs globally (IUCN & UNEP, 2014) and a shift towards strictly managed PAs in Africa in recent decades (Edmiston et al., 2014), understanding potential links between PAs and malaria prevalence is essential.

Protected areas often represent relatively intact ecosystems compared to surrounding landscapes, influencing land use and land cover within and around PAs. This influence can create environments that serve as potential habitats for malaria vectors at broad scales. Recent research suggests that proximity to forest cover could increase malaria risk (Haque et al., 2011; Valle & Clark, 2013), while other studies have found decreased malaria incidence associated with increased forest cover (Krefis et al., 2011). Anopheles species' habitat preferences can vary by species and change over

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time, depending on egg-laying and larval development conditions. Consequently, forested PAs may influence malaria prevalence, though the relationship is complex and multifaceted.

The classification and management of PAs also have significant implications for malaria prevalence by determining the extent of human contact with environments favored by malaria vectors. Although the IUCN does not directly mandate management practices, its classifications generally reflect PA management objectives. Strict nature reserves or wilderness areas that limit human access and PAs with defined borders typically restrict resource use, habitation, and even human movement, limiting exposure to some malaria vector species (Miller et al., 2011). For example, individuals engaged in timber harvesting may encounter microhabitats favored by malaria mosquitoes.

Thus, PAs may influence malaria prevalence patterns by affecting vector presence and abundance and by controlling human exposure to malaria vectors. To understand these dynamics better, national-level studies leading to continental-scale analyses with precise malaria prevalence recordings are necessary. While this study does not examine fine-scale variability in malaria prevalence, undertaking a continental-scale analysis may reveal broad patterns and general trends in the relationship between landscapes surrounding PAs and malaria.

2.2.2 In Nigeria

Nigeria faces the world's largest malaria burden, with approximately 51 million cases and 207,000 deaths annually. Nearly 97% of its estimated 160 million inhabitants are

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at risk of Plasmodium infection, a higher proportion than any other country globally, contributing 25% of Africa's total malaria burden (NPC et al., 2012; WHO, 2012). Malaria accounts for an estimated 60% of outpatient visits, 30% of hospitalizations, 30% of under-five child deaths, 25% of infant deaths, and 11% of maternal deaths in Nigeria (NPC et al., 2022). Beyond its impact on health, malaria imposes significant economic burdens on individuals and households, with indirect costs for prevention and treatment estimated at about 132 billion Naira ($835 million) (WHO, 2012).

According to the Nigeria Malaria Indicator Survey (NMIS) (NIMS, 2010), nearly the entire population of Nigeria is at risk of malaria infection, especially individuals with compromised immune systems. Only 3% of the population resides at altitudes of 1,200 to 1,400 meters, where transmission risk is relatively low. The duration of the malaria transmission season decreases from south to north Nigeria (NMIS, 2010).

Malaria transmission occurs nationwide, with 97% of the population at risk. Transmission varies from year-round in the south to less than three months in the north. Plasmodium falciparum is the predominant malaria species, with primary vectors including An. coluzzii (59.3%) and An. gambiae s.s. (39.0%) among An. gambiae s.l., and An. funestus as a secondary vector in certain regions (FY, 2023).

As of the 2022 World Malaria Report, Nigeria accounts for the highest global malaria burden, comprising 27% of estimated global cases and 31% of malaria-related deaths. The country also represented 55% of malaria cases in West Africa in 2022 (WHO, 2023). Case numbers remained stable at 306 per 1,000 population at risk in 2022 and 305 per 1,000 in 2021, while deaths decreased by 3.3% from 0.9 to 0.87 per 1,000 population at risk over the same period (WHO, 2023).

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Microscopy data from the 2018 Nigeria Demographic and Health Survey (NDHS) show a malaria parasitaemia prevalence of 23% in children under five years of age, a decrease from 27% in 2015 and 42% in 2010, with significant regional, rural-urban, and socioeconomic disparities (FY, 2023). Prevalence ranges from 16% in the South and South East Zones to 34% in the North West Zone. Rural populations exhibit a prevalence 2.4 times higher than urban populations (31% vs. 13%), and prevalence is seven times higher among children in the lowest socioeconomic group compared to the highest (38% vs. 6%) (FY, 2023).

In response to the malaria challenge, Nigeria's National Malaria Elimination Program (NMEP), with WHO and technical partners, launched the High Burden High Impact (HBHI) approach to guide implementation (FY, 2023). The current 2021–2025 National Malaria Strategic Plan (NMSP) aims for a malaria-free Nigeria, targeting less than 10% parasite prevalence and fewer than 50 malaria-related deaths per 1,000 by 2025 (FY, 2023).

To support health sector interventions, the Nigerian government secured $364 million in credits from the World Bank, African Development Bank, and Islamic Development Bank for malaria initiatives in 13 states over five years (2020–2024) (FY, 2023). A high-level ministerial meeting in May 2024 focused on malaria in Nigeria, emphasizing increased resource mobilization and utilization of new and existing tools.

Malaria in Pregnancy:

Nigeria adopted the 2016 WHO antenatal care (ANC) model, aiming for a minimum of eight prenatal contacts. The country targets 63% coverage of pregnant women

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receiving three or more doses of intermittent preventive treatment during pregnancy (IPTp) (NMSP 2021-2025). Coverage of at least three doses of sulfadoxine-pyrimethamine (SP) nearly doubled from 16.6% in 2018 to 31% in 2021 among pregnant women (FY, 2023).

Challenges in SP uptake among pregnant women include low antenatal care attendance, restrictions on dispensing SP by non-pharmacy workers, missed opportunities during visits, and SP availability issues (FY, 2023). National guidelines recommend injectable artesunate or intravenous quinine from the second trimester of pregnancy for severe malaria cases, with recent WHO guidelines extending injectable artesunate use to the first trimester (FY, 2023).

The Nigerian Ministry of Health committed in 2008 to a 50% reduction in malaria-related morbidity and mortality by 2013 (FMOH, 2012). Achieving this goal requires implementation of WHO-recommended prevention and control measures to protect at-risk populations in Nigeria. The National Malaria Control Strategic Plan set ambitious targets for 2009-2013, including 80% of households owning two or more insecticide-treated nets (ITNs) by 2010, 80% of pregnant women and children under five using ITNs nightly by 2010, and IRS coverage for 20% of targeted households by 2013 (WHO, 2011).

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Nigeria's National Malaria Strategic Plan 2021–2025:

Key Objectives:

1. Reduce malaria morbidity to less than 10% parasite prevalence by 2025.
2. Reduce malaria mortality to less than 50 deaths per 1,000 live births by 2025.
3. Ensure at least 80% of the population utilizes appropriate preventive measures such as insecticide-treated nets (ITNs) and indoor residual spraying (IRS).
4. Ensure at least 80% of the population has access to prompt and effective treatment.
5. Enhance malaria surveillance, monitoring, and evaluation (WHO, 2022).

Achievements to Date:

1. Distribution of ITNs:
    a. Large-scale distribution campaigns have successfully delivered millions of ITNs to households across Nigeria.
    b. Increased coverage and use of ITNs have contributed to the reduction in malaria incidence in several regions.

2. Case Management:
    a. Improved access to diagnostic tools such as rapid diagnostic tests (RDTs) and effective antimalarial treatments, especially artemisinin-based combination therapies (ACTs).
    b. Training of healthcare workers on malaria case management has been expanded.

3. Surveillance and Monitoring:
    a. Strengthened malaria surveillance systems to better track disease prevalence and intervention effectiveness.
    b. Regular monitoring and evaluation activities have been established to guide policy adjustments and resource allocation (NMEPN, 2021).

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Gaps and Areas Needing Revisit:

1. **Health Education and Community Engagement:**

   i. Current Status:

      a. While there have been efforts to educate communities about malaria prevention and treatment, these interventions have not reached all areas effectively, particularly remote and rural regions.

      b. Misconceptions about malaria transmission and treatment persist, reducing the effectiveness of prevention and treatment strategies.

2. **Need for Revisit:**

   ii. Comprehensive Health Education Programs:

      a. Develop and implement more comprehensive health education programs tailored to various community needs and literacy levels.

      b. Utilize local languages and culturally appropriate materials to enhance understanding and acceptance.

   iii. Community Involvement:

      a. Engage community leaders, traditional healers, and influencers to promote malaria prevention and treatment practices.

      b. Foster community-based surveillance and reporting systems to enhance local ownership and sustainability (UNICEF, 2021).

3. **Preventive Measures:**

   iv. Current Status:

      a. The use of ITNs and IRS has improved, but coverage is still uneven, with some regions having limited access.

4. **Need for Revisit:**

   v. Increase Coverage:

      a. Ensure consistent and equitable distribution of ITNs and IRS, focusing on underserved areas.

      b. Implement regular follow-ups to ensure proper use and maintenance of ITNs (NMIS, 2022).

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1. **Access to Healthcare:**

    i. Current Status:

        a. While access to diagnostic and treatment facilities has improved, there are still significant barriers, especially in remote and conflict-affected areas.

2. **Need for Revisit:**

    ii. Expand Healthcare Access:

        a. Strengthen the healthcare infrastructure in underserved areas.

        b. Mobile clinics and outreach programs could be expanded to reach remote populations (UNICEF, 2022).

3. **Data and Surveillance:**

    iii. Current Status:

        a. Improvements in data collection and surveillance have been made, but gaps remain in real-time data availability and accuracy.

4. **Need for Revisit:**

    iv. Enhance Data Systems:

        a. Invest in advanced data collection and reporting technologies.

        b. Train local health workers in data management to ensure timely and accurate reporting.

5. **Public Health Angle:**

    v. From a public health perspective, addressing the gaps in health education is crucial. Effective health education interventions can lead to:

    vi. Increased Community Awareness:

        a. Better understanding of malaria prevention methods, leading to higher ITN use and acceptance of IRS.

        b. Improved health-seeking behaviour, with more people seeking timely diagnosis and treatment.

6. **Behavioural Change:**

    vii. Adoption of preventive behaviours such as proper ITN use, environmental management to reduce mosquito breeding sites, and adherence to treatment regimens.

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7. Sustainability:

Community-driven initiatives are more likely to be sustainable in the long term. Educated communities can maintain and even improve malaria control efforts beyond the lifespan of specific programs (USAID, 2022).

Revisiting and enhancing health education interventions within Nigeria's National Malaria Strategic Plan 2021–2025 is essential for closing the gaps in malaria control efforts. A robust health education strategy, supported by comprehensive community engagement and improved healthcare access, can significantly reduce malaria's public health burden in Nigeria.

Recently, there has been a rapid expansion of Insecticide-Treated Nets (ITNs) or Long-Lasting Insecticidal Nets (LLINs) distribution programs in African countries (WHO, 2011). This expansion has been driven by randomized controlled trials (efficacy studies) demonstrating the impact of ITNs on various outcomes. According to a study on the epidemiology of malaria and anaemia by White, N. J. (2018), the risk of anaemia during pregnancy increases as the pregnancy progresses. Subsequent randomized trials have examined the effectiveness of ITNs in preventing malaria among pregnant women and children under five years of age under optimal conditions, but relatively few studies have assessed their effectiveness in mass distribution campaigns under real-world conditions in the general population.

A study by Lim et al., (2011) investigated the association between individual-level household ITN ownership and use and malaria parasitaemia among children and

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pregnant women in seven countries. However, this study did not specifically analyze the impact of ITNs on reducing malaria prevalence in areas covered by these nets.

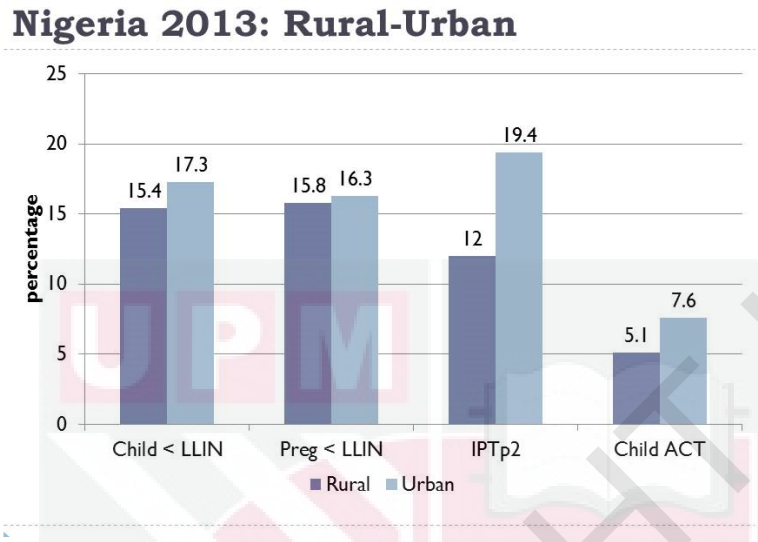


Figure 2.1: Percentage distribution of ITNs in Nigeria (Rural-Urban) [adapted from Tropical health matters (2015)]

Table 2.1: Malaria statistics in Nigeria, 2016

Indicator (in millions or otherwise indicated)	Nigeria	Sub-Saharan Africa	Global
Estimated number of people living with malaria	97%	99%	3.3 billion
Estimated number of pregnant women living with malaria in 2016	72%	90%	4.3 million
Estimated number of children living with malaria in 2016	90%	70%	86%
Estimated number of deaths due to malaria in 2016	300,000	90%	445 000
Number of pregnant women estimated to use ITNs in 2016	38%	53%	67%

2.2.3 Geographical location of Nigeria

Nigeria is a country located in West Africa along the Gulf of Guinea on the Atlantic Ocean. It shares land borders with Benin to the west, Cameroon and Chad to the east, and Niger to the north. Nigeria's major ethnic groups are Hausa, Igbo, and Yoruba. It

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is the most populous country in Africa and boasts one of the continent's fastest-growing economies. Nigeria serves as a regional hub for West Africa. The nation covers a total surface area of 923,768 km² with 800 km of coastline, situated between latitudes 4°1′ and 13°9′ North and longitudes 2°2′ and 14°30′ East. Nigeria is administratively divided into 36 states and the Federal Capital Territory (FCT) in Abuja, with a population of approximately 170 million (Awofala & Ogundele, 2016).

2.3 Malaria infection

2.3.1 Symptoms of malaria infection

i. Shaking chills that can range from moderate to severe.
ii. High fever.
iii. Profuse sweating.
iv. Headache.
v. Nausea.
vi. Vomiting.
vii. Diarrhea.
viii. Anemia

2.3.2 Diagnose and treatment of malaria infection

Controlled human malaria infection (CHMI) has proven to be a valuable tool for evaluating the efficacy of drugs and vaccines and studying the pathogenesis of clinical malaria. These challenge trials have become highly standardized (Laurens et al., 2012) and are considered critical in the clinical development of pre-erythrocytic malaria

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vaccines (Sauerwein et al., 2011). Traditionally, volunteers are monitored after CHMI with thick blood smears once to three times daily, and anti-malarial treatment is initiated immediately upon detecting two or more parasites by microscopy. In 2004, a standardized protocol for CHMI thick blood smears was introduced using a threshold of 4000 parasites/ml to improve comparability of study outcomes between centers (Roestenberg et al., 2012). Volunteers typically develop submicroscopic parasitemia for several days before becoming thick smear positive. The more sensitive quantitative PCR (qPCR) with a detection limit of 20 parasites/ml was introduced for retrospective analysis, feeding a statistical model for more detailed estimation of important parasite parameters including liver load and asexual parasite maturation and multiplication rates (Hermsen et al., 2004; Hermsen et al., 2001).

During pregnancy, the World Health Organization (WHO) now recommends that all women in the second or third trimester with uncomplicated P. falciparum malaria should be treated with artemisinin-based combination therapy (WHO, 2015). The short-acting but potent artemisinin component (artemether, artesunate, or dihydroartemisinin) substantially reduces parasite numbers during the first 3 days of treatment. The longer-acting partner drug (lumefantrine, piperaquine, amodiaquine, or mefloquine) eliminates remaining parasites, preventing recrudescent malaria. The longer-acting partner drug also provides post-treatment prophylaxis by preventing new infections while drug concentrations in the blood exceed the minimum inhibitory concentration for the parasite. Therefore, the duration of post-treatment prophylaxis depends on the drug's potency and elimination half-life. This mechanism is similarly employed in intermittent preventive treatment, where repeated curative anti-malarial treatments eliminate potential asymptomatic infections and prevent new infections.

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However, artemisinin-based combination therapy is not currently recommended for intermittent preventive treatment in pregnancy. The current WHO recommendation for all pregnant women in malaria-endemic areas of Africa is intermittent preventive treatment with sulfadoxine-pyrimethamine as part of antenatal care (WHO, 2015). Unfortunately, the effectiveness of sulfadoxine-pyrimethamine is compromised by widespread drug resistance in many regions.

Nevertheless, data on the safety, efficacy, and pharmacokinetics of artemisinin-based combination therapies in pregnant women remain limited.

2.3.3 Consequence of malaria infection

In 2022, malaria continued to be a significant global health issue with severe consequences, particularly in sub-Saharan Africa. According to the World Health Organization (WHO), there were approximately 249 million malaria cases worldwide, resulting in an estimated 608,000 deaths. The African region bore the brunt of this burden, accounting for 94% of cases and 95% of deaths. Children under five years old were the most vulnerable group, comprising nearly 80% of all malaria deaths in the region (WHO, 2022).

Several factors exacerbated the malaria situation in 2022. The COVID-19 pandemic, humanitarian crises, natural disasters, and resistance to insecticides and antimalarial drugs posed significant challenges. Despite efforts to maintain malaria prevention and treatment services, the pandemic's impact on health systems and funding constraints hindered progress (Beat Malaria, WHO, 2022).

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Climate change also played a role in altering malaria transmission patterns. Rising temperatures and changes in rainfall and humidity due to climate change have made some previously malaria-free areas susceptible to the disease, while increasing aridity in other areas could reduce mosquito populations and malaria transmission. Additionally, extreme weather events, such as monsoon rains in Pakistan, contributed to malaria outbreaks (WHO, 2022).

Efforts to combat malaria included the distribution of insecticide-treated bed nets (ITNs), with 171 million planned for 2021, although only 128 million were delivered, partly due to the pandemic. Indoor residual spraying (IRS) and intermittent preventive treatment in pregnancy (IPTp) were also crucial strategies. In 2021, 53 countries conducted IRS campaigns, and 35% of pregnant women in sub-Saharan Africa received IPTp, marking a significant increase compared to previous years (Beat Malaria, WHO, 2022).

Overall, while there were notable efforts to control malaria in 2022, significant challenges remain, necessitating continued investment and innovative strategies to reduce the global malaria burden.

Recent data suggest approximately 627,000 deaths from malaria worldwide in 2012 (WHO, 2013). These deaths, directly attributable to malaria, also indirectly impact birth weight and debilitate children through repeated infections, typically preceded by severe illness. With fewer than half of severe malaria cases reaching health facilities and assuming a case-fatality rate of 90% at home and 20% in hospitals (Thwing et al., 2011), the global annual incidence of severe malaria is estimated at about 2 million

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cases. In regions with intense and stable Plasmodium falciparum transmission, severe malaria primarily affects children from infancy to about 5 years old, becoming less common with increasing acquired immunity in older children and adults (Black et al., 2010). Approximately 90% of severe and fatal malaria cases globally affect young children in Sub-Saharan Africa.

Malaria is resurging in many African and South American countries, exacerbated by disruptions in health services due to COVID-19. In 2021, an estimated 247 million malaria cases and 619,000 deaths occurred in 84 endemic countries (WHO, 2022). Plasmodium falciparum strains partly resistant to artemisinins are entrenched in the Greater Mekong region and emerging in Africa. Meanwhile, Anopheles mosquito vectors continue evolving physiological and behavioral resistance to insecticides. The elimination of Plasmodium vivax malaria faces challenges due to impractical and potentially toxic antirelapse regimens. Parasitological diagnosis and treatment with oral or parenteral artemisinin-based therapy remain fundamental in-patient management (Antinori et al., 2021). Timely interventions such as blood transfusion, renal replacement therapy, and restrictive fluid management can improve survival in severe malaria cases. The rigorous implementation of intermittent preventive treatment in pregnancy and infancy, alongside seasonal chemoprevention and pre-erythrocytic vaccines endorsed by WHO in 2021 and 2023, can significantly reduce malaria morbidity. Enhanced surveillance, improved access to effective treatment, more efficient vector control, ongoing drug development, targeted mass drug administration, and sustained political commitment are essential to achieve malaria reduction targets by the end of this decade (Dhorda et al., 2021).

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Diagnosis

Diagnosing malaria in pregnant women in non-endemic countries presents challenges due to low immunity and the severe disease form often observed. Clinical presentations may include fever, anemia, and other nonspecific symptoms. Rapid diagnostic tests (RDTs) and blood smears are common for initial diagnosis, with polymerase chain reaction (PCR) used for confirmation in some cases. Hospitalization is immediate for pregnant women with confirmed malaria due to high risks for both mother and fetus. Intensive monitoring of vital signs and clinical assessments every 2-4 hours are recommended to detect complications early (White, N. J., 2022).

Antimalarial Treatment

i. **First Trimester:** Quinine combined with clindamycin is preferred due to potential teratogenic effects of other antimalarials.

ii. **Second and Third Trimesters:** Artemisinin-based combination therapies (ACTs) are the treatment of choice for their effectiveness and better safety profile for both mother and child (White, N. J., 2022).

Supportive Care

Management includes addressing complications such as hypoglycemia, anemia, and seizures. Regular monitoring of blood glucose levels, hemoglobin, and lactate is necessary, with blood transfusions required for severe anemia cases. Benzodiazepines like diazepam or lorazepam are used to manage seizures (White, N. J., 2022).

Preventive Measures

Pregnant women traveling to malaria-endemic areas should use insect repellent, insecticide-treated bed nets (ITNs), and appropriate chemoprophylaxis. Health

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education on malaria risks and symptoms is crucial for early detection and treatment (Piccioni et al., 2021).

Special Considerations

Cerebral Malaria: This severe form, characterized by coma and seizures, requires immediate intensive care. Diagnosis involves clinical criteria and laboratory findings, including blood smears, possibly requiring lumbar puncture to rule out other causes of coma. Parasitemia monitoring through daily blood smears is essential until clearance to adjust treatment and ensure efficacy (Piccioni et al., 2021).

Effective management of imported malaria in pregnant women in non-endemic countries necessitates a multidisciplinary approach involving obstetricians, infectious disease specialists, and intensive care teams to optimize outcomes for mother and child. Artesunate reduces severe malaria mortality by 35% in adults and is the preferred treatment across all pregnancy trimesters due to its avoidance of hypoglycemia (WHO, 2010). Hypoglycemia, which may be associated with lactic acidosis in severe multisystem disease, can present with varied symptoms including sweating, behavior changes, altered consciousness, or convulsions. Asymptomatic hypoglycemia is often overlooked, and cerebral effects may be mistakenly attributed to malaria. Late pregnancy hypoglycemia commonly recurs post intravenous glucose correction therapy.

Pregnant patients with severe falciparum malaria are at increased risk of developing acute pulmonary edema. Early signs include increased respiratory rate preceding chest sign development. Dyspnea and hypoxia may be present at admission or suddenly

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develop several days after hospitalization. Postpartum acute pulmonary edema often develops immediately after delivery and can occur within the first postpartum week. Women entering labor with severe anemia or fluid overload may develop postplacental separation acute pulmonary edema. Severe anemia is associated with increased maternal morbidity, postpartum hemorrhage, and perinatal mortality.

2.4 Malaria preventive interventions in Nigeria

2.4.1 In general population in Nigeria

In Nigeria, the National Malaria Control Strategic Plan (2009–2013) included strategies such as increased indoor residual spraying, universal access to long-lasting insecticide-treated nets (LLINs), and environmental management to reduce mosquito breeding sites (Nigeria FY, 2011; NPC et al., 2012). The LLIN distribution strategy from 2009 to 2010 involved a scale-up phase of free LLIN distribution through mass campaigns, ensuring each household had at least 2 LLINs. This strategy also included replacing torn or worn-out nets and providing LLINs to new families and members (Nigeria FY, 2011; NPC et al., 2012).

During the scale-up phase, LLIN distribution was carried out through standalone mass campaigns led by state authorities in collaboration with partners (Amajoh, 2011). Stakeholders, including the National Malaria Control Programme and various partners (government bodies, donors, and implementers), organized Federal and State LLIN Campaign Coordination Networks (Ajiboye, 2010; Amajoh, 2011). Each state established technical, coordination, and logistics teams to support campaign

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operations, deploying personnel to schools, primary health centers, and community leaders' homes to register households and issue net cards for obtaining LLINs during distributions (Amajoh, 2011; Kilian et al., 2010). These campaigns, supported by UNICEF, integrated child health interventions, such as polio immunization for children under five years old (Kilian et al., 2010; Nigeria FY, 2011). The distribution process in all states was monitored using Rapid SMS, a short message service-based data collection and communication tool (Ajiboye, 2010).

The World Bank supported campaigns in seven states (Akwa Ibom, Anambra, Bauchi, Gombe, Jigawa, Kano, and Rivers), UNICEF in four states (Adamawa, Sokoto, Kaduna, Kebbi), and the Global Fund (through the Society for Family Health and Yakubu Gowon Centre) in three states (Niger, Ogun, and Ekiti) (NPC et al., 2012; Nigeria FY, 2011). WHO led the distribution efforts for LLINs and insecticide-treated nets (ITNs). By August 2010, distribution campaigns in these 14 states had been completed (Nigeria FY, 2011).

In late 2008 and early 2009, USAID and the Canadian Red Cross independently distributed 676,877 LLINs to children under five years in Cross River State, ahead of the universal mass distribution campaigns in the 14 states (Nigeria FY, 2011).

In Kano State, LLIN mass distribution commenced in May 2009 (NNMIS, 2012), and by August 2010, over 24 million LLINs had been distributed across 14 of Nigeria's 37 states (Nigeria FY, 2011). Evaluation reports from Cross River State's campaign indicated that 81% of households received LLINs (Nigeria FY, 2011). The World Bank selected these seven states based on criteria such as high under-five mortality

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rates (> 260 deaths per 1,000 live births), demonstrated commitment to campaign implementation, high prevalence of drug-resistant Plasmodium falciparum malaria (> 85%), and lack of substantial aid from other donors (NPC et al., 2012).

According to the Nigeria Malaria Indicator Survey (NMIS) conducted between October and December 2010, 42% of households reported owning at least one insecticide-treated net (ITN), compared to 8% in the 2008 Nigeria Demographic and Health Survey (NDHS) (NPC et al., 2012; NPC et al., 2019). During the campaigns, 72% of households in World Bank booster areas and 75% in other campaign areas owned at least one ITN, compared to less than 1% in non-campaign areas, while less than 1% reported indoor spraying in the past 12 months prior to the survey (NPC et al., 2012).

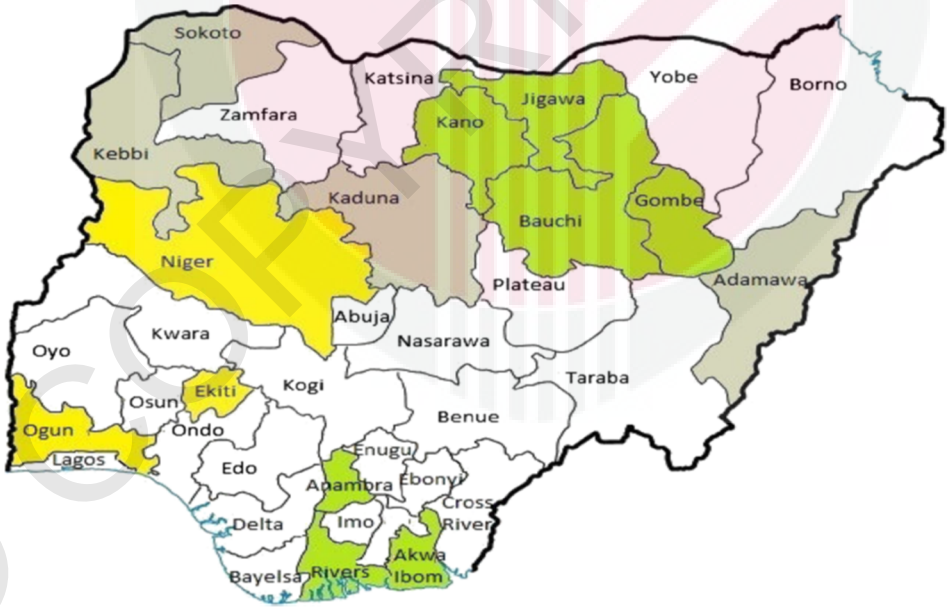


Figure 2.2: Map of LLIN Distribution Coverage in Nigeria

2.4.2 Preventive intervention measures among pregnant women in Nigeria

Malaria remains a significant health issue in Nigeria, contributing to approximately 33% of maternal deaths (Onoriode et al., 2015). Despite extensive efforts to make Insecticide-Treated Nets (ITNs) available to pregnant women in Nigeria, their usage remains low according to the Nigeria Malaria Indicator Survey (NMIS) 2012 (Onoriode et al., 2015). The National Malaria Control Strategic Plan (NMCSP), in collaboration with Roll Back Malaria (RBM) and the Millennium Development Goals, addresses national health and development priorities. A key priority of NMCSP is increasing the possession and utilization of ITNs and Long-Lasting Insecticidal Nets (LLINs), especially among children under five years and pregnant women (FMH, 2014). From 2009 to 2013, malaria prevention and treatment during pregnancy were among the three essential interventions of NMCSP, aiming for household ownership of at least two LLINs and ITNs with a target usage rate of 80% (FMH, 2014).

Public protective effects of ITNs and reduction in vector density have been observed in some settings (Pulford et al., 2011). However, despite the health benefits, usage rates remain low at 16.4% for ITNs and 16.0% for LLINs, with significant disparities across geopolitical areas (NPC, 2013). Understanding user profiles can provide valuable insights into the facilitators and barriers to ITN usage among pregnant women, where factors such as education level, malaria knowledge, community involvement, socio-economic status, and parity play crucial roles.

Challenges to achieving optimal ITN coverage include supply chain issues and costs (DHL, 2012). Significant disparities between ITN ownership and actual usage, with

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usage rates below 60% in many areas, also contribute to reduced effectiveness of interventions. ITNs are integral to national malaria control strategies across 45 African countries, with 36 conducting household surveys to measure net usage between 1999 and 2004. Recent surveys such as the Ghana Demographic and Health Survey (GDHS) 2020 provide comprehensive data on ITN ownership and usage, emphasizing their importance for vulnerable groups like children under five and pregnant women (GDHS 2020).

The Ghana Malaria Indicator Survey (MIS) 2019 similarly reports on ITN ownership and usage, highlighting the need for continued education and distribution efforts to improve usage rates (GMIS, 2019). Numerous studies underscore the potential for equitable mosquito net ownership through strategic distribution efforts (Beer et al., 2010; Noor et al., 2017), contingent upon context-specific settings and effective implementation strategies.

Despite ongoing free mass distributions of LLINs and ITNs in Nigeria, several challenges persist, including logistical barriers in remote areas, potential misallocation of nets, and residual costs associated with obtaining them. Cultural practices, discomfort in hot climates, and alternative mosquito prevention methods also influence ITN usage. Addressing these challenges requires a multifaceted approach encompassing improved logistics, targeted education campaigns, cultural considerations, and efforts to enhance comfort and acceptability of ITNs under local conditions. Continuous monitoring and adaptive strategies are essential to sustain distribution impacts and improve health outcomes over time (Wisniewski et al., 2019).

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2.4.3 Intermittent preventive treatment (IPT)

The policy of administering a full medicinal dose of Sulfadoxine-Pyrimethamine (SP) at least twice during pregnancy, regardless of malaria infection status, is known as Intermittent Preventive Treatment of malaria in pregnancy (IPTp). This intervention begins as early as possible in the second trimester, following the World Health Organization's (WHO) recommendation for all pregnant women at each scheduled antenatal care (ANC) visit, with doses given at least one month apart (WHO, 2010).

Importance of IPTp

Malaria infection during pregnancy poses significant risks to both the mother and the unborn child, particularly in sub-Saharan Africa where malaria burden is highest. Risks include severe maternal anemia, low birth weight, premature delivery, and increased infant mortality. IPTp aims to prevent these outcomes by administering antimalarial drugs at scheduled intervals during pregnancy (DHS, 2019).

To mitigate these risks, the WHO recommends the administration of Sulfadoxine-Pyrimethamine (SP) for IPTp. SP is administered at least three times during the second and third trimesters at routine ANC visits, irrespective of malaria infection status at the time of treatment. This strategy aims to clear existing infections and provide protective effects against new infections (GDHS, 2019).

The implementation of IPTp-SP in 2020 faced challenges including healthcare infrastructure, drug availability, healthcare worker training, and community awareness. The COVID-19 pandemic further disrupted malaria prevention efforts,

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including IPTp, leading to significant service interruptions globally. The WHO reported approximately 47,000 additional malaria deaths in 2020 due to pandemic-related service disruptions (WHO, 2020).

Coverage and Adherence

Despite challenges, many countries made efforts to continue IPTp services. However, coverage remains below target levels in many malaria-endemic countries, influenced by access to healthcare facilities, supply chain disruptions, and healthcare worker training gaps (WHO, 2020). In Ghana, for instance, the GDHS 2020 indicated suboptimal IPTp-SP coverage among pregnant women, prompting enhanced community outreach and education efforts (GDHS, 2020).

Impact of IPTp

Studies consistently show that IPTp-SP positively impacts maternal and neonatal health outcomes, reducing maternal malaria episodes, maternal anemia, low birth weight, and perinatal mortality rates. Research underscores the efficacy of IPTp-SP in improving pregnancy outcomes compared to non-receipt of IPTp-SP (GDHS, 2020).

Challenges and Future Directions

Despite the proven benefits of IPTp-SP, several challenges remain in its implementation:

1. **Drug Resistance:** Resistance to SP is emerging in some regions, potentially reducing IPTp-SP effectiveness. Ongoing research aims to identify alternative drugs and strategies.

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2. **Healthcare Infrastructure:** Strengthening healthcare systems, especially in rural areas, is crucial for ensuring consistent access to IPTp services.
3. **Community Engagement:** Increasing community awareness and education about IPTp importance can enhance adherence and uptake.
4. **Integration of Services:** Integrating IPTp delivery with other maternal and child health services can streamline care and improve coverage.

Intermittent Preventive Treatment for pregnant women is a vital component of malaria control efforts, particularly in sub-Saharan Africa. Despite challenges such as the impact of the COVID-19 pandemic and emerging drug resistance, IPTp-SP significantly improves maternal and neonatal health outcomes. Continued investment in healthcare infrastructure, research, and community engagement is essential to maximize IPTp benefits and reduce malaria burden during pregnancy.

2.4.4 Indoor residual spray (IRS)

The role and cost-effectiveness of Indoor Residual Spraying (IRS) in malaria control have received less attention compared to Insecticide-Treated Nets (ITNs). Recent comparisons between historical IRS trials in Africa and contemporary ITN evidence underscore the need to reassess the comparative advantages of these interventions under various endemic settings (Curtis & Mnzava, 2000). Despite extensive use and evaluation of ITNs and IRS in Asia (Kamolatanakul et al., 2001; Verle et al., 1999), comprehensive assessments in Africa have been limited. For instance, in high transmission areas like Tanzania, ITNs were cost-effective compared to IRS (Curtis et al., 1999), whereas in low transmission areas like KwaZulu-Natal, South Africa, ITNs were more effective albeit more expensive.

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IRS involves applying long-acting chemical insecticides to the walls and roofs of houses and animal shelters in a specific area to kill adult vector mosquitoes. Its primary effects include reducing mosquito lifespan and density, potentially leading to local malaria vector elimination. Some insecticides also repel mosquitoes, reducing their entry into sprayed rooms and human-vector contact.

Despite its historical success in malaria control and eradication efforts, IRS use has declined in recent years (WHO, 2017). Factors contributing to this decline include insufficient government commitment and funding, concerns about insecticide resistance, and community acceptance issues, particularly concerning Dichlorodiphenyltrichloroethane (DDT). While DDT was once widely used in agriculture and domestic hygiene, its environmental and health impacts have led to its disfavor, despite its effectiveness when used appropriately for IRS.

2.4.5 Use of insecticide treated nets (ITNS)

Using Insecticide-Treated Nets (ITNs) during sleep is a potent tool in combating malaria infections. Numerous studies demonstrate that ITN use significantly reduces malaria incidence rates. The effectiveness of ITNs is enhanced when they are treated with insecticides, providing superior protection compared to untreated nets, especially under ideal conditions (Clarke et al., 2011). A Cochrane review based on five community-randomized trials in sub-Saharan Africa indicated that full ITN coverage reduces all-cause child mortality by an average of 18%, illustrating substantial public health benefits (Lengeler, 2020).

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ITNs not only reduce clinical malaria episodes caused by Plasmodium falciparum and Plasmodium vivax infections by approximately 50%, but also decrease the prevalence of high-density parasitemia. Additionally, ITNs have proven effective against other disease vectors such as those transmitting leishmaniasis, Japanese encephalitis, lymphatic filariasis, and Chagas disease, while also providing protection against nuisance mosquitoes, head lice, and bedbugs (Sampath et al., 2018).

Among pregnant women, ITN use correlates with reduced stillbirths, improved birth weights, and lower prevalence of parasitemia and anemia (Pulford et al., 2011). Despite encouraging ownership rates, many pregnant women do not use available ITNs due to factors like discomfort, hanging difficulties, limited space, low awareness, and seasonal variations in use (Roll Back Malaria, 2019). Addressing these barriers through context-specific strategies and educational campaigns is crucial to increasing ITN utilization among pregnant women.

Promoting "net culture" and ensuring ITN affordability are pivotal for expanding coverage in regions like Ghana. Stakeholders should focus on raising awareness and motivating non-owners to adopt ITNs, thereby enhancing community-wide protection against malaria (Netmark, 2014).

2.4.5.1 The current level of insecticide treated nets (ITNs) coverage or in the progress of increasing ITNs coverage in Africa

Malaria in pregnancy affects over 25 million pregnant women annually, both in high and low malaria-endemic areas. The adverse outcomes associated with malaria impact both mother and newborn, including stillbirth, preterm birth, maternal and neonatal

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mortality, congenital malaria, maternal anemia, and low birth weight (LBW, i.e., birth weight < 2.5 kg) (McClure E.M et al., 2013).

In Ethiopia, considerable attention has been given to malaria prevention and control (FMOHE; 2010). With sustained universal coverage of key malaria interventions, the country aimed to eliminate malaria by 2020 (FMOHE; 2010). As part of this vision, the government aimed for malaria elimination in historically low transmission areas and near-zero malaria deaths across the rest of the country by 2015 (FMOHE; 2010). To achieve this, the national malaria control program planned to scale up distribution of long-lasting insecticidal nets (LLINs) to 100% coverage and ensure at least two LLINs per household in malaria-endemic areas. The goal was to achieve 86% LLIN use among pregnant women and children under five by 2015 (FMOHE; 2010). Given this timeline, the government and key malaria partners have updated their strategic plan to align with the long-term goal of global malaria elimination and eventual eradication by 2040–2050. For example, the President's Malaria Initiative (PMI) Strategy (2015–2020) emphasizes sustaining universal LLIN access and use to aid PMI-supported countries in progressing towards elimination and eventual eradication (PMI; 2015).

To ensure universal access, WHO recommends distributing one ITN for every two people at risk of malaria, prioritizing improved ITN access. Evidence shows a strong correlation between access and ITN use. However, in areas with low LLIN utilization, WHO recommends implementing well-designed behavior-change communication (BCC) interventions (WHO; 2017). For years, two main indicators have been used to assess ITN use: the proportion of households owning at least one ITN and the

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proportion of children under five and pregnant women using ITNs the previous night (RBM; 2015). These indicators, however, consistently show a significant gap between ownership and actual use by vulnerable groups, attributed partly to behavior-related issues (Hetzel et al., 2012).

To more accurately measure ITN access, Roll Back Malaria (RBM) recommended two additional core LLIN indicators (RBM; 2015): the proportion of households with at least one ITN for every two people and the proportion of the population with access to an ITN within the household (MIS; 2012). The first indicator complements the existing indicator by estimating the ownership gap (i.e., households lacking sufficient ITNs). The second indicator helps gauge the use gap resulting from behavioral factors. However, ITN access and use gaps have been inadequately studied in Ethiopia. Thus, this study investigated ITN access and use gaps among households in three districts of Jimma Zone, Southwestern Ethiopia.

In Ghana, malaria accounts for at least 20% of child deaths, 40% of pediatric hospital admissions, and over 50% of outpatient visits (Anon: Annual Report of the Ghana National Malaria Control Programme, 2016). The current strategy of the National Malaria Control Programme focuses on ITNs and indoor residual spraying (IRS). Since 2012, there has been significant expansion in ITN and IRS coverage. For instance, operational ITN coverage increased from 742,000 in 2002 to over 1,477,000 in 2007. By 2015, reports indicated a 60% ITN distribution coverage compared to 30% in 2013, with a prevalence still exceeding 85/1000 population (WHO, 2015). Although deaths from all Plasmodium species have decreased, admissions to public facilities rose from 1,200 in 2010 to over 1,800 in 2015 (WHO, 2015). Since 2013, the ITN

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distribution campaign has included extensive health education efforts and free or subsidized ITN supply, particularly targeting pregnant women. Between 2013 and 2015, approximately 40,035 bed nets were distributed through organizations like UNICEF and WHO (WHO, 2018).

According to the 2006 Multiple Indicator Cluster Survey (MICS) by UNICEF Ghana, the use of ITNs increased from 3.5% among under-five children in 2003 to 21.8% in 2013, with one in five children under five using ITNs (UNICEF, 2017).

In 2010, Rwanda distributed about 4.1 million ITNs during a universal coverage campaign, aiming for one ITN per two people to cover all sleeping areas in each household. This campaign increased ITN use among under-five children by 25% compared to 2007–2018 (NIS; 2011; Wiseman et al., 2017; Eisele et al., 2010). Despite achieving 75% ITN use among under-five children, which is relatively high compared to other sub-Saharan countries, Rwanda fell short of its national and international target of 80% (NIS; 2011).

2.4.5.2 The current level of insecticide treated nets (ITNs) coverage in Nigeria or in the progress of increasing ITNs coverage

In Nigeria, a World Health Organization fact sheet noted that ITNs are estimated to be twice as effective as untreated nets (Ntonifor & Veyufambom, 2016). The African Summit on Roll Back Malaria held in Abuja, Nigeria, on April 25, 2000, committed the continent to intensive efforts to reduce malaria mortality by 2010 through implementing Roll Back Malaria strategies as agreed at the summit. These strategies aimed for at least 60% of those at risk of malaria, especially children under five and

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pregnant women, to have prompt access to and correctly use effective malaria prevention measures, including ITNs (World Health Organization, 2020).

The Abuja target aimed to increase ITN coverage to 60% by 2005 as part of Africa's malaria control measures, leading to increased resources for malaria control in several countries in the region. A national household survey conducted in 2005 by the Malaria Control Programme in Nigeria assessed progress toward the Abuja target for ITN ownership and use among pregnant women and children under five since 2018. Over five years, Nigeria achieved only 2.8% of the expected 60% coverage for under-five children with insecticide-treated nets, which, while a significant achievement compared to 0%, was deemed too slow for meeting the 2010 target.

2.5 Socio-demographic determinants of the use of insecticide treated nets (ITNs)

2.5.1 Factors associated with knowledge and use of insecticide treated nets (ITNs)

i. Level of education

A cross-sectional study conducted by Humphrey et al. (2010) found that the respondents' level of education significantly influenced their knowledge ($p < 0.01$). Bed nets are widely recognized as effective personal protection against mosquitoes, and numerous studies have highlighted the benefits of insecticide treated nets (ITNs). It is crucial to emphasize community education on the importance of washing nets regularly. Logistic regression analyses identified higher educational attainment as a statistically significant factor positively associated with ITN use among pregnant women. This association is understandable, as individuals with higher education levels

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tend to possess more knowledge about the benefits and proper use of ITNs compared to those with no formal education. Higher education is often correlated with higher socioeconomic status, placing individuals at higher levels of socioeconomic categories. Notably, 85% of the population with lower educational attainment indicated lower usage of ITNs in these areas. Numerous studies across Africa have demonstrated a positive correlation between education and increased use of ITNs and other vector control measures (Dike et al., 2016), suggesting that higher education levels may play a crucial role in promoting acceptance of malaria prevention and control interventions. Ankomah et al. (2012) reported findings from a population-based household survey conducted between October and December 2008, involving 2,348 pregnant women selected through multi-stage probability sampling. Another study in Kenya also highlighted that knowledge level regarding ITNs was a determinant factor in their usage (NetMark, 2017), although this specific aspect was not the focus of this study due to the low number of participants who owned ITNs, limiting the analysis of ITN usage practices across various influencing factors.

ii. Place of residence

Kassie, G. A., et. al (2023) conducted a population-based cross-sectional household survey during the high malaria season among 871 pregnant women. The study found significantly higher ITN usage rates in urban areas (54.5%) compared to rural areas (34.1%) ($p < 0.001$). Their findings across rural and urban settings in the Raya Azebo region indicate relatively good knowledge about malaria transmission modes and ITN use among pregnant women. Bivariate analysis of factors influencing ITN use the previous night indicated a positive association with educational status and residence in urban areas. Ankomah et al. (2012) conducted a population-based household survey

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between October and December 2008, selecting 2,348 pregnant women through multi-stage probability sampling. The study explored differences between net owners who used them and those who did not. Significant differences in net use ($p < 0.0001$) were observed between urban (32.1%) and rural (20.7%) residents. Pregnant women in urban areas were 0.81 times less likely to own and use bed nets compared to their rural counterparts (OR = 0.805, 95% CI 0.663–0.978; $p = 0.029$), even after controlling for key demographic, knowledge, and risk indicators. The survey highlighted low ITN usage and ownership rates, with only 29% of pregnant women reporting ownership and use of bed nets. This trend is consistent with higher proportions of bed net ownership and usage among pregnant women in rural geopolitical zones, particularly in the North West and North East, compared to highly urbanized areas in the South West.

iii. Marital status

A cross-sectional study among 222 pregnant women attending Iringa Regional Hospital in Tanzania from July to September 2009 noted a significant association between marital status and bed net ownership ($p < 0.001$). Married women (OR 1.9, 95% CI 1.2–5.2) were more likely to own and use bed nets compared to primigravidae, divorced, and single women. Emmanuela et al. (2011) observed increasing use of ITNs among pregnant women in various African regions.

While not all pregnant women attending antenatal care (ANC) can afford subsidized nets (Matovu et al., 2019), over 50% reportedly obtained nets from private hospitals or sectors. In this study, access to ITNs from retail shops in the study area was relatively easy, though high costs could deter bed net purchases (Matovu et al., 2019;

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Mazigo et al., 2010; Noor et al., 2006; Osero et al., 2020). Affordability remains a significant barrier to ITN ownership and usage (Pulford et al., 2011). Public-private sector integration is essential to achieve maximum ITN distribution and coverage among at-risk groups, including pregnant women.

2.5.2 Factors associated with attitude use of insecticide treated nets (ITNS)

i. Age

Terefe et al. (2015) conducted a community-based cross-sectional study in May 2014, analyzing data from 398 pregnant women. Logistic regression using STATA version 11 indicated that respondents' age influenced their attitudes, with more positive attitudes observed among younger women aged 15–25 years (60%) compared to those aged 26–35 (50.7%) and 36–45 (35.5%) (P = 0.01). In this study, age was a significant determinant of attitude, with younger age groups showing more positive attitudes, contrasting with findings from other studies in Northern Ethiopia and Nigeria. Conversely, a study in Nigeria highlighted age as a significant factor affecting women's attitudes towards ITNs (Runsewe-Abiodun et al., 2012).

ii. Level of education

Sixty-eight percent (20 out of 29) of pregnant mothers attending secondary education or higher exhibited positive attitudes towards ITNs, higher than the 49% observed among illiterate women, although this difference was not statistically significant (p = 0.17). Runsewe-Abiodun et al. (2012) surveyed 505 respondents using semi-closed-ended questionnaires at first contact with antenatal clinics over three months. They

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found a significant relationship between education level and attitude (P = 0.01). In Nigeria, ownership and usage of ITNs have been consistently lower compared to other sub-regions (Afolabi et al., 2019; Amoran et al., 2011; Ehijie et al., 2017; Erhun et al., 2020; Oresanya et al., 2018; Tobi-West et al., 2011), possibly due to poor attitudes towards ITN use. Despite good knowledge about the benefits of ITNs, pregnant women in this community generally exhibited poor attitudes towards their use. Joel & Abimbola (2012) conducted a cross-sectional survey using a validated structured questionnaire among 335 postpartum mothers recruited proportionately from three fee-paying facilities in Ibadan, Nigeria, using simple random sampling. Women with higher levels of formal education were more likely to sleep under bed nets compared to those with lower or no formal education.

iii. Marital status

Marital status was significantly associated with attitudes towards ITN use (p = 0.001), according to Joel and Abimbola (2012). Their cross-sectional survey used a validated structured questionnaire for data collection. Another study from Nigeria by Runsewe-Abiodun et al. (2013) similarly reported a significant relationship between marital status and attitudes towards ITN use (p = 0.001).

iv. Place of residence

Akinleye et al. (2019) reported findings among women in rural South-West Nigeria, noting the adverse effects of ITNs on users contributing to negative attitudes, as mentioned earlier.

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2.5.3 Factors associated with health seeking behaviour towards the use of insecticide treated nets

2.5.3.1 Systematic review of interventions to improve Health Education on insecticide treated nets

Several interventions have been conducted to improve health education on insecticide-treated nets (ITNs) with varying outcomes in both developed and developing countries. A systematic review revealed that directly observed distribution of ITNs, ownership, incentives to encourage ITN use, and cell phone short message services can be effective in increasing health education in some settings in sub-Saharan Africa. However, some interventions were reported to produce only transient effects, while others were not effective in all settings (Barnighausen, Chaiyachati, Chimbindi, Peoples, Haberer & Newell, 2011).

Many studies reported improvements in health education alongside other associated outcomes, such as the intake of chloroquine, artemether-lumefantrine, and other treatment outcomes after interventions (Ezeama et al., 2014; Ebenezer & Sally, 2014). To develop effective interventions in a country like Nigeria, there is a need to investigate how these interventions improve health education and relate to the treatment goal of improving the use of chloroquine, artemether-lumefantrine, and the quality of life of pregnant women. To achieve this, we conducted a systematic review to examine the effectiveness of health education on ITNs and their appropriate use in sub-Saharan Africa. A literature search was conducted using ScienceDirect, CINAHL, PubMed, Prisma, Pico, Cochrane Library, and PsychINFO databases to retrieve articles published between 2000 and 2017. The keywords used were “health education”, “ITNs usage”, “malaria”, “general populations”, and “sub-Saharan Africa”.

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Data extraction from the journal articles was based on authors, study location, intervention, and results. The findings showed general improvements in outcomes in 15 out of 112 studies. During the abstract screening process, 571 references were excluded for failing to meet one or more inclusion criteria. The remaining 112 references were reviewed as full-texts, plus an additional three studies identified through reference-list checking and two identified through personal communication with experts. A total of 88 studies that did not meet our eligibility criteria were excluded, along with 11 others after obtaining information from the study authors. Ultimately, 18 studies met our eligibility criteria, and 15 were included in our review. Of the remaining three studies, two are ongoing, and one requires additional information from the authors.

Systematic reviews and meta-analyses have been conducted on interventions enhancing health education on ITNs in different parts of the world. Ebenezer and Sally (2014) conducted a systematic review of various intervention methods aimed at improving health education in community-based malaria prevention and control interventions in sub-Saharan Africa. The review included randomized controlled trials (RCTs) with at least 80% complete follow-up for six months or more, examining health education interventions on ITNs and their appropriate use.

The review investigated several types of interventions to increase ownership and appropriate use of ITNs, guided by the Evidence for Policy and Practice Information and Co-ordinating Centre's (EPPI-Centre) Methods for Conducting a Systematic Review (EPPI-Centre, 2010). This method allows for a variety of narrative synthesis and study designs when appropriate (Jackson & Waters, 2021), rather than including

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only RCTs, which is supported by traditional systematic reviews (e.g., Cochrane method). Studies considered included cluster RCTs, controlled before-after studies with contemporaneous data collection and two or more control and intervention sites, RCTs, non-randomized controlled trials, and interrupted time series studies with clearly defined intervention points and at least three data points before and after implementation.

The systematic review included both unifaceted and multifaceted interventions aimed at assessing the effectiveness and appropriate use of ITNs. Unifaceted interventions consist of a single component (e.g., ITN distribution only), whereas multifaceted interventions include two or more components (e.g., free ITNs bundled with health education about appropriate ITN use). Interventions were grouped into four main categories: health education, increasing ITN ownership through delivery strategies, appropriate use of ITNs, and combinations of these interventions.

Fifteen studies were included in this review: three before-and-after studies (Sarah et al., 2017; Ayi et al., 2010), two quasi-experimental studies (Afolaranmi et al., 2015; Natalie et al., 2016), three cluster RCTs (Bernard et al., 2019; Minja et al., 2021; Deribew et al., 2010), one non-randomized trial (Goodman et al., 2021), and six cross-sectional studies (Birhanu et al., 2015). Nigeria, South Africa, and Tanzania each had three studies conducted within their territories, with one study each from Ethiopia, Mali, Eritrea, and the Dangme-East district.

In reviewing the 15 studies (see Figure 1), four used educational interventions to promote ITN usage (Sarah et al., 2017; Dike et al., 2016), one study focused on

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delivery strategies to increase ownership (Fink, 2012), and two studies examined strategies for appropriate ITN use (Amoran, 2012; Deribew, 2010). Three other studies examined access to ownership and use of ITNs (Birhanu et al., 2015; Castro et al., 2019), while three others looked at strategies for implementing malaria education (Ayi et al., 2010; Afolaranmi et al., 2015; Goodman et al., 2011). The final two studies focused on interventions on knowledge and practices regarding malaria transmission, prevention, and treatment, and signs and symptoms of malaria (Natalie et al., 2016).

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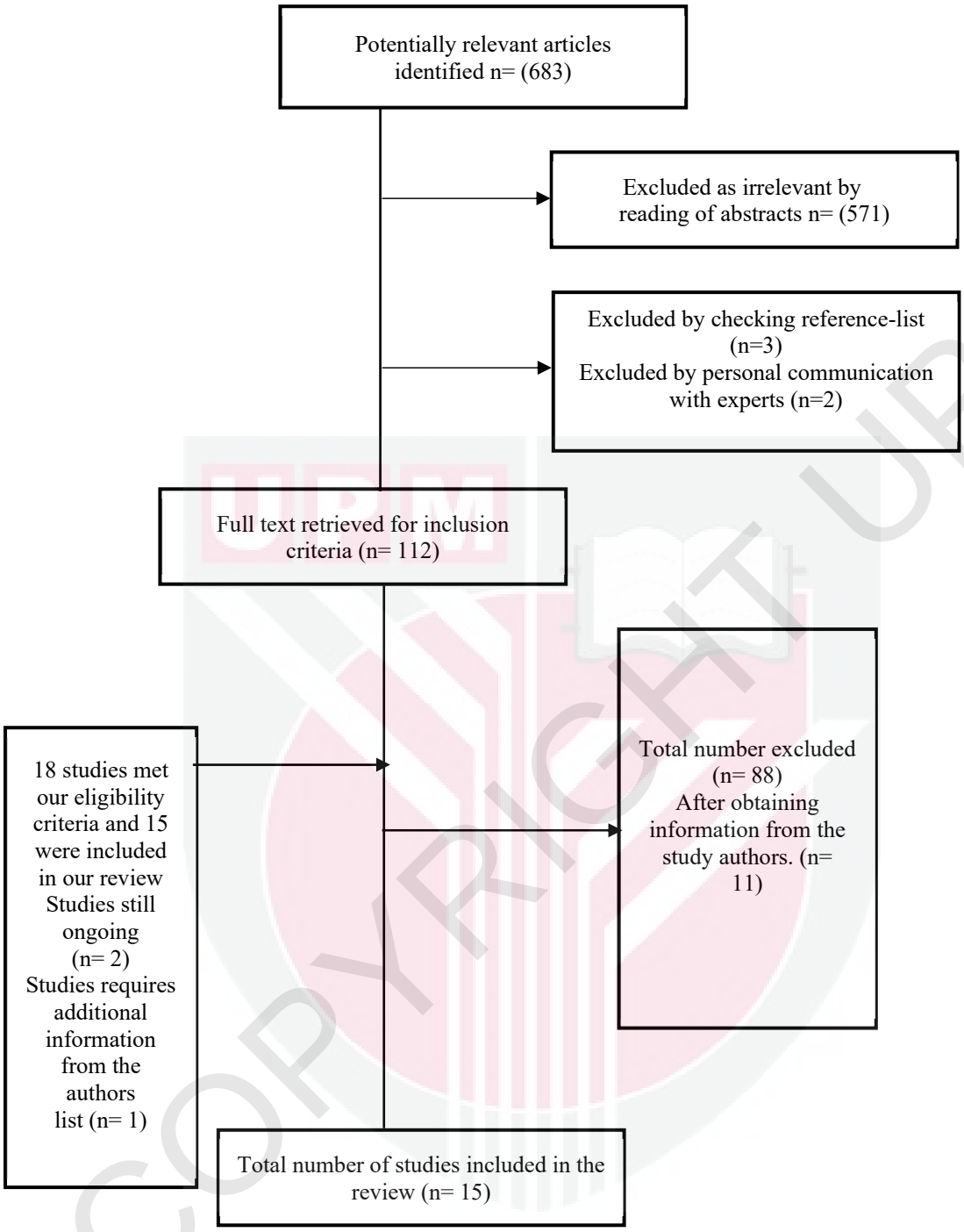


Figure 2.3: Flow diagram for study selection according to PRISMA

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Table 2.2: Overview of the studies included in the review

Study	Theory/Model	Study design	Nature of intervention	Target group	Implementation methods	Activities	Time frame of intervention exposure	setting	Study Quality
Randomised controlled trial									
Rhee et al., 2005	Not stated	Before and after	Educational programme to promote ITNs usage for malaria prevention	General population	Skill training and education about signs, symptoms, transmission and prevention of malaria.	Group discussions and malaria sensitization through public speaking and meeting	Not stated	Mali, Rural	low
Sarah et al., 2017	Not stated	Before and after	Malaria Education Intervention and its Effect on Community Participant Knowledge	General population	prospective observational data from the Malaria Awareness Program (MAP), an interactive malaria education initiative	Group discussions and Malaria knowledge was measured through surveys	Three- or four-week intervention	Vhembe District, Limpopo, South Africa	Moderate
Ayi et al., 2010	Not stated	Before and after	Health education for malaria control	Community members	health education intervention, malaria - related information, malaria signs and symptoms, and treatment and prevention.	strategies for effective implementation of malaria education activities, action plans for the health education intervention was developed.	12 months	Dangme-East district	Low
Bernard et al., 2009	Not stated	c-RCT	Coverage and knowledge on usage of ITNs	Household member	ITNs distribution and health education	Household members were interviewed about ITNs and health talk about ITNs	2 months	Muheza District, Tanzania	High
Minja et al., 2001	Not stated	c-RCT	Project and discuss health problems with a focus on malaria and its prevention	General population	Information, Education and Communication campaign	Discussion and interview on treating ITNs and questionnaire on knowledge, attitude, behaviour and practices were used to develop promotional materials for an IEC campaign	1 year	Morogoro region of south-eastern Tanzania	Moderate
Deribew et al., 2010	Not stated	c-RCT	An effect of training on the use of ITNs on the burden of malaria	General population	Preparatory, intervention and evaluation methods	Training, proper use of ITNs and establishing community network system	Not stated	south-west Ethiopia	High
Goodman et al., 2001	Not stated	Non-RCT	The effectiveness, acceptability and cost of the two interventions	General population	Cost and cost-effectiveness of ITNs	Distributed of ITNs free to households, effective in preventing malaria cases	1 year	KwaZulu-Natal, South Africa	Low
Quasi-experimental study									
Afolaranmi et al. 2015	Not stated	Quasi experimental	Health education intervention, knowledge on Malaria and ITNs	General population	Training, communication and information strategies	The health education focused on the cause of malaria, ways of preventing malaria, types of mosquito nets, benefits of ITNs and information on the importance of the consistent use of ITNs and actions to be taken to prevention malaria	Not stated	Plateau State, Nigeria	Moderate

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Table 2.2: Continued

Natalie et al., 2006	Not stated	Quasi-experimental	Impact of Freedom from hunger's malaria educational model	Community members	Information strategies, training,	Group discussion on the knowledge and practices regarding malaria transmission, prevention and treatment, signs and symptoms of malaria	Not stated	Ghana	Moderate
Birhanu et al., 2015	Not stated	Cross-sectional survey	Access to and use gaps of ITNs and malaria education intervention	Community member	Assess households' behavioral practices on malaria prevention and control	Access, ownership, and coverage of ITNs among the all-household members	2 months	Jimma Zone, southwestern Ethiopia	High
					Cross-sectional study				
Castro et al., 2009	Not stated	Cross-sectional survey	An evaluation of a community-based environmental management intervention to prevent malaria.	General population	Community sensitisation and involvement	Community sensitisation and environmental management activities	1 year and 7 months	Tanzania urban	Moderate
Dike et al., 2006	Not stated	Cross-sectional survey	Influence of education and knowledge on perceptions and practices to control malaria	General population	Education and communication	Information on their knowledge of the causes and symptoms of malaria, different methods of treating and preventing malaria and had untreated and insecticide-treated nets	Not stated	Oji-River, L.G.A, Enugu State	Moderate
Hanson et al., 2009	Not stated	Cross sectional	Ownership and use of ITNs	Household surveys	Tanzania National Voucher Scheme was implemented	A comprehensive monitoring and evaluation plan for the voucher scheme was developed alongside with the intervention and Household ownership of ITNs and their use	1 year and 7 months	Tanzania	Moderate
Govere et al., 2000	Not stated	Cross-sectional survey.	Community knowledge and perceptions about malaria and its control	General group	Community mobilization and advocacy and training	Malaria knowledge, treatment-seeking behaviour, compliance with the malaria control programmes, primary preventive measures and aspects of community participation in the MCP.	Not stated	Mpumalanga Province, South Africa	Low
Nyarango et al., 2006	Not stated	Cross-sectional survey	An intervention of assessing Eritrea's malaria control programme	General population	A holistic national programme with health system strengthening and information and communication strategy inclusion	Training, workshops, practice in the prevention and protection against malaria, community mobilisation and involvement and governmental policy	5 years	Eritrea, rural and urban	High

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2.6 The use of Theory to improve Use of ITNs among pregnant women

2.6.1 The health belief model

When dealing with the Health Belief Model, the main factors leading to behaviour change are perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. However, they are not the only ones. Cues to action and self-efficacy also play important roles in giving people the confidence to carry out the behaviour.

A study conducted in Ghana on the use of ITNs showed that those in the Kassena-Nankana district, which had more ITN-related interventions, were more likely to use an ITN compared to the Bulsa district, where there had been fewer interventions (Adongo et al., 2020). With perceived susceptibility, one considers their chances of contracting a disease. Many people in the Bulsa district did not connect mosquitoes to the transmission of malaria, indicating a lack of understanding of their susceptibility to malaria and, consequently, no perceived benefits from using an ITN.

Cues to action and self-efficacy have been much more abundant in the Kassena-Nankana district due to a high amount of malaria research (knowledge and ITN-based) (Tweneboah-Koduah et al., 2012). The people in the Bulsa district have not had the same opportunities to gain knowledge about malaria or to collect ITNs, adding to their perceived barriers related to ITN use. The most common problem when it comes to ITN usage, mentioned by public health officers, is entrenched sociocultural practices (DiClemente et al., 2011). The overall attitude of the individual toward ITN usage

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needs to be addressed. Without linking the effort put into sleeping beneath an ITN to a decreased risk of contracting malaria, people see no incentive to use ITNs. Alongside this intervention, the subjective norms within interpersonal relationships need to be considered. The attitude of pregnant women needs to improve to avoid the social pressure of others disapproving of their decision to use ITNs. Empowerment plays a role here in the form of behavioural intention and perceived behavioural control constructs. People need to feel that their choice to use an ITN, despite any hardships, is worthwhile. They need to feel in control and believe that the effort they put into preventing malaria is vindicated. Understanding that they have the power to affect their likelihood of developing malaria is essential.

2.6.2 The Information-Motivation-Behavioural skills (IMB)

The Information-Motivation-Behavioural Skills (IMB) theory postulates that three factors are necessary to create behaviour change: information, motivation, and behaviour skills. Each on its own is insufficient to result in behaviour change, but acting in concert, they enable an individual to successfully institute a change in behaviour. The IMB model is an appropriate framework to address ITN usage in Nigeria to prevent malaria because it focuses on the individual intervention level. This model emphasizes information, motivation, and behavioural skills as fundamental factors in malaria preventive behaviour. The model's past success in HIV prevention suggests that it serves health prevention interventions well (Balami, A. D et.al., 2021). In our approach to using the IMB model, information includes malaria transmission and prevention methods, correcting myths related to malaria, and cultural norms associated with malaria risk. Motivation reflects the attitudes of both users and

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purchasers of ITNs, which is an individual determinant but also influenced by social norms. The behavioural skills component of the model is a combination of an individual's actual ability and the perceived effectiveness of ITN usage.

To complement the construct of motivation in the IMB theory, the Theory of Reasoned Action (TRA) is also incorporated. This theory postulates that behavioural change occurs at an individual level and results from intention, attitude, and subjective norms. Under this theory, it is assumed that one's beliefs about health behaviours determine a person's intention toward making a behavioural change. Additionally, social norms are also considered important in instigating behavioural change. Put simply, this theory suggests that a person's likelihood of using an ITN is determined by their attitude and how they think society and others will view or judge them if they undertake that behaviour. This theory has been shown to be a successful model in examining condom use in Ghana and can be extrapolated to enhance the IMB model when focusing on malaria prevention (Cislaghi, B., & Heise, L. (2018).

Information – Reasoned Motivation – Behavioural Skills Model

The IMB and TRA combination model, called the Information – Reasoned Motivation – Behavioural Skills Model (IRMB), is based on the assumption that if individuals are well-informed, positively motivated, and have the necessary skills, they will undertake and maintain preventive behaviours (Balami, A. D et.al., 2021). Therefore, the model's hypothesis is that if individuals are informed about malaria's transmission and prevention techniques, are encouraged to act through financial, social, or individual incentives and beliefs, and are empowered with the necessary skills and resources,

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such as ITN ownership and the ability to set up and maintain its effectiveness, then ITN usage should increase.

i. Information

Information includes relevant and accurate knowledge about the behaviour, as well as incorrect beliefs and/or myths about the health behaviour (Amico, 2011). These two types of information can have opposite influences on the likelihood that an individual adopts and maintains a new health behaviour, such as using an ITN to prevent malaria. The type of information necessary for behaviour initiation can differ from that needed for behaviour maintenance. For example, an individual may need information about the efficacy of ITNs compared to indoor spraying to choose ITNs, but to ensure behaviour maintenance, information related to proper ITN cleaning is necessary.

ii. Reasoned Motivation

Reasoned motivation in the IRMB model incorporates beliefs and attitudes at both social and personal levels. These beliefs and attitudes pertain to what an individual or society perceives to be the positive or negative health consequences of a health behaviour. In the case of malaria prevention and ITN usage, motivation is derived from attitudes, norms, and actual intentions toward using ITNs. Attitudes are derived from both behavioural beliefs and personal evaluations of the benefits and consequences related to ITN usage. Similarly, norms are derived from normative societal beliefs and the desire to comply with influential groups (Balami, A. D et.al., 2021).

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iii. Behavioural Skills

Behavioural skills are necessary to foster behavioural change because they empower individuals with the necessary tools and strategies to initiate and adhere to the change. Amico et al. identified these skills as navigation, functional, and activation skills (Amico, 2011). Navigation skills enable individuals to access the resources necessary to initiate and maintain the behaviour. In the case of malaria prevention and ITN usage, navigation skills would be a person's ability to acquire an ITN. Functional skills are already present in individuals but can be transferred to help them initiate and maintain the behaviour. These could be parenting skills, such as the ability of parents to encourage their children to sleep under ITNs. Activation skills help individuals achieve success through motivation and engagement. An activation skill for ITN usage could be increasing health literacy to ensure individuals maximize the benefits of ITN usage and malaria prevention.

2.6.3 The health-seeking behaviour

Health-seeking behaviour encompasses the actions and decisions individuals make to maintain their health, prevent illness, and seek medical care when necessary. This behaviour is influenced by a multitude of factors, including socio-economic status, cultural beliefs, access to healthcare, and education. Understanding these behaviours is vital for public health professionals to develop effective interventions that improve health outcomes.

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Factors Influencing Health-Seeking Behaviour

1. Socio-Economic Status:

Income and Financial Resources: Individuals with higher incomes are more likely to afford healthcare services, medications, and health insurance, enabling them to seek medical help promptly. In contrast, those with lower incomes may delay or avoid seeking care due to the high costs associated with medical treatment (Latunji, O. O., & Akinyemi, O. O. 2018).

Education: Higher educational attainment is often associated with better health literacy, which enables individuals to understand health information and make informed health decisions. Educated individuals are more likely to recognize symptoms and seek appropriate care (Raghupathi, V., & Raghupathi, W. 2020).

2. Cultural Beliefs:

Traditional Medicine: In many cultures, traditional medicine and home remedies are the first line of treatment. People may only turn to modern medical care if traditional methods fail. Cultural beliefs about health and illness can significantly influence whether and when individuals seek professional medical care (WHO, 2023).

Perceptions of Illness: Cultural interpretations of symptoms and illnesses affect how people perceive the need for medical intervention. For example, some cultures may view certain symptoms as normal aging processes rather than signs of a treatable condition.

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3. Access to Healthcare:

Geographical Access: The proximity of healthcare facilities influences health-seeking behavior. Rural areas often have fewer healthcare providers and facilities, leading to challenges in accessing timely medical care. This geographic disparity can result in delayed treatment and poorer health outcomes (Coombs, N. C. et al., 2022).

Healthcare Infrastructure: The availability of healthcare services, including hospitals, clinics, and specialized care, affects how and when individuals seek medical help. Well-developed healthcare infrastructure facilitates easier access to care.

4. Health Literacy:

Understanding Health Information: Health literacy refers to the ability to obtain, process, and understand basic health information needed to make informed health decisions. Higher health literacy levels enable individuals to navigate the healthcare system effectively, understand medical advice, and adhere to treatment plans (Coughlin, S. S. et al., 2020).

Communication Skills: The ability to communicate effectively with healthcare providers is crucial. Language barriers and poor communication can hinder individuals from seeking care or following medical advice properly.

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Patterns of Health-Seeking Behaviour

1. Preventive Measures:

Vaccinations: Engaging in preventive measures such as vaccinations helps individuals avoid certain diseases. Public health campaigns and education play a significant role in encouraging preventive behaviours.

Regular Check-Ups: Routine health check-ups and screenings are proactive health-seeking behaviours that can detect potential health issues early, leading to better outcomes.

2. Self-Medication:

Over-the-Counter Drugs: Some individuals choose to self-medicate using over-the-counter drugs for minor ailments. While this can provide quick relief, it may also pose risks if not done properly or for serious conditions (Akande-Sholabi, W., & Akinyemi, O. O. 2023).

Home Remedies: Many cultures rely on home remedies and traditional medicine as initial treatments. While some remedies can be effective, others may lack scientific validation and could delay seeking appropriate medical care.

3. Formal Healthcare Services:

Professional Medical Help: Seeking professional medical help involves visiting doctors, specialists, and healthcare facilities for diagnosis and treatment. This is

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considered formal health-seeking behaviour and is crucial for managing serious health conditions.

Emergency Services: In urgent situations, individuals seek emergency medical services. The decision to use emergency services depends on the perceived severity of symptoms and the availability of emergency care.

Barriers to Health-Seeking Behaviour

1. Financial Constraints:

Cost of Healthcare: High out-of-pocket costs can deter individuals from seeking timely medical attention. In countries without universal health coverage, the financial burden can be a significant barrier (WHO, 2023).

Lack of Insurance: Individuals without health insurance are less likely to seek preventive care and more likely to delay treatment until conditions become severe.

2. Social Stigma:

Mental Health: Conditions like mental health issues and sexually transmitted infections are often stigmatized. Fear of discrimination and social judgment can prevent individuals from seeking help (WHO, 2023).

Chronic Illnesses: Some chronic illnesses carry social stigma, leading individuals to hide their conditions and avoid seeking necessary medical care.

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3. Mistrust in Healthcare Systems:

Negative Experiences: Previous negative experiences with healthcare providers, such as perceived discrimination or poor treatment, can lead to mistrust in the healthcare system. This mistrust can deter individuals from seeking necessary care (Bazargan, M., Cobb, S., & Assari, S. 2021).

Perceived Inefficiencies: Beliefs about the inefficiency or incompetence of healthcare systems can also influence health-seeking behaviour. Individuals may prefer self-treatment or alternative medicine over seeking formal care.

Strategies to Improve Health-Seeking Behaviour

1. Enhancing Health Literacy:

Education Programs: Public health initiatives aimed at improving health literacy can empower individuals to make informed decisions. Educational campaigns, community workshops, and school programs can increase awareness about the importance of health-seeking behaviours (Auld, M. E., et al., 2020).

Accessible Information: Providing health information in easily understandable formats and multiple languages can help individuals navigate the healthcare system better.

2. Improving Access to Healthcare:

Infrastructure Development: Expanding healthcare infrastructure, particularly in underserved rural areas, can enhance access to medical services. Mobile health clinics

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and telemedicine can also bridge the gap in remote locations (George, A. S., & George, A. H. 2023).

Financial Support: Implementing policies to reduce the financial burden of healthcare, such as subsidized healthcare services and health insurance programs, can encourage more proactive health-seeking behaviours.

3. Cultural Sensitivity Training:

Healthcare Provider Training: Training healthcare providers in cultural competence can improve patient-provider relationships. Understanding and respecting cultural differences in health beliefs and practices can reduce barriers to seeking care (Kaledio, P., & Favour, O. 2024).

Community Engagement: Engaging with community leaders and culturally relevant organizations can help tailor health interventions to meet the specific needs and preferences of different populations.

Health-seeking behaviour is a complex phenomenon influenced by various socio-economic, cultural, and systemic factors. Addressing the barriers and enhancing the facilitators to health-seeking behaviour requires a comprehensive and multifaceted approach. By understanding these behaviours and their determinants, public health professionals can design and implement interventions that promote timely and appropriate health-seeking actions, ultimately improving health outcomes for individuals and communities.

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The Health Belief Model (HBM) is a widely used theoretical framework for understanding health behaviours. It was chosen for its ability to explain and predict health-related behaviours by focusing on individual beliefs and perceptions. The HBM provides a comprehensive framework that covers a range of beliefs influencing health behaviour, making it well-suited for designing and evaluating health education interventions. By focusing on individual perceptions, the HBM can predict behaviour change in response to health education, allowing for the measurement of intervention effectiveness. The constructs of the HBM are actionable, meaning health education programs can be specifically designed to influence each construct (e.g., enhancing perceived severity and benefits, reducing barriers).

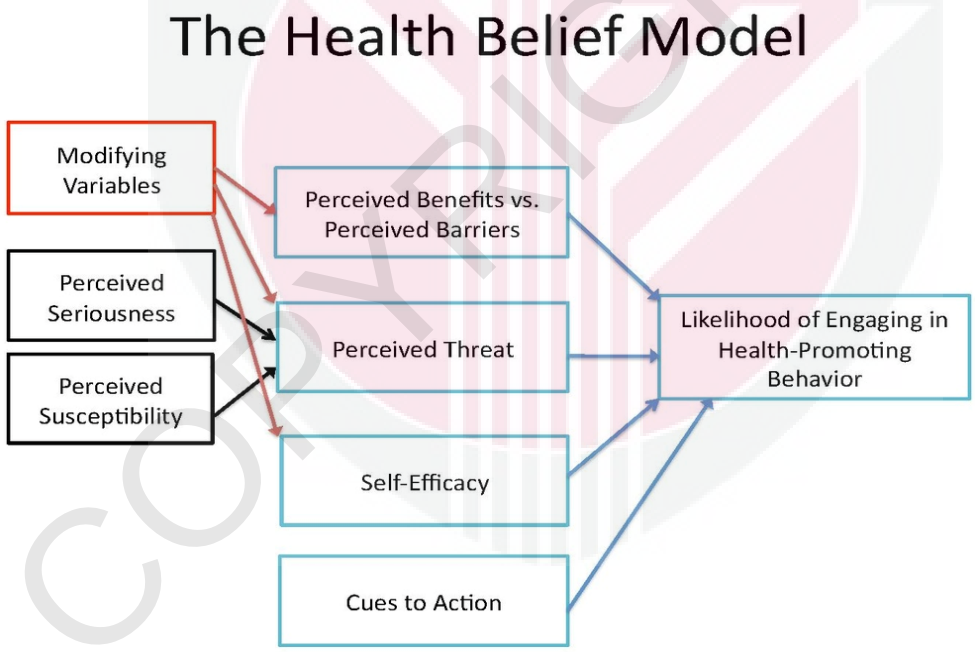


Figure 2.4: The health belief model of determinants of the use of insecticide-treated bed nets
(Godfrey M. Hochbaum et al., 1950s)

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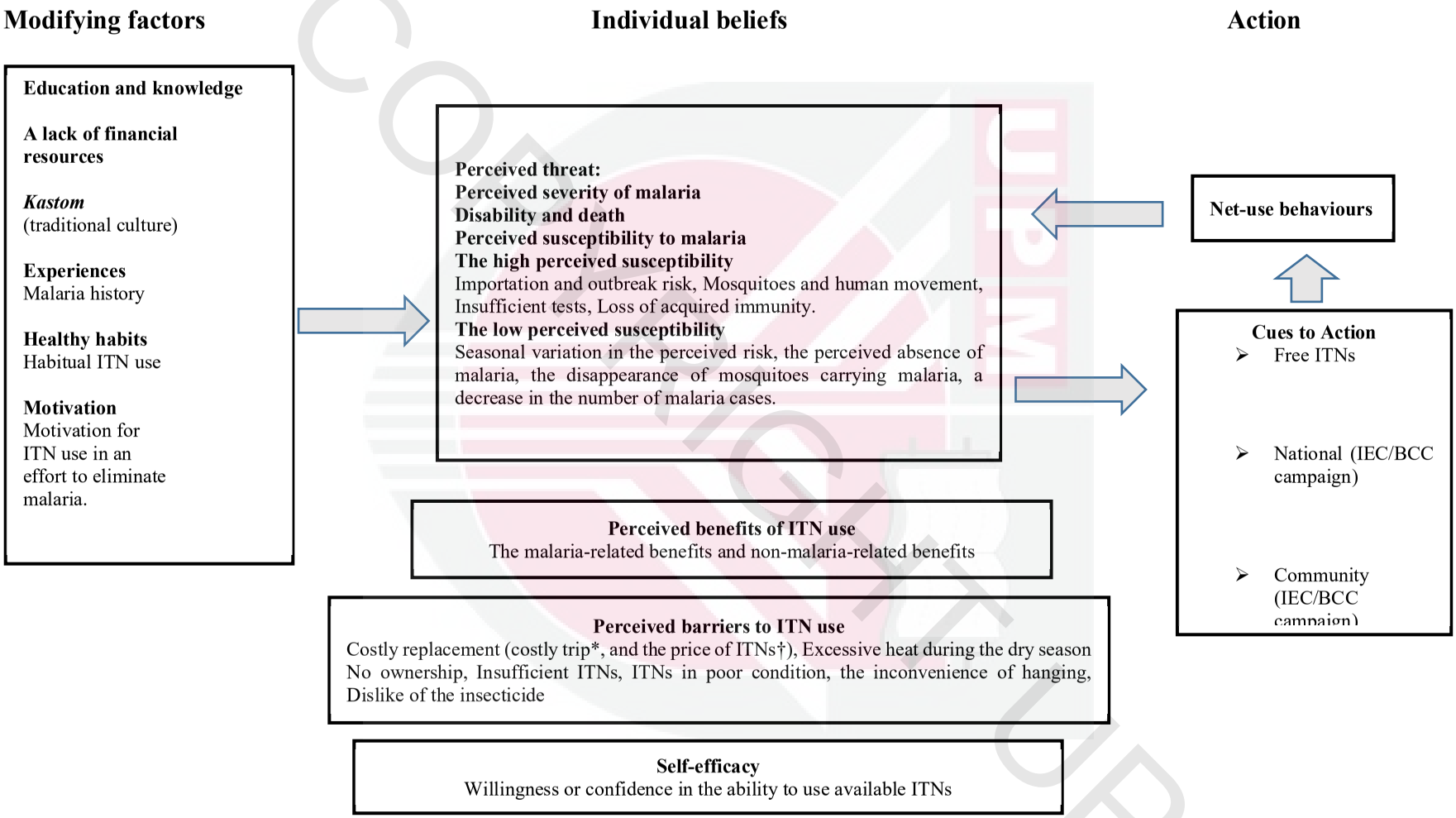


Figure 2.5: The health belief model of determinants of the use of insecticide-treated bed nets
(Godfrey M. Hochbaum et al., 1950s)

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2.7 Conceptual framework

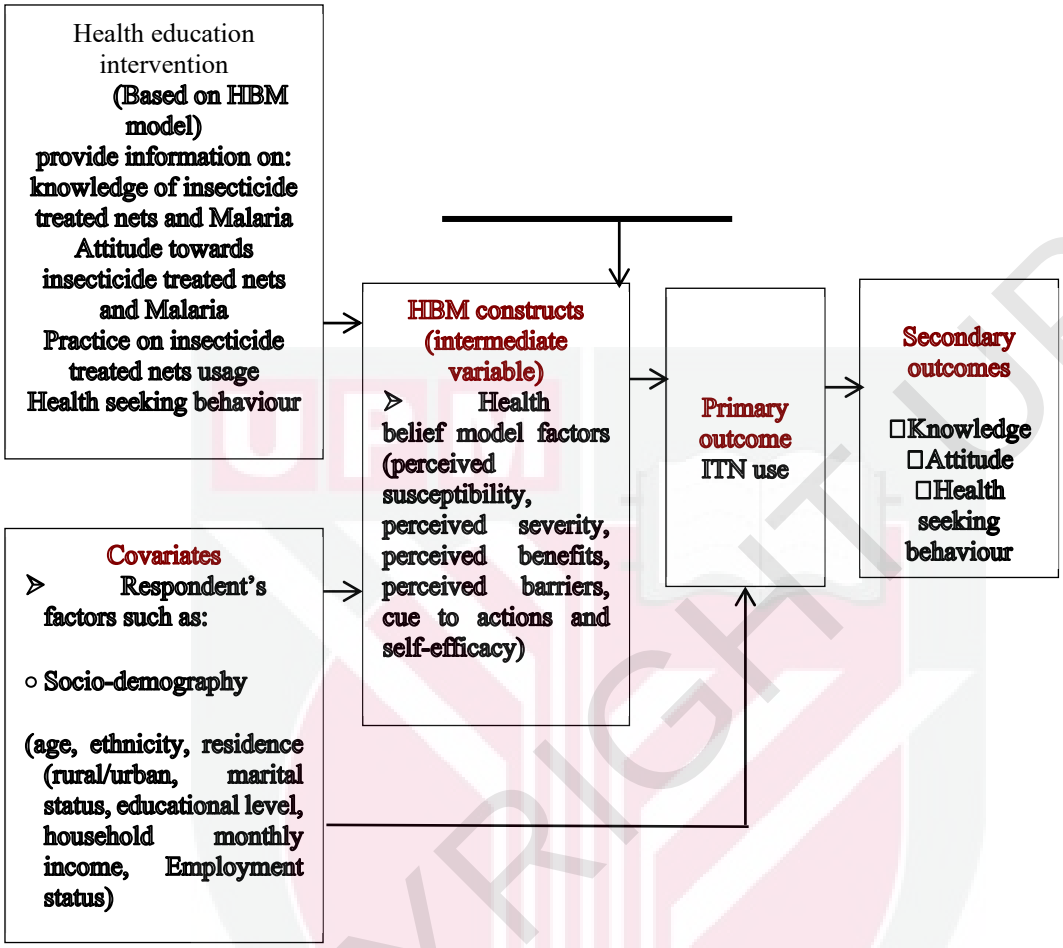


Figure 2.6: Conceptual framework of effect on health education of insecticide treated nets practices using HBM model

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CHAPTER 3

METHODOLOGY

3.1 Study location

The study was conducted among pregnant women at the University of Nigeria Teaching Hospital (UNTH) in Enugu, Nigeria. Enugu State, located in the eastern part of Nigeria at the foot of the Udi Plateau, is home to this significant medical institution. UNTH Enugu has a long history. Established early in the 20th century as a standard general hospital for Africans by colonial administrators, it evolved into a general hospital upon Nigeria's independence in the 1960s. After the Nigerian civil war ended in 1970, the government of the East Central State transformed it into a specialist hospital on July 1, 1970. At that time, the hospital had a total of 50 doctors, 10 wards, 300 beds, a chest bay with 60 beds, and 350 nurses.

Today, the hospital's capacity and resources have dramatically increased. The bed capacity at the permanent site exceeds 500, and the number of personnel, both professional and non-professional, has risen by 67% (UNTH, 2010). By decree number 23 of 1974, the Federal Military Government took over the hospital, leaving its management in the hands of the University of Nigeria, Nsukka. The University of Nigeria Teaching Hospital became independent in July 1976 with the appointment of an autonomous management board.

Physical constraints at the old site made it impossible to implement necessary expansions. Since the old site was developed and used as a general hospital, it could

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no longer meet the challenges of a teaching hospital. Consequently, the approval of the then Federal Military Government for the construction of a new complex for the teaching hospital was sought and received, providing much-needed relief.

Today, the new permanent site of the UNTH at Ituku/Ozalla is fully functional. It is located 21 kilometers from Enugu Capital City along the Enugu–Port Harcourt Expressway.

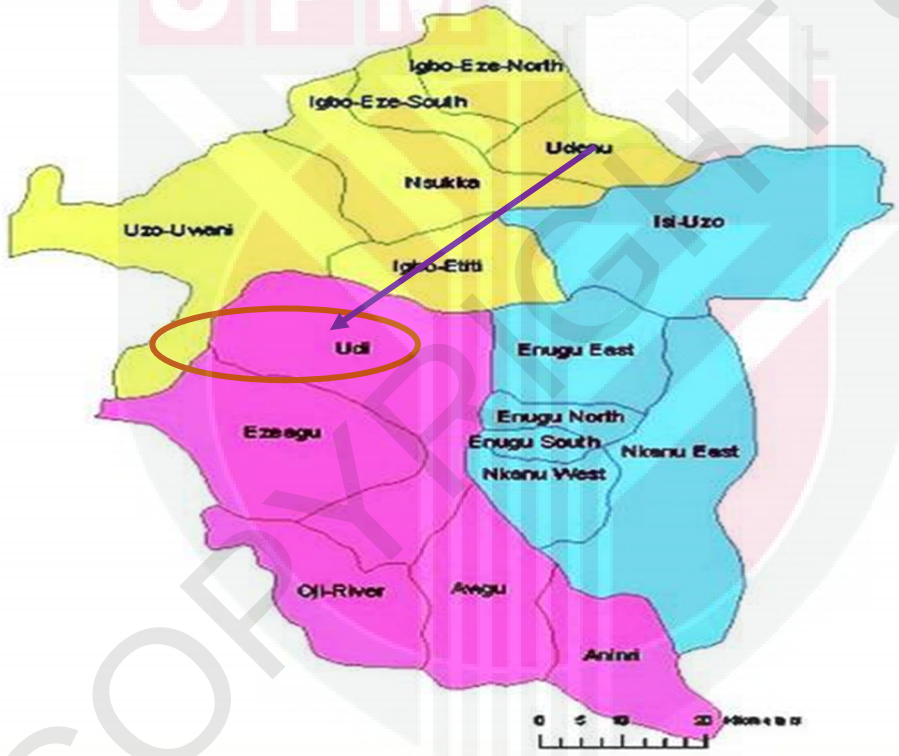


Figure 3.1: Map of Nigeria showing the location of Enugu State
(Source: Safer Nigeria Resources. May 11, 2011)

Justification for using one hospital

The University of Nigeria Teaching Hospital (UNTH) was chosen for this study for several reasons. It is a tertiary hospital serving the Enugu Nkanu West area, offering

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superior facilities compared to many private hospitals. Additionally, UNTH provides more affordable services, making healthcare accessible to all patients in Enugu State and neighboring states. The hospital is recognized as one of the best tertiary hospitals in eastern Nigeria, catering to all socio-economic levels, including high, middle, and low-income earners. There are several potential biases for choosing a teaching hospital. Teaching hospitals often serve a more diverse patient population compared to private hospitals, which may primarily cater to patients with higher socioeconomic status or better access to healthcare. The patient demographic in a teaching hospital may include individuals from lower socioeconomic backgrounds, uninsured or underinsured patients, and those with complex medical conditions. This diversity may introduce confounding variables that could affect the generalizability of research findings.

3.2 Study design

The study was a two-arm, double-blind, parallel, randomized controlled trial involving pregnant women enrolled in the Antenatal Clinic at the University of Nigeria Teaching Hospital (UNTH) in Enugu State, Nigeria. Only one hospital was used for this study.

The two groups were the intervention group and the control group. Respondents in the intervention group received health education in addition to routine clinic care, while respondents in the control group received only routine clinic care. All respondents were followed for six months, starting from the time of recruitment into the study. Health education was provided to the intervention group immediately after administering the questionnaires, and follow-up assessments were conducted at three and six months through home-based interventions. Baseline measurements on the level

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of knowledge, attitude and practice, health-seeking behavior, and Health Belief Model factors were performed for both the intervention and control groups.

3.3 Study duration

The study took more than 36 months to complete, from July 2022 to December 2022, due to the COVID-19 crisis, which affected data collection at the hospital. The study began with the preparation of the proposal and the collection of ethical approvals from both Jawatankuasa Etika Universiti Putra Malaysia (JKEUPM) and local Ethics Committees at UNTH Enugu or the Ministry of Health, Enugu State, Nigeria. This was followed by data collection, analysis, and submission of the report.

3.4 Study population

The study population consisted of all pregnant women aged 18 years and above who were enrolled in the antenatal clinic at UNTH, Enugu State, Nigeria.

3.5 Sampling frame

The sampling frame was the list of all pregnant women who attended the antenatal clinic at UNTH, Enugu State, Nigeria.

3.6 Sampling unit

The sampling unit was a pregnant woman who had commenced antenatal care in UNTH, Enugu State, Nigeria.

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3.7 Sample size estimation

The sample size required to test the study's hypothesis was calculated using the two-population proportion formula by Lemeshow and Lwanga (Lemeshow et al., 1990). The sample size for pregnant women's practice was based on a previous intervention study (Dagne, G., & Deressa, W., 2008).

$$n = \frac{[Z1\text{-}\alpha/2\sqrt{2P(1-P)} + Z1\text{-}\beta\sqrt{P_1(1-P_1) + P_2(1-P_2)}}{(P_1 - P_2)^2}$$

where:

$$P = (P_1 + P_2) / 2 = (0.705+0.467) / 2 = 0.586$$

P_1 = estimated utilization of ITNs in intervention group is = 0.705

P_2 = estimated utilization of ITNs in control group is = 0.467

$Z_{1-\alpha/2}$ = standard error when $\alpha = 0.05$ (95% Confidence Interval) = 1.96

$Z_{1-\beta}$ = standard error associated with power 80%= 1.282 ($\beta = 0.20$)

Therefore, the total sample size was 283

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Table 3.1: Sample size calculation

Title of article	Variables	Sample size calculation (n)	Design effect (1.3)	Adjusted for 80% response rate	Total
Impact of health education intervention on insecticide treated nets uptake among nursing mothers in rural communities in Nigeria (Amoran et al., 2012)	Knowledge $P_1 = 0.733$ $P_2 = 0.95$ $P = 0.842$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	57	148	185	185
	Attitude $P_1 = 0.694$ $P_2 = 0.61$ $P = 0.999$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	17.5	46	57	57
	Practice $P_1 = 0.726$ $P_2 = 0.316$ $P = 1.358$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	7	18	22	22
Knowledge, Attitude and Practices on Malaria Among the Rural Communities in Aliero, Northern Nigeria (Singh et al., 2014).	Knowledge $P_1 = 0.909$ $P_2 = 0.20$ $P = 0.555$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	50	130	162	162
	Attitude $P_1 = 0.685$ $P_2 = 0.110$ $P = 0.740$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	3	7	8	8
	Practice $P_1 = 0.426$ $P_2 = 0.524$ $P = 0.738$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	21	54	67	67

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Table 3.1: Continued

Knowledge, Attitude and Practice Towards Malaria and Associated Factors in Areka Town, Southern Ethiopia: Community-Based Cross-Sectional Study (Kebede et a., 2017).	Knowledge $P_1 = 0.504$ $P_2 = 0.496$ $P = 0.752$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 0.842$	224	582	728	728
	Attitude $P_1 = 0.551$ $P_2 = 0.449$ $P = 0.7755$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 0.842$	17	44	55	55
Knowledge and utilization of insecticide treated mosquito nets among freely supplied households in Wonago Woreda, Southern Ethiopia (Dagne, G., & Deressa W, 2008).	Practice $P_1 = 0.667$ $P_2 = 0.323$ $P = 0.8385$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 0.842$	2	5	6	6
	Knowledge $P_1 = 0.969$ $P_2 = 0.153$ $P = 1.046$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 0.842$	201	523	654	654
	Attitude $P_1 = 0.705$ $P_2 = 0.60$ $P = 0.6525$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	431	1121	1401	1401
	Practice $P_1 = 0.705$ $P_2 = 0.467$ $P = 0.586$ $z_{1-\alpha/2} = 1.96$ $z_{1-\beta} = 1.282$	87	226	283	283

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For detailed calculation, check appendix

3.8 Sampling technique

3.8.1 Random Sampling

A two-stage random sampling technique was employed to select eligible pregnant women from the University of Nigeria Teaching Hospital (UNTH). First, the antenatal clinics within the hospital where pregnant women receive prenatal care were identified. Using a random sampling method, a predetermined number of antenatal clinics were selected from the list to ensure each clinic had an equal chance of being chosen.

In the second stage, the list of appointments for pregnant women attending the selected antenatal clinics during the study period was obtained. A systematic random sampling method was then used to select 283 eligible pregnant women aged 18 years and above from each selected clinic. We ensured that each eligible pregnant woman attending the clinic had an equal chance of being selected.

The sample size for each clinic was determined based on the proportion of pregnant women included. The sampling interval (Kth) was determined by dividing the total number of eligible participants by the sample size. This value was then used as the sampling interval; consequently, every Kth person was selected to take part in the study.

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Proportionate sample:

$$\frac{\text{Sample size } \mathbf{X} \text{ Eligible pregnant women}}{\text{Total number of registered pregnant woman}}$$

3.8.2 Randomization

Randomization was done to eliminate selection bias. A simple randomization technique, using a random sequence generator program by an independent project biostatistician, was used to randomly allocate the sample population into the intervention and control groups in a 1:1 ratio.

3.8.3 Concealment

The numbers generated from the randomization list were inserted into opaque sealed envelopes as unique codes. The codes were, for instance, "AX" for the first control group participant and "BX" for the first participant of the intervention group. These codes were maintained throughout the study for each participant and were used to track participants who left the study. There were 283 envelopes, with 141 for the intervention group and 142 for the control group. The envelopes were prepared by an independent person from the pharmacy department, who was not aware of the study. The allocation sequence was concealed from the research assistant enrolling participants using the sequentially numbered, opaque, sealed, and stapled envelope method. The envelopes were rendered impermeable to intense light with aluminum foil placed inside to prevent subversion of the allocation sequence. The participant's name and date of birth were written on the envelope and recorded on a separate sheet

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of paper. The allocation codes were made visible only after the corresponding envelopes were opened at the time of consultation, after the enrolled participants completed all their baseline assessments. The allotted treatment was given as stated by the information in the envelope, which was then kept in the participant's folder for subsequent follow-up.

3.8.4 Blinding

Blinding ensured that all pregnant women were unaware of which group they were assigned to during both enrollment and follow-up periods. This prevented the pregnant women from altering their behavior or responses based on knowledge of their group assignment. Additionally, the nurse educators involved in data collection or interactions with the pregnant women were also blinded to the group assignment to prevent bias. All nurse educators received standardized training on research ethics and confidentiality to ensure consistency in their interactions with the pregnant women and to minimize the likelihood of inadvertently influencing participants based on their group assignment.

Pregnant women from the control and intervention groups were scheduled to attend the clinic on alternate days. This prevented participants from different groups from coming into contact with each other during clinic visits, reducing the opportunity for information exchange or influence. Each pregnant woman had only one contact with the nurse educator, typically during a health education session. This minimized the opportunity for pregnant women to receive additional information or support from the nurse educator outside of the designated session. After each encounter with a pregnant

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woman, the nurse educator would sign an opaque coded card. This served as a record of the interaction and ensured that the pregnant woman could not have any further contact with that particular nurse educator, reducing the risk of additional information exchange or influence.

An opaque coded card is a tool used in research studies to maintain confidentiality and track participant interactions without revealing sensitive information. It typically consists of a card made of opaque or non-transparent material, such as heavy paper or plastic, to prevent others from seeing what is written on it. The term "coded" indicates that each card is assigned a unique identifier or code that corresponds to a specific participant or study condition. This code helps researchers keep track of participant interactions while protecting their privacy and anonymity.

In this study, after each encounter with the pregnant women, the nurse educator would sign the opaque coded card. This signature served as a record of the interaction without revealing any identifiable information about the participant. Additionally, the use of opaque material ensured that the contents of the card remained confidential and could not be seen by others, further protecting the privacy of the pregnant women. Opaque coded cards are an effective tool for maintaining confidentiality, tracking participant interactions, and ensuring the integrity of research studies, particularly in situations involving sensitive information or where participant anonymity is crucial.

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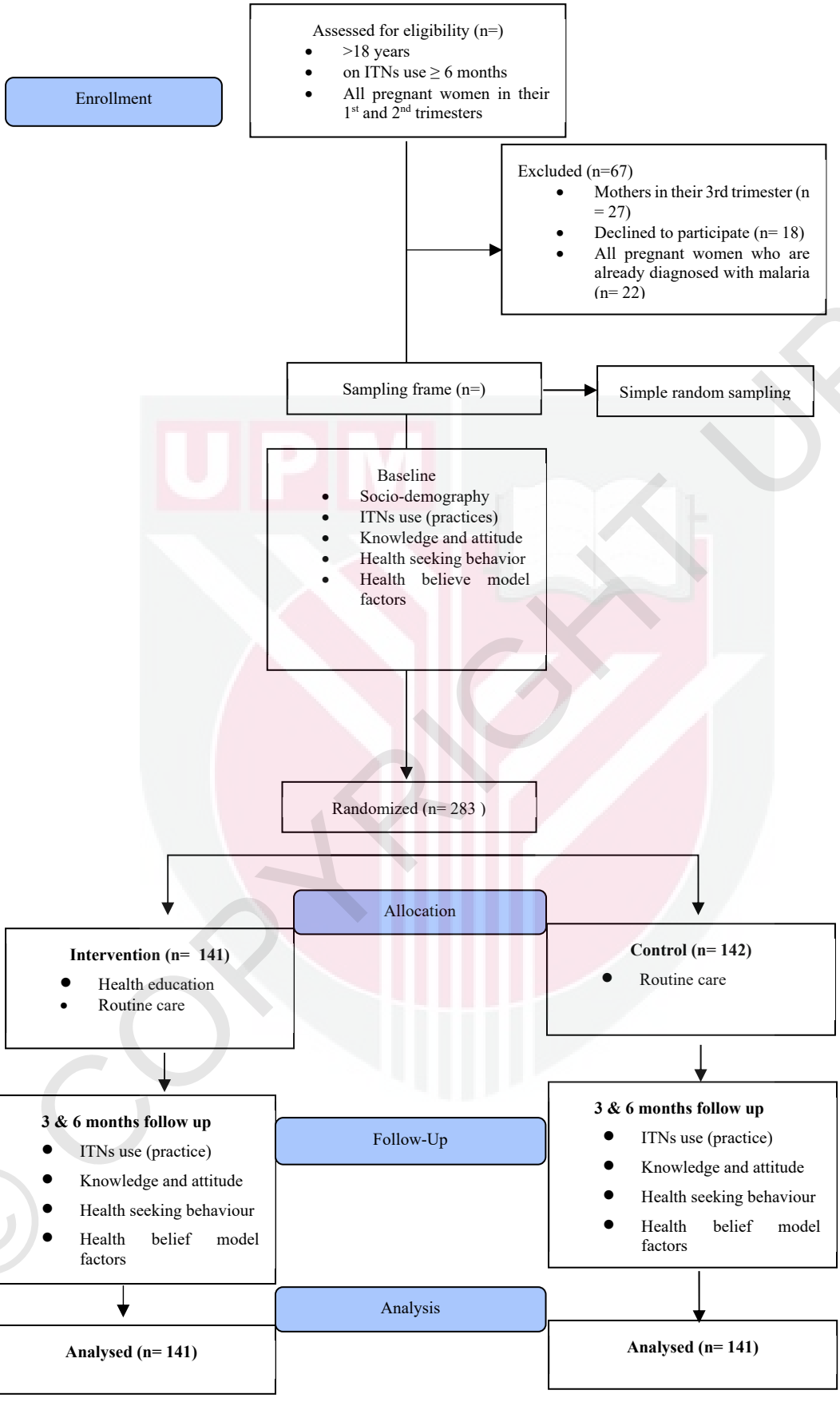


Figure 3.2: Study Flowchart adapted from CONSORT 2010

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3.8.5 Development of Health Education Module

A comprehensive literature review was conducted to understand existing research on the use of insecticide-treated nets (ITNs) among pregnant women, as well as studies that have applied the Health Belief Model (HBM) in similar contexts. This review helped identify the relevant determinants of ITN use and effective strategies for behavior change. The HBM provides a theoretical framework for understanding and predicting health-related behaviors by examining individuals' beliefs and perceptions. When developing a health education module for promoting the use of ITNs among pregnant women, the HBM guided the selection of content and strategies to address key determinants of behavior change. The key constructs of the HBM relevant to ITN use among pregnant women were identified:

1. Perceived Susceptibility: Pregnant women must perceive themselves as vulnerable to malaria infection during pregnancy and recognize the potential consequences for themselves and their unborn child.
2. Perceived Severity: They should perceive malaria during pregnancy as a serious threat to their health and the health of their baby, understanding the potential complications such as maternal anemia, low birth weight, and neonatal mortality.
3. Perceived Benefits: Pregnant women should believe that using ITNs can effectively reduce their risk of malaria infection and its associated complications.
4. Perceived Barriers: Recognize and address barriers that may hinder ITN use, such as cost, discomfort, perceived inconvenience, or misconceptions about ITNs.
5. Cues to Action: Provide cues or triggers to prompt action, such as educational messages, reminders from healthcare providers, or social norms supporting ITN use.
6. Self-efficacy: Enhance pregnant women's confidence in their ability to obtain, properly use, and maintain ITNs, addressing any perceived barriers or obstacles.

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The HBM constructs were identified and developed based on educational materials that effectively address each construct and provide information on the risk of malaria during pregnancy, its consequences, and the protective effects of ITNs. The module highlighted the benefits of ITN use in preventing malaria and protecting both the pregnant woman and her unborn child. The health education module addressed common barriers to ITN use, such as misconceptions about ITN efficacy, discomfort, or affordability, by providing accurate information and practical solutions. Several strategies were included in the module to enhance self-efficacy, such as demonstrating proper ITN hanging and maintenance techniques, addressing concerns about ITN durability and effectiveness, and providing support resources.

Before developing the health education materials, a survey on knowledge, attitude, and practice (KAP) was conducted to understand the baseline beliefs and behaviors of the pregnant women. The module content was validated by seeking input from experts in maternal and child health, malaria prevention, and health education. The experts reviewed the content to ensure accuracy, relevance, and cultural appropriateness. We acknowledged their contributions and expressed gratitude for their time and expertise.

3.9 Recruitment and implementation of the health education module among pregnant women

The health education intervention was carried out among pregnant women by the research assistant. The discussion on health education took about 30 minutes with the respondents. The presentation included the definition of health education, types of health education, the importance of health education, and the distribution of health education materials. This segment took about 45 minutes to complete. Group activities,

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such as brainstorming, lectures, role play, and group discussions on health education, were conducted with each pregnant woman and took approximately 30 minutes to complete. The research assistants reviewed all the activities conducted during the group sessions.

There were four sessions for the health education

Session 1: Health Education includes:

1. **Posters:** In recent years, the use of posters to communicate health messages has increased dramatically. Since a poster consists of pictures, symbols, and words, it effectively communicates health messages to both literate and illiterate people. Posters are particularly valuable for communicating with illiterate individuals as they can serve as visual aids. The main purposes of posters are to reinforce or remind people of a message received through other channels and to provide information and advice. For example, posters can advise pregnant women to learn more about malaria and the use of ITNs.
2. **Flip chart:** Flip charts are useful for presenting several steps or aspects relevant to a central topic, such as demonstrating the proper use of insecticide-treated nets or explaining how malaria is transmitted. When using a flip chart in health education, each page should be discussed thoroughly before turning to the next, ensuring that every pregnant woman understands each message. At the end, we review the first charts to reinforce the subject and help participants remember the ideas.
3. **Power Point Presentation:** The learning methods included group discussions, role-playing, and game evaluations.

Session 2: Basic Facts on Malaria and Insecticide-Treated Nets Among Pregnant Women:

The activities:

1. **Brainstorming:** The research assistant went through the material, actively involving the pregnant women through brainstorming, especially during the evaluation at the end of the course. Activities include a game on the impact of malaria on the immune system of pregnant women and a discussion on compliance with ITNs (30 minutes).

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2. **Group activity:** Discuss strategies to promote ITNs (30 minutes).
3. **Review:** 15 minutes
4. **Materials and Method:** Power point presentation, game, flip charts
5. **Activity:** Discuss factors affecting compliance with ITNs and measuring compliance.

Session 3: The Intervention

OBJECTIVE: To educate the research assistant about the theoretical concepts of the intervention (health education) and the intervention protocol.

Activities:

1. **Presentation:** The intervention based on HBM model (30 minutes).
2. **Group activity:** Role play on how to carry out health education (30 minutes).
3. **Review.** 15 minutes.

Total: 1 hour 15 minutes

Materials and Method: flip charts, pamphlets, posters, pictograms and pill boxes.

Intervention Framework: The intervention is based on the Health Belief Model (HBM), adapted from Rosenstock (1974). The HBM is a psychological model that attempts to explain and predict health behaviors by focusing on the attitudes and beliefs of individuals. The HBM model constructs were identified and discussed.

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Session 4: The Conclusion

Preventive measures, community norms, and how best they continue with what they have learnt spreading the information to their peers.

Time: 1 hour.

Materials: flip chart.

Method: In this session, all pregnant women were the primary focus. They provided feedback for each question related to knowledge, attitude, practice, preventive measures, and HBM constructs. Pregnant women were encouraged to ask questions, seek advice based on given scenarios, and brainstorm with the research assistant to arrive at reasonable conclusions.

3.10 Selection criteria

Eligibility criteria were based on the selection of study participants, and only pregnant women who met these criteria were included in the study. However, those who did not meet the listed criteria were excluded from the study.

3.10.1 Inclusion criteria

1. All pregnant women aged 18 years and above, registered for antenatal clinic at UNTH, Enugu State, Nigeria.
2. All pregnant women in their 1st and 2nd trimesters.
3. All pregnant women with a past history of malaria.

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3.10.2 Exclusion criteria

1. Pregnant women in their 3rd trimester (reason: mothers in the 3rd trimester cannot be followed up for 6 months because majority of them are close to their expected date of delivery and may not be present at the hospital during follow-up).
2. All pregnant women already diagnosed with malaria were excluded from the study.

3.11 Study Instrument

A validated, pre-tested, and self-administered questionnaire was used in this study at both baseline and follow-up home visits. Validation involved assessing whether the questionnaire accurately measures its intended variables. The questionnaire was re-tested by administering it to 30 pregnant women from a different private hospital to identify and rectify any ambiguities or issues with the questions.

The questionnaire covered various aspects related to:

- Knowledge about malaria and the use of insecticide-treated nets (ITNs).
- Attitudes towards the use of ITNs and malaria.
- Practices related to malaria preventive measures.
- Health-seeking behaviors.
- Constructs of the Health Belief Model.
- Compliance/adherence to the use of ITNs.

The health education intervention aimed to increase knowledge and awareness about malaria and its prevention methods, which was the primary intervention of the study.

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The questionnaire was administered in both English and Igbo languages to accommodate pregnant women proficient in either language. For those who could not read, the questionnaire was read aloud to ensure language barriers did not affect their participation.

Data was collected at three points in time: before the health education intervention (baseline), at 3 months (during the intervention), and at 6 months (follow-up), allowing researchers to assess the intervention's impact over time.

3.11.1 Baseline and follow-up questionnaire

This consisted of seven sections, with data collected for baseline measurements and the same questionnaire used at 3 months post-intervention and 6 months follow-up. The ITNs questionnaire gathered data on:

- Current knowledge, attitudes, and practices regarding malaria and ITNs.
- Health-seeking behaviors.
- Health behavior model constructs.
- Compliance/adherence with malaria preventive measures using ITNs over the past three and six months.

Section A: Demographic profile of pregnant women, including age, ethnicity, residence (city/village), marital status, educational level, household monthly income, and employment status.

Section B: Knowledge of malaria and ITNs, with 18 questions offering options of "True", "False", and "I don’t know" (denoted by "T", "F", and "DK"), and open options

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to choose more than one answer. The questionnaire format was adopted from previous studies (Humphrey et al., 2010; Adibe et al., 2017; M'mauta, D. K. 2014).

Section C: This section consists of 18 statements measuring attitudes towards Malaria and ITNs using a 5-point Likert scale coding: "strongly disagree [1]", "disagree [2]", "unsure [3]", "agree [4]", "strongly agree [5]". The format was adopted from Adibe et al., 2017.

Section D: This section comprises 12 questions assessing practices related to malaria preventive measures and ITN use. Responses are recorded on a 5-point Likert scale: "never [1]", "rarely [2]", "every once in a while [3]", "sometimes [4]", "almost always [5]". The questionnaire format was adopted from Adibe et al., 2017.

Section E: This section includes 11 statements on health-seeking behavior to predict respondents' healthcare and behavioral changes in response to illness. The format was adopted from Minne, A. (2010).

Section F: This section contains 28 questions on constructs of the health behavior model, utilizing a 5-point Likert scale coding: "strongly disagree [1]", "disagree [2]", "unsure [3]", "agree [4]", "strongly agree [5]". The questionnaire format was adopted from Sheeran, P., & Abraham, C. (1996).

Section G: This section consists of 8 questions assessing compliance/adherence to the use of insecticide-treated bed nets. The format was adopted from Ovadje, L. (2014) based on adherence to the Use of Insecticide-Treated Bed Nets by Nigerian Children.

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3.12 Quality control of study instrument

Generally, the validity of an instrument refers to how accurately it measures what it is intended to measure. The study instruments in this research were tested for both content validity and face validity.

3.12.1 Content validity

Content validity involved verifying all questions to systematically examine whether the test content is representative of the sample to be measured. In other words, it assesses whether the instrument measures the intended variables of the research and represents the content of the study accurately. In this study, all instruments were reviewed by two panels of experts from the Department of Public Health at the University of Nigeria, Nsukka. These panels included experts from the fields of health education and promotion, behavioral intervention, and infectious diseases in public health. The instruments were adopted/adapted from English versions and translated. Since this study was conducted in Enugu State, Nigeria, where the most spoken languages after English are Pidgin/Broken English and Igbo, the questionnaire was translated into both Pidgin/Broken English and Igbo. Bilingual experts (English and Igbo) from the Department of Modern Languages at the Institute of Management and Technology, Enugu State, Nigeria, assisted in the forward and backward translation of the questionnaires to ensure that the original content and message were preserved across the translation process.

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A review of the back translation was done by another set of Igbo language experts for validation, with adjustments made as needed. Thereafter, face validity (pre-testing) was conducted.

3.12.2 Face validity

Face validity establishes whether the measure under study seems to assess the intended construct. The face validation of the questionnaire was conducted using 10% of other pregnant women with similar demographic backgrounds within the study population (WHO, 2017). These women were randomly selected to answer all items in the questionnaire (but were not part of the main study).

For each section of the questionnaire, the respondents were asked to comment on the clarity of the language, its appropriateness, level of understanding, comprehensiveness of the questions, and the order in which they were arranged (format of questioning). Corrections and modifications to the questionnaire were made after face validity according to the recommendations of the chosen respondents.

3.13 Content validity of Module for intervention

3.13.1 Intervention Protocol

Health education intervention in addition to routine clinic care was used in this RCT as a means for improving ITN use among pregnant women in the intervention group, while the control group received only their normal routine clinic care. A training

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module was developed based on information on healthcare-seeking behavior and patients' illness responses (Luyiga, 2013) to ensure it could achieve the desired results. The module was validated for content validity. Validation was carried out by experts from the fields of epidemiology, infectious diseases, and health promotion from the Department of Public Health at the University of Nigeria, Nsukka. These experts, with their vast knowledge and experience in malaria research and treatment, provided valuable insights into the appropriateness of the module's content regarding language, confidentiality of health education sessions, and their perception of how tolerable the intervention would be for pregnant women. Their inputs and recommendations were used to improve the content of the module, particularly regarding confidentiality and language. Of utmost importance was their review of the theoretical concept used in this study, which was the Health Belief Model, and its relation to the present research and intervention.

Upon completion of the module validation, pre-testing was conducted among two nurses in the clinic who were not part of the study. This ensured that the research assistants understood the module's content. They were educated on the research objectives and their views regarding the perceived benefits of delivering the intervention.

3.13.2 Training of the research assistants

The research assistants involved in this process were selected based on the following criteria:

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Experience: Must have worked in the Antenatal Care Unit of UNTH for at least one year to ensure adequate experience and knowledge of malaria treatment and care.
Training: Must be trained in counseling.

A two-day training session was conducted for the selected nurses (who served as research assistants) using the developed health education intervention training module. Each day's training lasted for three hours.

A total of four research assistants from the Antenatal Care Unit at UNTH were trained. The selection was based on volunteerism and inclusion criteria. The first session covered aspects of health education, including types, importance, and materials. It ended with a role play and discussion on health education. The research assistants were taught on how the pregnant women will participate in role-play scenarios where they learned how to properly install and maintain ITNs in their sleeping areas. This involved practicing techniques for hanging the net securely, tucking it under the mattress, and ensuring there were no gaps where mosquitoes could enter. They were also advised on how to teach the pregnant women on how to simulate a regular inspection to check for tears or holes in the net and learned how to repair them. Role-playing focused on incorporating ITN use into the bedtime routine and advocating for ITN usage within the broader community. Research assistant were trained to teach the pregnant women to be developed problem-solving skills to overcome barriers to ITN usage through these scenarios.

The second session covered the basics of ITN distribution, goals for ITN levels, barriers to usage, consequences of non-usage, methods to monitor ITNs, and strategies

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and tools to enhance ITNs and malaria. It included discussions on strategies to promote ITNs. The third session covered the intervention protocol, including role-playing on how to conduct health education, frequently asked questions, and their answers.

Research assistants were chosen base on the following characteristics:

Research assistants can spend more time on data collection tasks, enabling the researcher to concentrate on other aspects of the study, such as designing the study, analyzing data, and interpreting the results. This streamlines the research process and boosts productivity. Employing a research assistant can be more economical than having the researcher spend their time on data collection. This allows for efficient resource allocation by utilizing the assistant's skills and expertise without incurring the full cost of their salary. Research assistants contribute specialized skills to the data collection process, such as proficiency with specific research methods, data collection tools, or participant recruitment strategies. Their expertise improves the quality of data collection and reduces errors or biases. Having a research assistant collect data diminishes potential biases that could occur if the researcher has personal or professional ties to the participants. Research assistants maintain a more objective perspective, reducing the impact of researcher bias on the data collection process.

3.13.3 Health education intervention

To educate pregnant women on the use of insecticide-treated nets (ITNs) using the Health Belief Model (HBM) as the guiding framework, a systematic approach was adopted. Here is a step-by-step explanation of how pregnant women were educated on

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ITN usage, incorporating the principles of the HBM, and how they were gathered in the hospital setting.

Before the intervention, an assessment was conducted to understand pregnant women's perceptions of malaria risk during pregnancy and barriers to ITN usage. This included exploring their beliefs about the severity and susceptibility to malaria, perceived benefits of ITN usage, and perceived barriers such as cost, accessibility, and discomfort. Educational materials were developed, emphasizing the severity of malaria during pregnancy, the benefits of ITN usage for maternal and fetal health, and practical strategies for overcoming barriers to ITN usage. The messages within the educational materials were tailored to resonate with the target population's beliefs and attitudes. They highlighted the risk of malaria transmission in the local context, the effectiveness of ITNs in preventing malaria, and strategies for overcoming barriers such as misconceptions or perceived inconvenience.

Pregnant women were gathered in the hospital where they received the educational intervention on ITN usage during their antenatal care clinics. The intervention group received the educational intervention and their normal routine clinic care, while the control group received only their normal routine clinic care. Interactive educational sessions were conducted to engage pregnant women and facilitate learning. These sessions included group discussions, demonstrations of ITN installation, role-playing scenarios, and question-and-answer sessions to address concerns and misconceptions. During the educational sessions, emphasis was placed on building pregnant women's confidence in their ability to use ITNs effectively. Practical demonstrations, hands-on practice, and problem-solving exercises were incorporated to enhance self-efficacy

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and overcome barriers to ITN usage. As part of the intervention, ITNs were distributed to pregnant women free of charge to ensure accessibility. Clear instructions on ITN usage and maintenance were provided along with the distribution of nets. Throughout the intervention, pregnant women's knowledge, attitudes, and behaviors related to ITN usage were monitored and evaluated. This allowed for the ongoing assessment of the intervention's effectiveness and adjustments to improve its impact.

3.13.4 Process of translation of questionnaire

According to WHO (2017), the translation process involved four steps: forward translation, expert panel back translation, pre-testing and cognitive interviewing, and final version. First, a translator, preferably a health professional familiar with the terminology of public health and malaria and with interview skills, was tasked with translating the questionnaire into Igbo. The use of natural and acceptable language was ensured, as well as conceptual rather than literal translations.

The next stage involved a bilingual (in English and Igbo) expert panel who served as editor-in-chief. The objective of this step was to resolve any inadequate expressions/concepts of the translation and any divergences between the forward translation and existing or comparable previous versions of the questions. The panel included the original translator, experts in health, and an expert knowledgeable in instrument development and translation.

The next step was back translation. Using the same approach as in the first step, the instrument was translated back to English by an independent translator with a major

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qualification in English and no knowledge of the questionnaire. Emphasis in the back translation was on conceptual and cultural uniformity, not just linguistics. The expert panel discussed and rectified any noted discrepancies. Problematic words or phrases that did not completely capture the concept addressed by the original item were brought to the attention of the lead researcher, who then reported to the relevant authorities.

The next step was to pretest the translated instrument among 20 respondents enrolled in the antenatal clinic at Enugu State Teaching Hospital (ESTH), Nigeria, but not participating in the main study. According to Sudman (1983), the use of 20-50 cases in a pretest study is usually sufficient to unearth major flaws in a questionnaire before any further damage to the main study. The respondents were encouraged to air their views regarding the instrument, their understanding of the questions, and their recommendations, which were discussed among the panel of experts. After the final version was produced, the itinerary of the translation process was documented.

3.13.5 Reliability

Reliability refers to the extent to which a questionnaire, test, observation, or any measurement procedure yields the same result on repeated trials. It can also be said to be the consistency of scores over time or across raters. The reliability of the pretested questionnaires was ascertained using the test-retest reliability test for questions with a nominal scale, while the questions with a Likert scale were assessed using internal consistency reliability. An interval of 10 days was used between the pretest and the re-test.

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Below is a schematic diagram of the development and validation of the questionnaire:

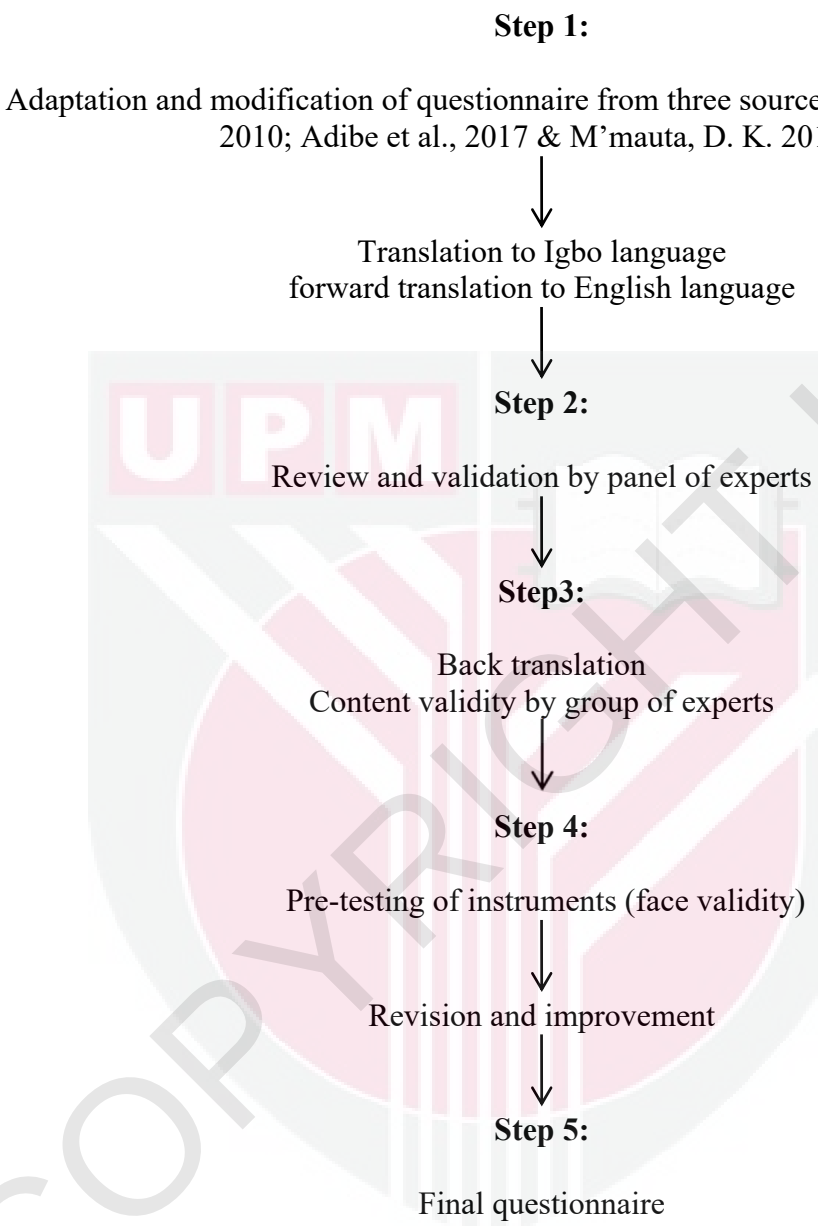


Figure 3.3: Schematic diagram of the development and validation of the questionnaire

3.14 Data collection

Data was collected from July 2022 to December 2022. The selected pregnant women were educated on the purpose and procedures of the trial by the research assistants

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during their antenatal clinic visits. An informed consent form was given to the pregnant women who willingly agreed to participate in the study. They were asked to read and sign the form. Afterwards, the validated questionnaire was administered to the pregnant women at baseline to collect their data. It was filled either in English or Igbo, and the research assistants read it out to those who could not read but understood either language. The research assistants ensured privacy and confidentiality during the data collection process. They scheduled follow-up appointments with the pregnant women at 3 months and 6 months.

The research assistants administered the same validated questionnaire used at baseline to collect data on the variables of interest after the 3-month intervention period face-to-face. They ensured consistency in data collection procedures to maintain the validity and reliability of the findings. The research assistants administered the validated questionnaire again to collect data on the same variables measured at baseline and 3 months post-intervention. They recorded any changes in pregnant women's health outcomes over the 6-month period, obtaining information on patients' malaria status from their folders.

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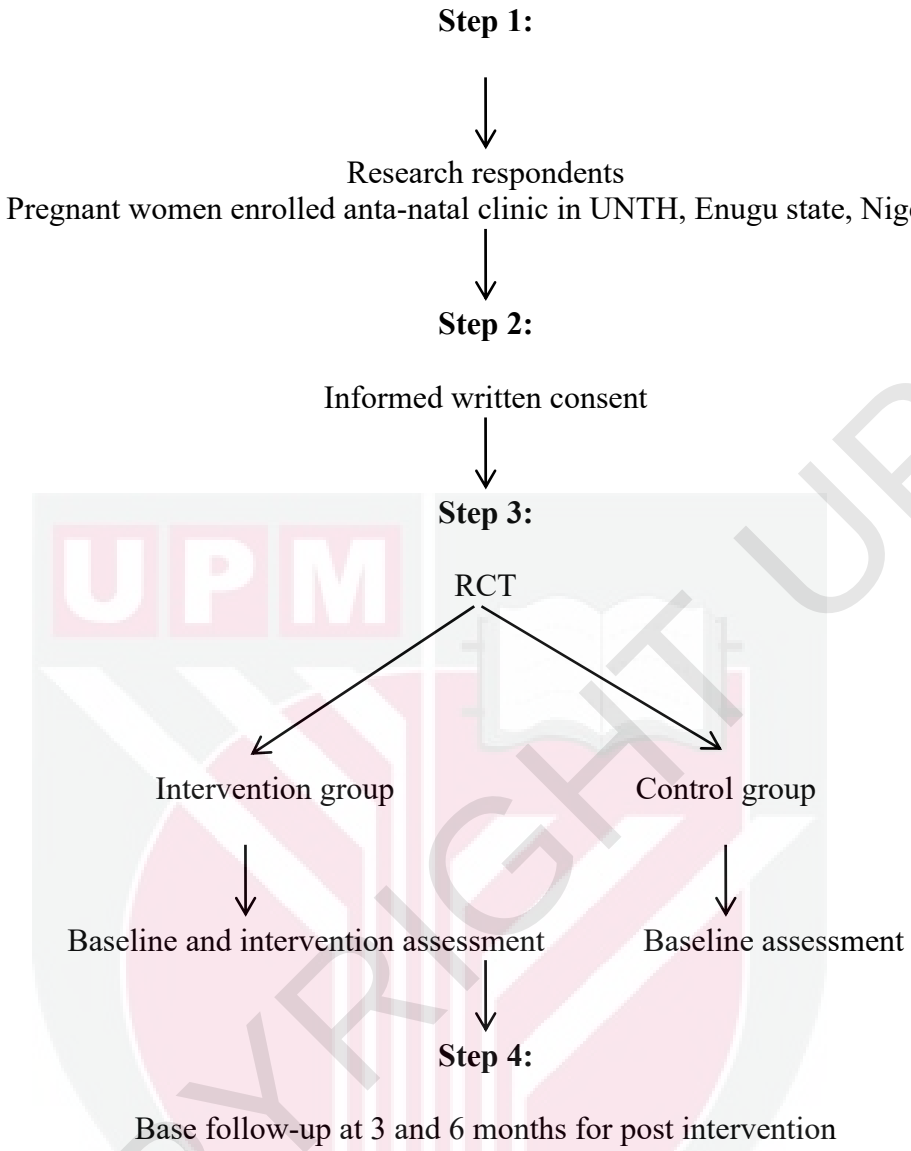


Figure 3.4: Flow chart for data collection

3.15 Pre-test

The purpose of the pre-test was to identify any potential issues with the questionnaire, such as confusing or ambiguous questions, and to assess its clarity, comprehensiveness, and relevance among pregnant women in the study. A pre-test was conducted by administering the questionnaire to a diverse group of pregnant women who attended the antenatal clinic at Royal Hospital, Enugu State, Nigeria.

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Royal Hospital is a private hospital in Enugu State. The researcher provided clear instructions on how to complete the questionnaire and any necessary guidance to ensure accurate responses. The pregnant women were observed by the researcher as they completed the questionnaire to identify any difficulties they encountered, such as confusion about specific questions or uncertainty about how to respond. A debrief session was conducted with the pregnant women after they completed the questionnaire to gather additional insights and clarify any points of confusion. Pre-test results identified any modifications needed in the study instrument. The researcher made the necessary modifications to the words that were not understood by the pregnant women.

3.16 Ethics and Consent

Ethical clearance was first obtained from the ethics committee Jawatankuasa Etika Universiti Putra Malaysia (JKEUPM). Another ethical approval was obtained from the local Ethics Committees at UNTH Enugu, Nigeria. Informed consent forms were explained and administered to all pregnant women willing to participate in the survey. These documents contained information about the research: the purpose and procedures, benefits, risks, confidentiality, how the data and results obtained would be used, and the freedom to withdraw at any point during the research. Also included were the name and contact of the researcher. All documents were in English.

3.17 Data processing and analysis

Data collected was collated, checked, cleaned, and analyzed using the Statistical Package for Social Sciences (SPSS) software, version 23. The patient selection process

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and flow throughout the study were summarized and presented in a flow diagram. The analysis results of mothers' socio-demographic and baseline outcome variables (both primary and secondary) were presented using descriptive summary measures: expressed as mean (standard deviation) or median (minimum-maximum) for continuous variables, while number (percent) was used for categorical variables.

The intention-to-treat principle was adopted to analyze all outcomes where needed. This means that data from participants was analyzed according to the group to which they were initially randomized, despite not receiving the allocated intervention. According to Fisher et al. (1990), one of the major practical problems that investigators usually encounter in RCTs, apart from the dropout of study subjects, is non-adherence to instructions by study subjects. Consequently, RCTs habitually suffer from two major complications: non-compliance and missing outcomes. Hypothetically, the intention-to-treat (ITT) is a statistical concept considered a solution to this problem. ITT analysis involves including every subject who is initially randomized according to randomized treatment assignment. ITT overlooks issues of non-compliance, protocol deviations, withdrawal, and anything that happens after randomization; therefore, it is commonly described as "once randomized, always analyzed." However, as a result of dilution due to non-compliance, the estimate of treatment effect is generally conservative in ITT analysis, hence the introduction of heterogeneity since dropouts and compliant subjects are mixed together in the final analysis (Fisher et al., 1990). As such, in this study, it was ensured that completed outcome data were available for all randomized subjects. Care was taken to minimize missing responses and to continue to follow up with those who withdrew from treatment.

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Table 3.2: Summary of analyses that was been conducted

Variables	Analyses
Descriptive	Independent T-Test
Socio-demography	
To determine the changes within intervention group and control group from baseline to 3 and 6 months post intervention	Repeated Anova
To compare the changes between intervention group and control group at 3 and 6 months post intervention	Repeated Anova
IV and all covariates	GEE- General Estimating Equation

3.18 Study variables

Covariates

i. Age
ii. Location/address (rural or urban)
iii. Marital status
iv. Education level
v. Household monthly income
vi. Employment status

Outcome Variables

i. Knowledge of malaria and ITN use
ii. Attitude towards malaria and ITN use
iii. Practices towards malaria and ITN use
iv. Health-seeking behavior
v. Health Belief Model factors

3.19 Operational definition of variables

Age: Age in this study referred to the age of participants at the time data was collected.

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Ethnicity: Ethnicity referred to the cultural group of the respondent based on self-report. Ethnicity was grouped into: Igbo, Hausa, Yoruba, Ibibio, Efik, or other ethnic groups (specified by the respondent).

Residence - City/Village: Residence referred to a respondent's home, i.e., the place where she lives. It could be rural or urban. Rural residence was defined as residence in an area outside a metropolitan area, while urban residence referred to living within a metropolitan area in Nigeria.

Marital Status: Marital status was taken as self-report of being single, married, divorced, or widowed.

Educational Level: Educational level referred to the highest level of education that a person had successfully completed before the data collection.

Household Monthly Income: Household income is a measure of the combined incomes of all people sharing a particular household or place of residence. It includes every form of income, e.g., salaries and wages, retirement income, near-cash government transfers like food stamps, and investment gains.

Employment Status: Employment status is the status of a worker in a company on the basis of the contract of work or duration of work done. A worker may be a full-time employee, part-time employee, or an employee on a casual basis. S/he could be employed temporarily for a specific project only or on a permanent basis.

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Knowledge: In this study, knowledge was assessed using a knowledge questionnaire. Knowledge refers to the facts and information on malaria and the use of insecticide-treated nets and their benefits acquired by pregnant women through experience. The questionnaire consisted of 18 items with options of "True," "False," and "I don't know." This was scored by allocating one point for a correct answer and zero for a wrong answer. Reverse scoring was used for questions 1, 7, 11, 13, 16, and 17. The highest possible score was 18, while the lowest possible score was 0. A composite score was computed for each respondent. During data analysis, exploratory data analysis was carried out to determine the mean score, which was used as a cut-off point for good and poor knowledge according to M'mauta (2014).

Attitude: This was assessed using attitude questions. In this study, attitude referred to participants' feelings about the use of insecticide-treated nets and malaria. If she evaluated it as a negative or positive attitude. The questions were modified into 18 statements (14 positive statements and 4 negative statements) and a 5-point Likert scale coding ranging from "strongly disagree [1]," "disagree [2]," "unsure [3]," "agree [4]," "strongly agree [5]" was used to measure the attitude of the respondents. The range of possible scores was 18 to 90. The negative statements were coded in reverse during analysis. Higher mean scores indicated a positive attitude of pregnant women. Mean scores were then categorized into two groups towards malaria and ITN use according to Adibe et al. (2017).

Practices: This was assessed using practice questions. In this study, practices referred to respondents' practices regarding the use of insecticide-treated nets. The questions were modified into 12 statements (8 positive statements and 3 negative statements)

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and a 5-point Likert scale coding ranging from “never [1],” “rarely [2],” “every once in a while [3],” “sometimes [4],” “almost always [5]” was used to measure the practices of the respondents regarding bed net use. The range of possible scores was 11 to 55. The negative statements were coded in reverse during analysis. Higher mean scores indicated high practices of pregnant women regarding the use of insecticide-treated nets. Mean scores were then categorized into two groups of high practice and low practice towards the use of insecticide-treated nets according to Adibe et al. (2017).

Health-Seeking Behavior: Health-seeking behavior was preceded by a decision-making process governed by individual and/or household behavior, community norms, and expectations as well as provider-related characteristics and behavior. Care-seeking behavior can be defined as any action undertaken by individuals who perceive themselves to have a health problem or to be ill for the purpose of finding an appropriate remedy. The questions were modified into 11 statements to suit this study.

Health Belief Model: The Health Belief Model (HBM) is a psychological model that attempts to explain and predict health behaviors by focusing on the attitudes and beliefs of individuals. This was assessed by using HBM questions such as:

i. Perceived susceptibility:

Perceived susceptibility is one of the influential factors that motivate people to practice healthier behaviors. It refers to individuals’ own beliefs regarding the risk of contracting an illness; the greater the perceived susceptibility, the greater the likelihood of engaging in behaviors to decrease the susceptibility.

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ii. Perceived severity:

This referred to individuals' beliefs about the severity or the consequences the disease might have on them if actions are not taken. Perceived severity is also shaped by previous experiences with the illness and can include assessment of the health, social, and economic consequences of acquiring the disease. In this study, people needed to perceive serious negative consequences from malaria to opt for health-seeking behavior and continue with care.

iii. Perceived benefits:

This signifies an individual's own judgment on the advantages of adopting and continuing with the proposed actions to reduce the severity or consequences of the illness. In this context, people with malaria needed to feel that the benefits of using insecticide-treated nets were greater than if they did not use them; they needed to feel certain that adopting ITN practices would have favourable outcomes.

iv. Perceived barriers:

This referred to an individual's evaluation of what would stop them from adopting the new behaviour. If people perceived obstacles to using ITNs to prevent malaria, it was less likely that a decision for ITN usage would be made.

v. Self-efficacy:

This is realized when perceived benefits outweigh perceived barriers. People are normally hesitant to attempt new behaviour unless they believe they can do it.

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vi. Cues to action:

These relate to information and ideas about malaria that people have and the sources thereof, whether internal (symptoms, past experiences) or external (health care workers, friends, relatives, mass media), which influence their health-seeking behaviour and continuity with care.

In this study, it was assessed using a question on constructs of the Health Belief Model. The questionnaire consisted of 28 items involving a 5-point Likert scale coding ranging from "strongly disagree [1]," "disagree [2]," "unsure [3]," "agree [4]," "strongly agree [5]."

Compliance/adherence with preventive measures towards using insecticide-treated Nets: In medicine, compliance (also adherence) describes the extent to which the patient correctly follows medical instructions. Most commonly, it refers to medication or drug compliance, but it can also apply to other situations such as medical device use, self-care, self-directed exercises, or therapy sessions. This section was assessed using 9 questions on compliance/adherence to the use of insecticide-treated bed nets. It was adopted from Ovadje (2014), which was based on adherence to the Use of Insecticide-Treated Bed Nets by Nigerian children.

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CHAPTER 4

RESULTS

4.1 Overview

The study was implemented among pregnant women aged 18 years and above in one selected hospital in Ituku-Ozalla Enugu, Enugu State, Nigeria. This chapter presents the results of the study, including the study response rate, normality test, descriptive statistics, and inferential statistics.

4.1.1 Response Rate

A total of 350 pregnant women were assessed for eligibility. Of these, 67 women were excluded: 27 did not meet the inclusion criteria, 18 declined to participate, and 22 were transferred to other hospitals for emergency care and did not consent.

A total of 283 women consented to participate in the study, with 141 assigned to the intervention group and 142 to the control group. At baseline, 100% of participants in both groups completed the questionnaire. At 3 months, 136 (98%) respondents in the intervention group and 139 (99%) in the control group completed the questionnaire. At the 6-month follow-up, 132 (96%) respondents in the intervention group and 137 (98%) in the control group completed the questionnaire.

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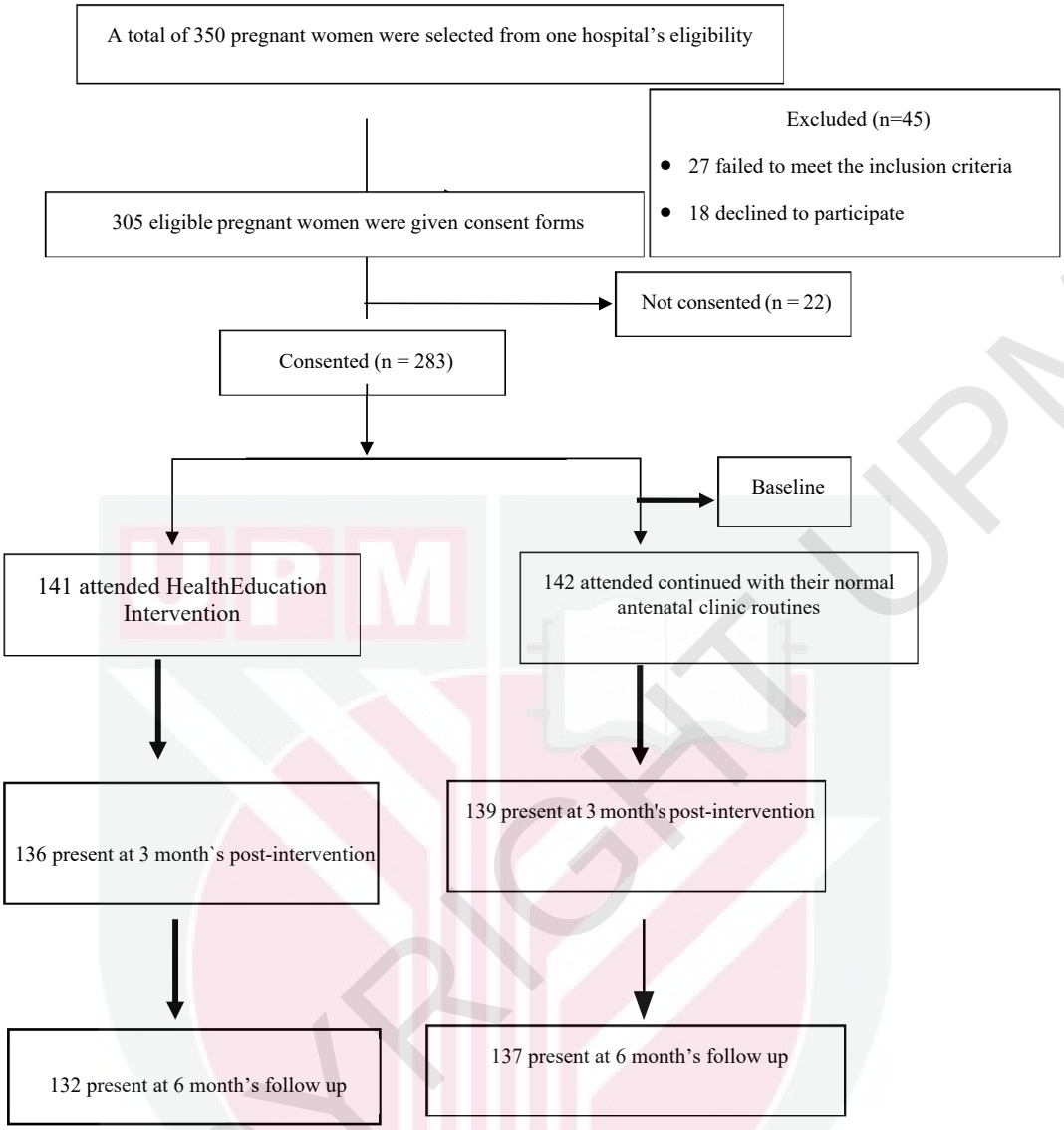


Figure 4.1: Flow of respondent's recruitment and retention during the study

4.1.2 Normality test

Normality was assessed using the Shapiro-Wilk Test for continuous variables such as knowledge, attitude, practice, health-seeking behaviour, and health belief model construct scores at baseline, post-intervention, and follow-up. The internal consistency reliability of the questionnaire was assessed using Cronbach's alpha coefficient, which yielded a value of 0.677. This indicates moderate internal consistency reliability for the scale. While this value is slightly below the commonly accepted threshold of 0.70

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for acceptable reliability, it suggests some degree of consistency among the items in the questionnaire. However, it also indicates room for improvement in terms of enhancing the scale's internal consistency.

Strategy for Analysis

Intention-to-treat analysis was employed, and all respondents randomized were included in the analysis by imputing the mean of the responses at 3 months and 6 months post-intervention (James D. Dziura, Lori A. Post, Qing Zhao, Zhixuan Fu, 2013). The proportion of respondents with missing data due to attrition was 4% in the intervention group and 2% in the control group.

4.2 Comparison of baseline socio-demographic characteristics between intervention and control group

Table 4.2 presents the results of the baseline comparison of socio-demographic characteristics between the intervention group and the control group. The median age of the respondents was 2.61 (1.075). It was observed that the majority were married (85.5%), with only 0.7% divorced. Most resided in urban areas (92.9%), while 7.1% lived in rural areas. A significant portion of the respondents were unemployed (60.1%), with 39.6% employed. The majority of the respondents were from the Igbo tribe (86.8%), followed by the Ibibio tribe (4.6%). Respondents with secondary education as their highest level of education had the highest percentage (68.6%), while those with primary education made up 3.2%. Most respondents earned between #10,000 - #50,000 (76.7%).

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There was no statistically significant association between the intervention and control groups for all socio-demographic characteristics at baseline.

Table 4.1: Comparison of baseline socio-demographic characteristics between intervention and control group (N=283)

Variables	Intervention		Control		Total X^2/t	p value
	n (%)	Mean (SD)	n (%)	Mean (SD)	n (%)	
Age (years)		2.61 (1.037)		2.60 (1.120)	**0.040**	0.247[a]
18-22	3 (2.1)		17 (12.1)		20 (7.1)	
23-27	91 (64.1)		63 (44.6)		154 (54.4)	
28-32	20 (14.0)		30 (21.3)		50 (17.7)	
33-37	14 (9.9)		20 (14.2)		34 (12.0	
38 above	14 (9.9)		11 (7.8)		25 (8.8)	
Ethnicity						0.086[b]
Ibibio	2 (1.4)		11 (7.8)		13 (4.3)	
Efik	1 (0.7)		8 (5.7)		9 (3.2)	
Hausa	4 (2.9)		3 (2.1)		7 (2.5)	
Igbo	128 (90.1		117 (83.0)		245 (86.8)	
Yoruba	7 (4.9)		2 (1.4)		9 (3.2)	
Residence						0.488[b]
City	130(91.5)		133 (94.3)		263 (92.9)	
Village	12 (8.5)		8 (5.7)		20 (7.1)	
Marital status						0.213[b]
Single	4 (2.8)		9 (6.4)		13 (4.6)	
Married	120(84.5		122 (86.5)		242 (85.5)	
Widowed	17 (12.0)		9 (6.4)		26 (9.2)	
Divorced	1 (0.7)		1 (0.7)		2 (0.7)	
Education level						0.218[b]
Non-formal	8 (5.6)		6 (4.3)		14 (4.9)	
Primary	1 (0.7)		8 (6.3)		9 (3.5)	
Secondary	108 (76.1		86 (61.0)		194 (68.6)	
Tertiary	25 (17.6)		40 (28.4)		65 (23.0)	
Monthly income						0.091[b]
N10k – N50k	121(76.2)		96 (68.1)		217 (76.7)	
N51k – N100k	19 (22.4)		33 (23.4)		52 (18.3)	
N101k–N200k	1 (0.7)		12 (8.5)		13 (4.6)	
N201k above	1 (0.7)		0 (0.0)		1 (0.4)	
Employment status						0.846[b]
Employed	39 (27.5)		74 (52.5)		113(39.6)	
Unemployed	103(72.5)		67 (47.5)		170 (60.4)	

*Significant at $p<0.05$

[a] = t test

[b] =chi square

To determine the changes within intervention group from baseline to 3 and 6 months post intervention for Practice, Knowledge and Attitude of Respondents at Baseline

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4.3 Practice of Respondents at Baseline

The baseline practice scores of the respondents are shown in Table 4.5. The intervention group had a higher median practice score (33.00±7.1) compared to the control group (25.00±5.7), although there was no statistically significant difference between the two groups. At baseline, the majority of respondents (203, 71.7%) had poor practices towards ITN use.

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Table 4.2: Practice Towards ITNs use at Baseline

Items		Scale	Intervention N (%)	Control N (%)	Total N (%)	X^2	p-value
1.	How often do you receive insecticide treated nets from the health center?	Never	42(24.5)	32(22.9)	74(26.1)	0.442	0.223
		Rarely	20(11.7)	22(13.9)	42(14.8)		
		Every once in a while	11(9.5)	8(4.5)	19(6.4)		
		Sometimes	68(53.8)	79(58.2)	147(52.3)		
		Almost always	1(0.5)	0(0.5)	1(0.4)		
2.	How frequently do you neglect to use your insecticide-treated nets?	Never	46(24.1)	21(15.5)	67(13.7)	0.001	0.171
		Rarely	2(3.5)	5(3.5)	7(2.5)		
		Every once in a while	50(37.7)	76(49.8)	126(54.5)		
		Sometimes	13(16.1)	19(15.9)	32(11.3)		
		Almost always	31(18.6)	20(15.3)	51(18.0)		
3.	How often do you wash your mosquitoes net?	Never	42(19.1)	8(4.9)	50(17.7)	0.001	0.033
		Rarely	0(2.0)	4(2.0)	4(1.4)		
		Every once in a while	92(63.4)	96(72.6)	188(66.4)		
		Sometimes	4(7.0)	20(12.0)	24(8.5)		
		Almost always	4(8.5)	13(8.5)	17(6.0)		
4.	How often do you check for holes in your nets?	Never	42(26.1)	10(7.9)	52(18.4)	0.001	0.069
		Rarely	57(38.7)	68(49.3)	125(44.2)		
		Every once in a while	10(21.1)	32(24.9)	42(14.8)		
		Sometimes	6(2.5)	15(5.5)	21(7.4)		
		Almost always	27(11.6)	16(12.4)	43(15.2)		
5.	How often do you Repair your nets?	Never	49(27.1)	15(11.8)	64(22.6)	0.039	0.065
		Rarely	6(14.0)	22(15.0)	28(9.9)		
		Every once in a while	7(8.5)	10(8.5)	17(6.0)		
		Sometimes	53(32.2)	71(51.8)	124(43.8)		
		Almost always	27(18.2)	23(12.9)	50(17.7)		
6.	How often do you use anti-mosquito spray in your hose	Never	0(1.0)	2(1.0)	2(0.7)	0.168	0.124
		Rarely	50(32.2)	58(46.8)	108(38.2)		
		Every once in a while	10(11.5)	13(11.5)	23(8.1)		
		Sometimes	30(20.6)	33(17.4)	63(22.3)		
		Almost always	52(34.7)	35(23.3)	87(30.7)		

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Table 4.2: Continued

7.	How often do you clean/cut brushes around your house	Never	0(0.0	0(0.0)	0(0.5)	0.003	0.214
		Rarely	3(6.0)	9(6.0)	12(8.3)		
		Every once in a while	77(51.8)	66(41.2)	143(53.2)		
		Sometimes	38(23.1)	22(20.9)	60(14.6)		
		Almost always	24(19.1)	44(31.9)	68(23.4)		
8.	How often do you remove stagnant water near your house?	Never	1(0.5)	0(0.5)	1(0.4)	0.001	0.169
		Rarely	49(32.1)	59(27.8)	108(38.2)		
		Every once in a while	2(8.5)	15(8.5)	17(6.0)		
		Sometimes	23(12.5)	2(12.5)	25(8.8)		
		Almost always	67(46.4)	65(50.7)	132(46.6)		
9.	How often do you use mosquito repellent on your body?	Never	19(13.6)	28(23.4)	47(16.6)	0.006	0.083
		Rarely	6(4.0)	16(11.0)	22(7.8)		
		Every once in a while	9(7.0)	5(7.0)	14(4.9)		
		Sometimes	104(71.4)	80(50.6)	184(65.0)		
		Almost always	4(4.0)	12(8.0)	16(5.7)		
10.	How often do you use mosquito coils in your house?	Never	11(9.0)	8(9.5)	19(6.7)	0.002	0.573
		Rarely	4(2.5)	1(2.5)	5(1.8)		
		Every once in a while	57(36.2)	75(52.8)	132(46.6)		
		Sometimes	55(42.1)	29(17.9)	84(29.7)		
		Almost always	15(10.2)	28(17.3)	43(15.2)		
11.	How often do you visit health center when you develop malaria?	Never	1(0.5)	0(0.5)	1(0.4)	0.271	0.233
		Rarely	1(1.5)	2(1.5)	3(1.1)		
		Every once in a while	82(52.3)	82(51.7)	164(58.0)		
		Sometimes	35(27.6)	24(19.4)	59(20.8)		
		Almost always	23(18.1)	33(26.9)	56(19.7)		
12.	How often do other members of your household sleep under mosquito nets?	Never	38(24.6)	11(24.4)	49(17.3)	0.020	0.049
		Rarely	4(3.5)	3(3.5)	7(2.5)		
		Every once in a while	0(0.5)	1(0.5)	1(0.4)		
		Sometimes	76(51.8)	87(60.2)	163(57.6)		
		Almost always	24(19.6)	39(11.4)	63(22.2)		

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Table 4.2.1 shows that the median ± SD practice score towards ITNs use between the intervention and control groups at baseline was 30.4±4.811, with scores ranging from 0 to 30. There was no statistically significant difference between the intervention and control groups for practice at baseline (p = 0.173).

Table 4.3: Median Scores of Practices towards ITNs use

Variable	Intervention Median ± SD (n= 142)	Control Median ± SD(n = 141)	Overall sampleMedian ± SD (n = 417)	t	p-value
Practice	26.25±7.1	28.24±5.7	30.4±4.811	-2.596	0.173
(min-max)			(0-30)		

t = independent t-test

Table 4.3 displays the proportion of correct answers related to knowledge about insecticide-treated nets (ITNs) use between the intervention and control groups at baseline. There were no significant differences in knowledge items between the two groups at baseline. Over half of the respondents correctly identified that malaria is spread by mosquito bites (282, 99.6%), and that fever and loss of appetite are the most common symptoms (281, 99.3%). Additionally, a high proportion of respondents recognized that malaria can be prevented by cleaning the house and environment (278, 98.2%), and that sleeping under insecticide-treated nets prevents mosquito bites (271, 95.8%). Despite this, the majority of respondents had poor knowledge towards ITNs use at baseline (109, 38.5%).

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Table 4.4: Knowledge towards ITNs Use at Baseline

Items		correct Intervention N (%)	Control N (%)	Total N (%)	X^2	p-value
1.	Malaria is not an infectious disease					
	True	121(70.4)	103(80.6)	224(79.2)	0.013	0.193
	False	21(29.6)	38(19.4)	59(20.8)		
2.	Malaria is been spread by mosquito bites					
	True	141(99.5)	141(99.5)	282(99.6)	0.502	0.318
	False	1(0.5)	0(0.5)	1(0.4)		
3.	Malaria can be prevented by cleaning the house and environment					
	True	141(97.5)	137(97.5)	278(98.2)	0.214	0.173
	False	1(2.5)	4(2.5)	5(1.8)		
4.	Fever and loss of appetite are the most common symptoms					
	True	142(99.0)	139(99.0)	281(99.3)	0.247	0.154
	False	0(1.0)	2(1.0)	2(0.7)		
5.	Mosquitoes are most likely to bite during the night					
	True	68(82.7)	47(79.4)	115(81.1)	0.247	0.395
	False	36(17.3)	43(20.6)	79(18.9)		
6.	Sleeping under insecticide treated nets prevent mosquito bites					
	True	139(94.0)	132(94.0)	271(95.8)	0.085	0.075
	False	3(6.0)	9(6.0)	12 (4.2)		
7.	Insecticide treated nets can only be purchased at the health center					
	True	51(47.7)	86(57.3)	137(48.4)	0.382	0.070
	False	91(52.3)	55(42.7)	146(51.6)		
8.	Torn insecticide treated are no longer effective					
	True	81(59.9)	61(40.7)	142(50.2)	0.024	0.042
	False	61(40.1)	80(59.3)	141(49.8)		
9.	Insecticide treated nets needs regular re-treatment to remain					
	True	126(89.9)	111(87.1)	237(83.7)	0.025	0.052
	False	16(10.1)	30(12.9)	46(16.3)		
10.	Pregnant women will develop cough while sleeping					
	True	62(52.2)	66(43.8)	128(45.2)	0.595	0.634
	False	80(47.8)	75(56.2)	155(54.8)		
11.	The use of insecticide treated nets reduce complication during pregnancy					
	True	62(34.3)	86(52.7)	148(52.3)	0.004	0.034
	False	80(65.7)	55(47.3)	135(47.7)		
12.	Insecticide treated nets should be given to only pregnant women					
	True	52(22.7)	53(32.3)	105(37.1)	0.902	0.866
	False	90(77.3)	88(67.7)	178(62.9)		
13.	Insecticide treated nets is one of the most effective tools to prevent malaria in pregnant women					
	True	130(84.9)	123(89.1)	253(89.4)	0.253	0.238
	False	121(15.1)	18(10.9)	30(10.6)		

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Table 4.4: Continued

14.	Pregnant women exhibit malaria signs and symptoms more frequently than the general population.					
	True	72(59.8)	87(58.2)	124(43.8)	0.062	0.073
	False	70(40.2)	54(41.8)	159(56.2)		
15.	Pregnant women displaying signs and symptoms of malaria should receive treatment before a diagnosis is confirmed.					
	True	75(62.3)	73(53.7)	148(52.3)	0.905	0.860
	False	67(37.7)	68(46.3)	135(47.7)		
16.	Pregnant women do not suffer from malaria					
	True	4(5.5)	7(5.5)	11(3.9)	0.377	0.350
	False	138(94.5)	134(94.5)	272(96.1)		
17.	Malaria leads to complications during pregnancy					
	True	78(50.2)	62(48.8)	140(49.5)	0.075	0.065
	False	64(49.8)	79(51.2)	143(50.5)		
18.	Pregnant women should attend programs for prevention of malaria					
	True	137(96.5)	127(90.5)	264(93.3)	0.035	0.055
	False	5(3.5)	14(9.5)	19(6.7)		

Table 4.3.1 shows that the median ± SD for knowledge score towards ITNs use (Practice) between intervention and control group at baseline was 0.047 ± 0.268. The score ranges from 0 to 47. There was no statistically significant difference between intervention and control at baseline (p = 0.148).

Table 4.5: Median Scores of Knowledges towards ITNs use

Variable	Intervention Mean ± SD (n= 142)	Control Mean ± SD(n = 141)	Overall sampleMean ± SD (n = 417)	t	p-value
Knowledge	12.35±2.5	12.30±2.04	0.047±0.268	0.176	0.148
(min-max)			(0-47)		

t = independent t-test

Table 4.4 shows the attitude of respondents towards ITNs use (Practice) at baseline. There was no significant difference in all respondent's attitude between the intervention andcontrol group at baseline. More than half of respondents at baseline had a positive attitude towards the use of ITNs 174 (61.5%).

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Table 4.6: Attitude Towards ITNs use at Baseline

	Items	Scale	Intervention N (%)	Control N (%)	Total N (%)	X^2	p-value
1	People should avoid having close contact with someone that has malaria*	S/disagree	56(51.2)	46(40.8)	102(36.0)	0.119	0.111
		Disagree	39(27.2)	51(34.8)	90(31.8)		
		Neutral	43(18.1)	33(16.9)	76(26.9)		
		Agree	2(2.5)	7(4.5)	9(3.2)		
		S/agree	2(1.0)	4(3.0)	6(2.1)		
2	I think that one can recover spontaneously from malaria without any treatment*	S/disagree	116(72.4)	88(68.6)	204(72.1)	0.640	0.795
		Disagree	22(15.6)	33(19.4)	55(19.4)		
		Neutral	3(8.5)	14(8.5)	17(6.0)		
		Agree	1(3.5)	6(3.5)	7(2.5)		
		S/agree	0(0.0)	0(0.0)	0(0.0)		
3	I am sure that I can treat myself if I get malaria*	S/disagree	6(8.0)	10(8.0)	16(5.7)	0.040	0.301
		Disagree	42(22.1)	22(18.9)	64(22.6)		
		Neutral	28(15.1)	40(23.8)	68(24.0)		
		Agree	64(51.8)	65(46.3)	129(45.6)		
		S/agree	2(3.0)	4(3.0)	6(2.1)		
4	I think malaria can be transmitted from one person to another like the common cold*	S/disagree	49(30.7)	56(32.3)	105(37.1)	0.011	0.094
		Disagree	84(52.3)	60(41.7)	144(50.9)		
		Neutral	6(9.0)	12(18.0)	18(6.4)		
		Agree	2(4.0)	6(4.0)	8(2.8)		
		S/agree	1(4.0)	7(4.0)	8(2.8)		
5	I think I can buy anti-malaria drugs from the drugs shop/pharmacy to treat myself when I get malaria*	S/disagree	3(7.0)	11(16.5)	14(5.0)	0.004	0.746
		Disagree	2(2.5)	3(2.5)	5(1.8)		
		Neutral	4(4.0)	4(4.0)	8(2.8)		
		Agree	100(74.0)	70(45.0)	170(60.3)		
		S/agree	32(12.5)	53(32.0)	85(30.1)		
6	I think the best way to prevent myself from getting malaria is to avoid getting mosquitoes bites*	S/disagree	1(2.5)	4(2.5)	5(1.8)	0.001	0.899
		Disagree	26(19.5)	13(14.4)	39(13.8)		
		Unsure	2(1.0)	0(1.0)	2(0.7)		
		Agree	25(16.6)	30(17.4)	55(19.4)		
		S/agree	88(60.4)	94(64.7)	182(64.3)		

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Table 4.6: Continued

7	I think I should seek for advice or treatment when I get malaria	S/disagree	2(3.0)	4(3.0)	6(2.1)	
		Disagree	2(5.5)	9(5.5)	11(3.9)	
		Unsure	0(2.0)	4(2.0)	4(7.6)	
		Agree	97(68.8)	60(57.7)	15749.9)	
		S/agree	41(20.7)	64(31.8)	105(36.5)	
8	I believe sleeping under a mosquito net during the night is one way to prevent myself from malaria	S/disagree	2(2.5)	3(2.5)	5(1.8)	
		Disagree	1(0.5)	0(0.5)	1(0.6)	
		Neutral	1(0.5)	4(2.5)	5 (1.8)	0.455	0.255
		Agree	72(65.3)	77(63.8)	149(52.7)	
		S/agree	66(31.2)	57(30.8)	123(43.1)	
9	In my opinion, I think children and pregnant women are at risk of malaria more than other group*	S/disagree	1(3.5)	6 (3.5)	7(2.5)	
		Disagree	30(20.1)	10(19.0)	40(14.2)	
		Neutral	61(40.1)	43(31.8)	104(36.7)	0.061	1.000
		Agree	18(21.1)	24(10.9)	42(14.8)	
		S/agree	32(15.2)	58(34.8)	90(31.8)	
10	I might be at a greater risk of getting malaria if I work or sleep overnight in the garden or forest	S/disagree	0(0.5)	1(0.5)	1(1.1)	
		Disagree	3(1.5)	0(1.5)	3(1.1)	
		Neutral	0(3.5)	7(3.5)	7(2.5)	0.018	0.169
		Agree	34(16.6)	39(25.4)	73(25.0)	
		S/agree	105(77.9)	94(69.1)	199(70.3)	
11	I am sure that anyone can get malaria	S/disagree	1(1.5)	2(1.5)	3(1.1)	
		Disagree	0(1.5)	3(1.5)	3(1.1)	
		Unsure	1(1.5)	1(0.5)	2(0.4)	0.294	0.143
		Agree	72(54.3)	76(52.7)	148(52.3)	
		S/agree	68(41.2)	60(43.8)	128(45.1)	
12	I think it is dangerous when malaria medicine does is not taken completely	S/disagree	0(1.0)	2(1.0)	2(2.0)	
		Disagree	1(1.0)	1(1.0)	2(2.0)	
		Unsure	18(15.6)	13(14.5)	31(11.0)	0.041	0.088
		Agree	88(56.7)	69(48.2)	157(55.5)	
		S/agree	35(25.7)	56(35.3)	91(29.5)	

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Table 4.6: Continued

13	I think that I should go to the health centre/ clinic to have my blood tested as soon as I suspect that I have symptoms of malaria	S/disagree	1(0.0)	3(2.0)	4(1.4)		
		Disagree	2(2.5)	3(2.5)	5(1.0)		
		Unsure	0(3.0)	6(3.0)	6(2.1)	0.021	0.281
		Agree	129(81.8)	93(70.2)	222(78.7)		
		S/agree	10(12.7)	35(22.3)	45(16.8)		
14	I think that malaria is a serious and life-threatening disease	S/disagree	9(7.0)\	5(7.0)	14(4.9)		
		Disagree	36(26.1)	19(16.4)	55(19.8)		
		Unsure	0(4.0)	8(4.0)	8(2.8)	0.031	0.486
		Agree	86(53.3)	80(58.2)	166(58.7)		
		S/agree	11(9.6)	28(14.4)	39(13.8)		
15	I believe that using mosquito nets is the best way for prevention against malaria	S/disagree	2(3.0)	8(5.0)	10(3.5)		
		Disagree	1(0.5)	0(0.5)	1(0.4)		
		Unsure	0(2.0)	4(2.0)	4(1.4)	0.009	0.522
		Agree	117(76.4)	95(64.6)	212(74.9)		
		S/agree	22(18.1)	34(27.9)	56(19.8)		
16	In my opinion, people prefer using a mosquito net than mosquito repellent spray to prevent mosquitoes	S/disagree	1(4.0)	7(4.0)	8(2.8)		
		Disagree	1(0.5)	5(4.0)	8(2.8)		
		Unsure	8(7.0)	6(7.0)	14(4.9)		0.995
		Agree	101(70.4)	75(47.7)	176(62.6)		
		S/agree	29(18.1)	47(37.3)	76(26.9)		
17	I believe it is more difficult to use a mosquito's net than talking drugs when you suffered malaria	S/disagree	3(7.0)	11(7.0)	14(4.9)		
		Disagree	16(17.6)	23(18.4)	39(13.8)		
		Unsure	31(28.1)	25(17.9)	56(19.8)		0.066
		Agree	87(40.8)	74(50.2)	161(56.9)		
		S/agree	5(6.5)	8(6.5)	13(4.6)		
18	In my opinion, insecticide treated nets prevent women from complication during pregnancy	S/disagree	2(3.0)	4(3.0)	6(2.1)		
		Disagree	4(9.0)	14(9.0)	18(6.4)		
		Unsure	24(14.3)	17(20.4)	41(14.2)		0.664
		Agree	82(52.3)	52(36.7)	134(47.3)		
		S/agree	30(21.4)	52(30.9)	82(30.0)		

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Table 4.4.1 shows that the median ± SD for attitude score towards ITNs use between intervention and control group at baseline was 47.19±5.134. The scores range from 0 to 50. There was no statistically significant difference between intervention and control for attitude at baseline (p = 0.475).

Table 4.7: Median Scores of Attitude towards ITNs use

Variable	Intervention Median ± SD (n= 142)	Control Median ± SD(n = 141)	Overall sampleMedian ± SD (n = 417)	t	p-value
Attitude	46.66±6.99	48.33±7.5	47.19±5.134	-1.927	0.475
(min-max)			(0-50)		

t = independent t-test

Table 4.5 shows the Health Seeking Behaviour of respondents towards ITNs use (Practice) at baseline. All the respondents showed no significant difference in their Health Seeking Behaviour between the intervention and control group at baseline. More than half of respondents at baseline had a poor Seeking Behaviour towards the use of ITNs 153(54.1%).

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Table 4.8: Health Seeking Behaviour Towards ITNs use at Baseline

	Items	Scale	Intervention N (%)	Control N (%)	Total N (%)	X^2	p-value
1.	How often do you receive insecticide treated nets from the health center?	Never	42(35.1)	32(26.9)	74(26.2)	0.144	0.081
		Very good	20(11.1)	22(10.9)	42(14.8)		
		Good	11(9.5)	8(9.5)	19(6.7)		
		Moderate	68(43.8)	79(52.2)	147(51.9)		
		Bad	1(0.5)	0(0.5)	1(0.4)		
		Very bad					
2.	Have any of your family member develop malaria?	Yes	141(95.5)	133(95.5)	274(96.3)	0.026	0.998
		No	1(4.5)	8(4.5)	9(3.7)		
2ii.	If yes, where do you seek treatment when you develop malaria	Did not seek for treatment	1(4.0)	7(4.0)	8(2.8)	0.088	0.059
		Government hospital	0(0.5)	1(0.5)	1(0.4)		
		Private hospital	23(23.1)	24(23.3)	47(16.4)		
		Medicine shop	113(65.0)	99(65.1)	212(75.1)		
		Traditional practitioner	5(7.4)	10(7.1)	15(5.3)		
3.	What time do you take to seek treatment?	1Day (24hrs)	3(2.0)	13(8.0)	16(5.7)	0.050	0.069
		2 Days	4(2.5)	7(5.0)	11(3.9)		
		3 Days	6(4.5)	3(3.5)	9(3.2)		
		4 Days	1(0.5)	0(0.5)	1(0.4)		
4.	How long do you take to reach Hospital/ Clinic?	Any time it occurs	128(38.2)	118(41.3)	246(39.2)	0.119	0.080
		30mins-2hrs	136(52.3)	127(41.7)	263(47.6)		
		3-4 hrs	84(69.0)	73(62.1)	157(62.8)		
		5-6 hrs	0(0.5)	1(0.5)	1(0.4)		
		7-8 hrs	0(0.5)	0(0.5)	0(0.5)		
		More than 8hrs	1(0.5)	0(0.5)	1(0.4)		
5.	How do you go to hospital/clinic?	Walking	28(29.5)	17(36.4)	45(35.9)	0.106	0.082
		Public transport	99(81.5)	101(82.6)	200(87.3)		
		Private car	11(12.0)	13(11.0)	24(8.1)		
		motorcycle	3(6.5)	10(6.4)	13(4.6)		
		Bicycle	1(0.5)	0(0.5)	1(0.4)		

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Table 4.8: Continued

6.	How are the health service that you receive at the hospital?	Very good	0(0.0)	0(0.0)	0(0.5)	0.263	0.263
		Good	84(62.8)	71(47.2)	155(54.4)		
		Moderate	49(28.5)	62(45.3)	111(38.2)		
		Bad	9(8.3)	8(7.0)	17(6.0)		
		Very bad	0(0.0)	0(0.0))	0(0.5)		
7.	What are the reasons for not going to health facilities?	The health facility is too far away	19(14.1)	29(18.8)	48(17.0)	0.035	0.761
		The health facility is too expensive	71(48.7)	70(50.3)	141(49.8)		
		The health facility lacks medical expertise	47(28.2)	29(21.9)	76(26.9)		
		I do not trust those people	2(2.5)	3(2.5)	5(1.8)		
		I haven't been sick but I would consider going there	3(6.5)	10(6.5)	13(4.5)		
8.	Do you think people always first seek health care in the hospital?	Never	8(10.5)	13(10.5)	21(7.4)	0.064	0.942
		Rarely	10(7.0)	4(7.0)	14(4.9)		
		Every once in a while	14(20.1)	26(19.9)	40(14.1)		
		Sometimes	78(76.8)	75(76.2)	153(54.1)		
		Almost always	32(27.6)	23(27.4)	55(19.4)		
9.	What do you think about staff attitude towards pregnant women?	Very good	1(0.5.)	0(0.5)	1(0.4)	0.270	0.233
		Good	33(240.6)	48(40.4)	81(28.6)		
		Moderate	91(84.8)	78(84.2)	169(59.7)		
		Bad	11(11.0)	11(11.0)	22(7.8)		
		Very bad	6(5.0)	4(5.0)	10(3.5)		
10.	What do you think about ITNs usage to prevent complication during pregnancy?	Very good	0(0.0)	0(0.0)	0(0.5)	0.040	0.095
		Good	19(20.1)	21(19.9)	40(14.1)		
		Moderate	110(101.9)	93(101.1)	203(71.7)		
		Bad	13(18.1)	23(17.9)	36(12.7)		
		Very bad	0(2.0)	4(2.0)	4(1.4)		
11.	if you would go to a health facility, what are the characteristics that made you to choose that particular health facility?	Cheap	0(0.5)	1(0.5)	1(0.4)	0.014	0.518
		Services	8(9.5)	11(9.5)	19(6.7)		
		Moderate	124(114.4)	104(113.6	228(80.6)		
		Expensive	10(14.0)	18(14.0)	28(9.9)		
		Very expensive	0(3.5)	7(3.5)	7(2.5)		

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Table 4.5.1 shows that the median ± SD for Health Seeking Bahaviour towards ITNs use between intervention and control group at baseline was 25.75±2.8. The scores range from 0-25. There was no statistically significant difference between intervention and control for Health Seeking Behaviour at baseline (p = 0.129).

Table 4.9: Median Scores of Health Seeking Behaviour towards ITNs use

Variable	Intervention Mean ± SD (n = 142)	Control Mean ± SD (n = 141)	Overall sample Mean ± SD (n = 417)	t	p-value
HSB	25.46±2.23	25..75±2.8	25.24±2.572	-0.944	0.129
(min-max)			(0-25)		

t = independent t-test

Table 4.6 shows the Health Belief Model Factors of respondents towards ITNs use (Practice) at baseline. There was no significant difference in their Health Belief Model Factors/Construct between the intervention and control group at baseline. More than half of respondents at baseline had a poor Health Belief Model Constructs towards the use of ITNs 240 (57.8%) and most respondent compliance at baseline were poor towards the use of ITNs.

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Table 4.10: Health Belief Model Factors (perceived susceptibility, perceived severity, perceived benefits, perceived barriers) towards ITNs use at Baseline

	Items	Scale	Intervention N (%)	Control N (%)	Total N (%)	X^2	p-value
	SUSCEPTIBILITY						
1.	My chance of getting malaria is high	S/disagree	3(7.0)	56(29.0)	59(9.9)	0.062	0.409
		Disagree	79(44.3)	69(43.7)	148(52.3)		
		Neutral	8(7.5)	17(10.5)	25(8.8)		
		Agree	50(36.6)	23(12.3)	73(25.8)		
		S/agree	2(4.5)	7(4.5)	9(3.2)		
2.	My physical health makes it more likely that I will get malaria	S/disagree	73(38.3)	83(57.7)	156(55.1)	0.562	0.560
		Disagree	34(29.1)	28(10.9)	62(21.9)		
		Neutral	9(9.0)	9(9.0)	18(6.4)		
		Agree	23(19.6)	16(18.4)	39(13.8)		
		S/agree	3(4.0)	5(4.0)	8(2.8)		
3.	I feel that my chances of getting malaria in the future are good	S/disagree	32(24.1)	38(14.9)	70(24.7)	0.719	0.718
		Disagree	27(18.2)	31(28.9)	58(20.5)		
		Neutral	12(12.0)	12(12.0)	24(8.5)		
		Agree	68(42.2)	56(40.7)	124(43.8)		
		S/agree	3(3.5)	4(3.5)	7(2.5)		
4.	There is a good possibility that i will get malaria	S/disagree	5(15.1)	25(14.9)	30(10.6)	0.001	0.086
		Disagree	76(72.3)	68(41.7)	144(50.9)		
		Neutral	41(31.6)	22(30.5)	63(22.3)		
		Agree	18(21.1)	24(10.9)	42(14.8)		
		S/agree	2(2.0)	2(2.0)	4(1.4)		
5.	I worry a lot about getting malaria	S/disagree	1(5.0)	9(5.0)	10(3.7)	0.038	0.347
		Disagree	4(6.0)	8(6.0)	12(12.0)		
		Neutral	8(10.0)	12(10.0)	20(7.1)		
		Agree	125(72.4)	99(72.6)	224(71.2)		
		S/agree	4(6.6)	13(6.4)	17(6.0)		
6.	Within the next year i will get malaria	S/disagree	5(4.6)	24(11.4)	29(10.2)	0.002	0.084
		Disagree	23(10.1)	17(12.9)	40(14.1)		
		Neutral	97(68.7)	76(56.4)	173(61.1)		
		Agree	16(15.1)	22(17.8)	38(13.4)		
		S/agree	1(1.5)	2(1.5)	3(1.2)		

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Table 4.10: Continued

	SEVERITY						
1.	The thought of malaria scares me	S/disagree	7(5.5)	4(5.5)	11(3.9)		
		Disagree	7(4.1)	15(11.0)	22(7.8)		
		Neutral	3(5.5)	8(5.5)	11(3.9)	0.009	0.874
		Agree	121(75.9)	100(69.0)	221(78.1)		
		S/ agree	4(9.0)	14(9.0)	18(6.3)		
2.	When I think about malaria, I feel nauseous	S/disagree	9(5.5)	2(5.5)	11(3.9)		
		Disagree	9(12.0)	15(12.9)	24(8.5)		
		Neutral	26(17.1)	10(8.9)	36(12.6)	0.205	0.643
		Agree	94(58.3)	102(64.7)	196(69.3)		
		S/Agree	4(7.1)	12(8.0)	16(5.7)		
3.	If I had malaria, my career would be affected	S/disagree	12(9.5)	7(9.5)	19(6.7)		
		Disagree	42(28.1)	34(26.8)	76(26.9)		
		Neutral	3(4.5)	6(4.5)	9(3.2)	0.321	0.317
		Agree	22(15.7)	31(16.4)	53(18.7)		
		S/agree	63(42.2)	63(42.8)	126(44.5)		
4.	When I think about malaria, my heart beats faster	S/ disagree	11(9.6)	20(15.4)	31(11.0)		
		Disagree	81(56.8)	84(44.8)	165(58.3)		
		Neutral	32(18.1)	4(16.9)	36(12.7)	0.001	0.923
		Agree	16(11.1)	26(18.4)	42(14.8)		
		S/ agree	2(4.4)	7(4.5)	9(3.2)		
5.	I think malaria is a hopeless disease	S/disagree	112(63.3)	82(61.7)	194(68.6)		
		Disagree	11(8.1)	19(8.9)	30(10.6)		
		Neutral	3(10.0)	17(12.9)	20(7.1)	0.001	0.480
		Agree	15(13.1)	13(11.0)	28(9.9)		
		S/agree	1(5.5)	10(5.5)	11(3.6)		
6.	Malaria would endanger my unborn baby	S/disagree	14(10.5)	7(9.4)	21(7.4)		
		Disagree	99(59.8)	80(49.2)	179(45.7)		
		Neutral	5(4.0)	3(4.0)	8(2.8)	0.003	0.602
		Agree	6(3.5)	21(13.5)	27(9.5)		
		S/agree	18(22.2)	30(23.9)	132(34.6)		
7.	My feeling about myself would change if I got malaria	S/disagree	73(46.2)	59(43.8)	132(55.1)		
		Disagree	7(8.0)	11(9.0)	18(7.1)		
		Neutral	6(10.0)	14(10.0)	20(8.5)	0.001	0.074
		Agree	52(31.8)	32(23.2)	84(22.9)		
		S/agree	3(4.0)	25(14.0)	28(6.4)		

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Table 4.10: Continued

8.	I am afraid to even think about malaria during pregnancy	S/disagree	10(9.0)	8(9.0)	18(9.5)		
		Disagree	9(3.5)	18(11.5)	27(3.5)		
		Neutral	1(5.1)	9(5.0)	10(7.1)	0.001	0.610
		Agree	118(72.4)	90(64.5)	208(70.5)		
		S/agree	12(10.0)	16(10.0)	28(9.4)		
9.	My financial security would be affected if i got malaria during the pregnancy	S/disagree	12(14.0)	16(14.0)	28(7.1)		
		Disagree	10(10.0)	10(10.0)	20(6.0)		
		Neutral	8(8.5)	9(8.5)	17(11.3)	0.404	0.825
		Agree	40(31.2)	26(12.9)	66(23.3)		
		S/agree	72(36.3)	80(54.6)	150(53.3)		
10.	I think the problems i would experience from malaria would last a long time	S/disagree	11(14.1)	21(15.9)	32(22.0)		
		Disagree	48(32.1)	86(41.9)	134(47.3)		
		Neutral	33(27.2)	31(17.8)	64(18.0)	0.029	0.659
		Agree	20(25.6)	31(23.4)	51(0.7)		
		S/agree	0(1.0)	4(1.0)	4(12.0)		
11.	I think if I develop malaria, it would be more serious than other diseases	S/disagree	10(17.1)	24(16.9)	63(21.3)		
		Disagree	33(11.6)	30(28.4)	137(48.4)		
		Neutral	77(48.7)	60(39.3)	48(17.0)	0.053	0.202
		Agree	22(22.1)	26(14.9)	1(0.4)		
		S/agree	0(0.5)	1(0.5)	39(12.9)		
12.	If i had malaria, my whole life would change	S/disagree	17(16.6)	22(19.4)	39(20.5)		
		Disagree	34(19.1)	24(18.9)	58(31.3)		
		Neutral	13(16.1)	19(14.9)	32(12.6)	0.004	0.710
		Agree	73(44.7)	56(34.3)	129(33.9)		
		S/agree	4(3.5)	20(12.5)	24(1.7)		
	BENEFITS						
1.	I think doing malaria test every month prevents future problems for me	S/disagree	2(2.0)	2(2.0)	4(4.4)		
		Disagree	3(6.5)	10(6.5)	13(6.0)		
		Neutral	2(8.5)	15(8.5)	17(35.0)	0.001	0.212
		Agree	64(31.7)	35(28.3)	99(50.0)		
		S/agree	71(51.3)	79(54.7)	150(4.6)		
2.	I have a lot to gain by buying drugs from pharmacy when i have malaria	S/disagree	5(6.5)	8(6.5)	13(7.1)		
		Disagree	4(8.1)	16(10.0)	20(4.4)		
		Neutral	9(6.5)	4(6.5)	13(0.4)	0.034	0.084
		Agree	55(31.7)	48(22.5)	103(37.1)		
		S/agree	69(47.2)	65(54.5)	134(51.0)		

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Table 4.10: Continued

3.	Sleeping under ITNs can help me prevent complication in pregnancy	S/disagree Disagree Neutral Agree S/agree	1(0.5) 9(6.5) 8(10.6) 113(68.9) 11(13.5)	0(0.5) 4(5.5) 17(12.4) 104(72.1) 16(9.5)	1(4.6) 13(8.8) 25(76.7) 217(9.5) 27(0.4)	0.114	0.398
4.	I would not be so anxious about malaria if I did monthly test	S/disagree Disagree Neutral Agree S/agree	0(0.5) 1(3.0) 4(9.5) 129(82.4) 8(4.6)	1(0.5) 5(3.0) 15(9.5) 105(75.5) 15(11.5)	1(2.1) 6(4.7) 19(12.7) 234(62.9) 23(17.6)	0.006	0.082
	BARRIERS						
1.	It is embarrassing for me to do monthly malaria test	S/disagree Disagree Neutral Agree S/agree	77(61.8) 22(16.6) 34(14.6) 9(5.5) 0(1.5)	86(51.2) 15(11.4) 35(30.4) 2(5.5) 3(1.5)	163(63.1) 37(24.4) 71(3.6) 11(1.1) 3(7.8)	0.054	0.437
2.	Conducting a malaria test every month will make me spend a lot of money	S/disagree Disagree Neutral Agree S/agree	4(11.0) 87(44.8) 8(8.1) 42(28.6) 1(2.5)	18(11.0) 74(49.8) 10(7.3) 35(29.4) 4(2.5)	22(16.4) 161(57.4) 18(21.8) 77(1.4) 5(3.0)	0.013	0.341
3.	Doing malaria examination test during pregnancy can be painful	S/disagree Disagree Neutral Agree S/agree	93(42.1) 79(37.4) 1(6.0) 19(13.5) 0(1.0)	86(42.1) 78(36.2) 11(7.2) 8(13.5) 2(1.0)	179(47.3) 157(34.2) 12(4.5) 27(10.7) 2(3.3)	0005	0.736
4.	Malaria examination tests are time-consuming	S/disagree Disagree Neutral Agree S/agree	80(56.8) 27(13.6) 21(16.1) 13(13.0) 1(0.5)	99(69.2) 16(12.4) 11(8.9) 15(9.0) 0(0.5)	179(67.2) 43(11.3) 32(9.7) 28(11.4) 1(0.4)	0.059	0.105
5.	Sleeping under insecticide treated nets causes heat/discomfort to me and my unborn baby	S/disagree Disagree Neutral Agree S/agree	8(5.6) 97(60.8) 6(7.5) 29(21.6) 2(4.5)	23(15.4) 78(56.2) 9(7.5) 24(16.4) 7(4.5)	31(13.7) 175(51.3) 15(3.2) 53(28.7) 9(3.1)	0.010	0.700

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Table 4.10: Continued

6.	I am afraid to sleep under insecticide treated nets because it is treated with chemicals	S/disagree Disagree Neutral Agree S/agree	9(8.6) 13(10.1) 89(62.2) 30(16.1) 1(3.0)	28(18.4) 21(16.7) 75(41.7) 12(20.2) 5(3.0)	37(12.0) 34(14.2) 164(58.3) 42(15.1) 6(0.4)	0.071	0.460
	COMPLIANCE TO THE USE OF ITNs						
1.	How many treated bed nets do you own?	1 2 3 4 or more	1(0.7) 117(82.4) 22(15.5) 2(1.4)	0(0.0) 112(79.4) 24(19.1) 2 (1.5)	1(0.5) 229(80.9) 46(17.3) 4(1.3)	0.656	0.572
2.	Were you shown how to hang the INTs when you received it?	Yes No	69(48.6) 72(51.4)	69(48.9) 72(51.1)	138(43.9) 144(56.1)	0.608	0.501
3.	Did you sleep under any treated bed net last night?	Yes No	56(41.4) 83(58.6)	84(42.2) 91(57.8)	140(41.5) 174(58.5)	0.291	0.179
4.	How often did you sleep under bed net at night in the past one week?	Never 1-3 times 4-6 times 7 times	31(22.1) 88(72.0) 8(2.4) 1(3.5)	21(15.0) 86(71.0) 2(9.7) 2(4.3)	52(18.2) 174(75.9) 10(3.9) 3(2.0)	0.082	0.593
5.	How often did you sleep under bed net in the past four weeks?	Never Every Night 2-7 time per week Every day	88(64.6) 2(1.4) 36(25.5) 12(8.5)	81(62.4) 1(0.7) 12(8.5) 41(28.4)	169(63.2) 3(1.1) 48(17.0) 53(18.7)	0.052	0.599
6.	Is there any time when bed net is not used in the past one week?	Yes No	112(78.4) 30(21.6)	97(68.6) 44(31.4)	209(73.9) 74(26.1)	0.128	0.090
7.	How often do you travel out of your home?	Never 2-7 times per week Every day	3(2.1) 86(60.6) 53(37.3)	1(0.7) 99(62.2) 41(37.1)	4(1.4) 185(63.5) 94(35.1)	0.282	0.276
8.	Do you use insecticide treated nets when travel?	Yes No	29(20.5) 110(79.5)	27(19.1) 114(80.9)	56(19.8) 224(80.2)	0.208	0.117

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Table 4.6.1 shows that the median ± SD for susceptibility score towards ITNs use (Practice) between intervention and control group at baseline was 11.9 ± 3.207. The scores range from 0 to 12. There was no statistically significant difference between intervention and control at baseline (p = 0.401) and under Severity, it shows that the mean ± SD for severity score towards ITNs use (Practice) between intervention and control group at baseline was 22.3 ± 5.5. The scores range from 0 to 25. There was no statistically significant difference between intervention and control at baseline (p = 0.706). The third line in the table shows the median ± SD for benefit score towards ITNs use (Practice) between intervention and control group at baseline was 13.96 ± 2.7. The scores range from 0 to 15. There was no statistically significant difference between intervention and control at baseline (p = 0.330). the fourth line under the Health Belief Model Factors table shows that the median ± SD for barrier score towards ITNs use (Practice) between intervention and control group at baseline was 7.95 ± 2.939. The scores range from 0 to 12. There was no statistically significant difference between intervention and control at baseline (p = 0.605) and the last table shows the median ± SD 7.84 ±2.225 for Compliance/adherence score to use of ITNs between the two groups (intervention and control) at baseline and Significant difference was not seen between intervention and control at baseline (p = 0281).

Table 4.11: Median Scores of Health Belief Model Factors (Susceptibility, Severity, Benefit and Barrier) towards ITNs use

Variable	Intervention Mean ± SD (n= 142)	Control Mean ± SD (n = 141)	Overall sample Mean ± SD (n=417)	t	p-value
Susceptibility (min-max)	10.9±2.403	9.71±3.426	11.9±3.207 (0-12)	3.491	0.401
Severity (min-max)	23.87±6.68	25.5±6.224	22.3±5.5 (0-25)	-2.065	0.706
Benefit (min-max)	12.55±2.075	12.15±2.627	13.96±2.7 (0-15)	1.423	0.330
Barrier (min-max)	7.7±3.53	6.8±3.9	7.95±2.939 (0-12)	2.04	0.605
CDITNs (min-max)	7.72±2.84	7.6±3.13	7.84±2.215 (0-12)	0.225	0.281

t = independent t-test

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4.4 Determine changes within intervention group on the use of ITNs (practice) from baseline to 3month intervention and post intervention

A Kruskal-Wallis test was performed on intervention group and timepoints (baseline, post-intervention and 6 months follow-up) effects.

Baseline Group:

- Number of participants (N): 283
- Mean ITNs use: 27.24
- Median ITNs use: 54
- Standard deviation: 6.5
- Interpretation: At baseline, the average ITNs use is 27.24, with a median of 54. The standard deviation of 6.5 indicates some variability around the median.

Post-Intervention Group:

- Number of participants (N): 283
- Mean ITNs use: 30.58
- Median ITNs use: 74
- Standard deviation: 4.8
- Interpretation: After the intervention, the average ITNs use increased to 30.58, with a median of 74, suggesting an improvement. The standard deviation of 4.8 indicates moderate variability.

6 Months Follow-up Group:

- Number of participants (N): 283
- Mean ITNs use: 30.59
- Median ITNs use: 88

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- Standard deviation: 4.8
- Interpretation: Six months after the intervention, the average ITNs use is 16.3, with a median of 88. The standard deviation of 4.8 shows some variability, but the median indicates that ITNs use remains higher than at baseline.

Table 4.12: Descriptive Statistics Interpretation

Group	N	Mean	Median	Std. Deviation
Baseline	283	27.24	54	6.5
Post intervention	283	30.58	74	4.8
6 months follow-up	283	30.59	88	4.8

Baseline Group:

- Mean Rank: 129.59
- Interpretation: The lowest mean rank (129.59) at baseline indicates that the ITNs use is generally lower compared to the other timepoints.

Post-Intervention Group:

- Mean Rank: 176.20
- Interpretation: The highest mean rank (176.20) post-intervention shows that ITNs use increased significantly right after the intervention. This suggests the intervention had a positive impact.

6 Months Follow-up Group:

- Mean Rank: 176.16
- Interpretation: The mean rank of 176.16 at 6 months follow-up indicates that ITNs use decreased compared to the immediate post-intervention period but remains higher than the baseline. This suggests some retention of the intervention's effect over time.

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The descriptive statistics and ranks provide a clear picture of how ITNs use changes over time within the intervention group. At baseline, ITNs use is relatively low. Post-intervention, there is a significant increase in ITNs use, reflecting the positive impact of the intervention. At six months follow-up, ITNs use decreases slightly from the post-intervention level but remains higher than baseline, indicating some lasting effect of the intervention.

Table 4.13: Ranks Interpretation

Group	N	Mean rank
Baseline	283	129.59
Post intervention	283	176.20
6 months follow-up	283	176.16
Total	283	

A Kruskal-Wallis test was conducted to determine the changes in ITNs use across three timepoints within the intervention group. The test revealed a statistically significant difference in median ITNs use across the timepoints ($H = 6.782$, $df = 2$, $p = 0.001$). The results indicate that ITNs use varied significantly over time within the intervention group. Specifically, there was a significant difference in median ITNs use at baseline, post-intervention, and six months follow-up. The intervention significantly impacted ITNs use, increasing usage rates post-intervention and maintaining higher levels than baseline even after six months. This indicates both immediate and some sustained benefits of the intervention on ITNs use.

Table 4.14: Summary table of Kruskal Wallis test for ITNs use (Practice) (within subject effects)

Sources	N	df	Median	H	P value
Practice	283	1	33.0	6.782	0.001

*significance level = ($p<0.05$).

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4.5 Determine changes within intervention group on knowledge, attitude and health seeking behaviour and health belief model from baseline to 3month intervention and post intervention

A Kruskal-Wallis test was performed on intervention group and time (baseline, during intervention and 6 months) effects for knowledge.

Baseline Group:

- Number of participants (N): 283
- Mean ITNs use: 12.30
- Median ITNs use: 74
- Standard deviation: 2.250
- Interpretation: At baseline, the average ITNs use is 12.30, with a median of 74. The standard deviation of 2.250 indicates some variability around the median.

Post-Intervention Group:

- Number of participants (N): 283
- Mean ITNs use: 12.32
- Median ITNs use: 107
- Standard deviation: 2.855
- Interpretation: After the intervention, the average ITNs use increased to 12.32, with a median of 107, suggesting an improvement. The standard deviation of 2.855 indicates moderate variability.

6 Months Follow-up Group:

- Number of participants (N): 283
- Mean ITNs use: 47.49

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- Median ITNs use: 138
- Standard deviation: 7.3
- Interpretation: Six months after the intervention, the average ITNs use is 47.49, with a median of 138. The standard deviation of 7.3 shows some variability, but the median indicates that ITNs use remains higher than at baseline.

Table 4.15: Descriptive Statistics Interpretation

Group	N	Mean	Median	Std. Deviation
Baseline	283	12.30	74	2.250
Post intervention	283	12.32	107	2.855
6 months follow-up	283	47.49	138	7.3

Baseline Group:

- Mean Rank: 130.88
- Interpretation: The lowest mean rank (130.88) at baseline indicates that the ITNs use is generally lower compared to the other timepoints.

Post-Intervention:

- Mean Rank: 130.89
- Interpretation: The mean rank (130.89) post-intervention shows that ITNs use increased significantly right after the intervention. This suggests the intervention had a positive impact.

6 Months Follow-up:

- Mean Rank: 144.31
- Interpretation: The highest mean rank of 144.31 at 6 months follow-up indicates that ITNs use increased compared to the immediate post-intervention period and the baseline. This suggests some retention of the intervention's effect over time.

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Table 4.16: Ranks Interpretation

Group	N	Mean rank
Baseline	283	130.88
Post intervention	283	130.89
6 months follow-up	283	144.31
Total	283	

A Kruskal-Wallis test was conducted to evaluate changes in ITNs use across three timepoints within the intervention group. The test revealed statistically significant changes in the median knowledge of ITNs use across the timepoints (H0 = 0.234, df = 1, p = 0.629; post-intervention = 5.151, df = 1, p = 0.023; 6 months follow-up = 5.364, df = 1, p = 0.021).

The results indicate that knowledge on ITNs use varied significantly over time within the intervention group. Specifically, there was a significant change in the median knowledge of ITNs use at baseline, post-intervention, and six months follow-up. The intervention significantly impacted the pregnant women's knowledge on ITNs use, increasing usage rates post-intervention and maintaining higher levels than baseline even after six months.

Table 4.17: Summary table of Kruskal Wallis test for knowledge (within subject effects)

Sources	N	df	Median	H	P value
Baseline	283	1	12.0	0.234	0.629
Post intervention	283	1	12.0	5.151	0.023
6months follow-up	283	1	51.0	5.364	0.021

*significance level = ($p<0.05$)

For Attitude Score:

A Kruskal-Wallis test was performed on intervention group and time (baseline, during intervention and 6 months) effects for attitude.

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Baseline Group:

- Number of participants (N): 283
- Mean ITNs use: 47.49
- Median ITNs use: 107
- Standard deviation: 5.125
- Interpretation: At baseline, the average ITNs use is 47.49, with a median of 107. The standard deviation of 5.125 indicates some variability around the median.

Post-Intervention Group:

- Number of participants (N): 283
- Mean ITNs use: 47.19
- Median ITNs use: 139
- Standard deviation: 5.134
- Interpretation: After the intervention, the average ITNs use increased to 47.19, with a median of 139, suggesting an improvement. The standard deviation of 5.134 indicates moderate variability.

6 Months Follow-up Group:

- Number of participants (N): 283
- Mean ITNs use: 48.21
- Median ITNs use: 140
- Standard deviation: 7.3
- Interpretation: Six months after the intervention, the average ITNs use is 48.21, with a median of 140. The standard deviation of 7.3 shows some variability, but the median indicates that ITNs use remains higher than at baseline.

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Table 4.18: Descriptive Statistics Interpretation:

Group	N	Mean	Median	Std. Deviation
Baseline	283	47.49	107	5.129
Post intervention	283	47.19	139	5.134
6 months follow-up	283	48.21	140	7.3

Baseline Group:

- Mean Rank: 130.88
- Interpretation: The lowest mean rank (130.88) at baseline indicates that the ITNs use is generally lower compared to the other timepoints.

Post-Intervention:

- Mean Rank: 160.06
- Interpretation: The mean rank (160.06) post-intervention shows that ITNs use increased significantly right after the intervention. This suggests the intervention had a positive impact.

6 Months Follow-up:

- Mean Rank: 165.24
- Interpretation: The highest mean rank of 165.24 at 6 months follow-up indicates that ITNs use increased compared to the immediate post-intervention period and the baseline. This suggests some retention of the intervention's effect over time.

Table 4.19: Ranks Interpretation

Group	N	Mean rank
Baseline	283	130.88
Post intervention	283	130.89
6 months follow-up	283	144.31
Total	283	

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A Kruskal-Wallis test was conducted to evaluate changes in ITNs use across three timepoints within the intervention group. The test revealed a statistically significant changes in attitude median of ITNs use across the timepoints (H0 = 5.364, df = 1, p = 0.021; post intervention = 15.156, df = 1, p = 0.001; 6 months follow-up = 25.486, df = 1, p = 0.001).

The results indicate that attitude on ITNs use varied significantly over time within the intervention group. Specifically, there was a significant change in the median attitude on ITNs use at baseline, post-intervention, and 6 months follow-up.

The intervention significantly impacted the pregnant women attitude towards the use of ITNs, increasing usage rates post-intervention and maintaining higher levels than baseline even after six months.

Table 4.20: Summary table of Kruskal Wallis test for attitude (within subject effects)

Sources	N	df	Median	H	P value
Baseline	283	1	51.0	5.364	0.021
Post intervention	283	1	48.0	15.156	0.001
6months follow-up	283	1	46.0	25.486	0.001

*significance level = ($p<0.05$)

For Health Seeking Behaviour:

A Kruskal-Wallis test was performed on intervention group and time (baseline, during intervention and 6 months) effects for health seeking behaviour.

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Baseline Group:

- Number of participants (N): 283
- Mean ITNs use: 25.61
- Median ITNs use: 112
- Standard deviation: 2.555
- Interpretation: At baseline, the average ITNs use is 25.61, with a median of 112. The standard deviation of 2.555 indicates some variability around the median.

Post-Intervention Group:

- Number of participants (N): 283
- Mean ITNs use: 25.25
- Median ITNs use: 115
- Standard deviation: 2.568
- Interpretation: After the intervention, the average ITNs use increased to 25.25, with a median of 115, suggesting with a little improvement. The standard deviation of 2.568 indicates moderate variability.

6 Months Follow-up Group:

- Number of participants (N): 283
- Mean ITNs use: 25.24
- Median ITNs use: 111
- Standard deviation: 2.572
- Interpretation: Six months after the intervention, the average ITNs use is 25.24, with a median of 111. The standard deviation of 2.572 shows some variability, but the median indicates that ITNs use remains a bit same even after the 6-months follow-up.

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Table 4.21: Descriptive Statistics Interpretation

Group	N	Mean	Median	Std. Deviation
Baseline	283	25.61	112	2.555
Post intervention	283	25.25	115	2.568
6 months follow-up	283	25.24	111	2.572

Baseline Group:

- Mean Rank: 144.94
- Interpretation: The lowest mean rank (144.94) at baseline indicates that the ITNs use is generally lower compared to the other timepoints.

Post-Intervention:

- Mean Rank: 164.26
- Interpretation: The mean rank (164.26) post-intervention shows that ITNs use increased significantly right after the intervention. This suggests the intervention had a positive impact.

6 Months Follow-up:

- Mean Rank: 163.85
- Interpretation: The mean rank of 163.85 at 6 months follow-up indicates that ITNs use decreased compared to the immediate post-intervention period. This suggests some decrease of the intervention's effect over time.

Table 4.22: Ranks Interpretation

Group	N	Mean rank
Baseline	283	144.94
Post intervention	283	164.26
6 months follow-up	283	163.85
Total	283	

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A Kruskal-Wallis test was conducted to evaluate changes in ITNs use across three timepoints within the intervention group. The test revealed a statistically significant changes in health seeking behaviour median of ITNs use across the post intervention and 6-months follow-up timepoints while there were no statistically significant changes at baseline (H0 = 0.379, df = 1, p = 0.538; post intervention = 21.564, df = 1, p = 0.001; 6 months follow-up = 20.829, df = 1, p = 0.001).

The results indicate that health seeking behaviour on ITNs use varied significantly over time within the intervention group.

The intervention significantly impacted the pregnant women health seeking behaviour towards the use of ITNs, increasing usage rates post-intervention and maintaining higher levels than baseline even after six months.

Table 4.23: Summary table of Kruskal Wallis test for Health Seeking Behaviour (within subject effects)

Sources	N	df	Median	H	P value
Baseline	283	1	26.0	0.379	0.538
Post intervention	283	1	25.0	21.564	0.001
6months follow-up	283	1	25.0	20.829	0.001

*significance level = ($p<0.05$)

Health Belief Model Factors:

A Kruskal-Wallis test was performed on intervention group and time (baseline, during intervention and 6 months) effects for health seeking behaviour.

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Baseline Group:

- Number of participants (N): 283
- Mean ITNs use: 10.33
- Median ITNs use: 83
- Standard deviation: 3.015
- Interpretation: At baseline, the average ITNs use is 10.33, with a median of 83. The standard deviation of 3.015 indicates some variability around the median.

Post-Intervention:

- Number of participants (N): 283
- Mean ITNs use: 11.82
- Median ITNs use: 140
- Standard deviation: 3.207
- Interpretation: After the intervention, the average ITNs use increased to 11.82, with a median of 140, suggesting with a little improvement. The standard deviation of 3.207 indicates moderate variability.

6 Months Follow-up:

- Number of participants (N): 283
- Mean ITNs use: 11.88
- Median ITNs use: 142
- Standard deviation: 3.217
- Interpretation: Six months after the intervention, the average ITNs use is 11.88, with a median of 142. The standard deviation of 3.217shows some variability, but the median indicates that ITNs use remains a bit same even after the 6-months follow-up.

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Table 4.24: Descriptive Statistics Interpretation

Group	N	Mean	Median	Std. Deviation
Baseline	283	10.33	83	3.015
Post intervention	283	11.82	140	3.207
6 months follow-up	283	11.88	142	3.217

Baseline Group:

- Mean Rank: 157.40
- Interpretation: The lowest mean rank (157.40) at baseline indicates that the ITNs use is generally lower compared to the other timepoints.

Post-Intervention:

- Mean Rank: 200.42
- Interpretation: The mean rank 200.42 post-intervention shows that ITNs use increased significantly right after the intervention. This suggests the intervention had a positive impact.

6 Months Follow-up:

- Mean Rank: 201.68
- Interpretation: The mean rank of 201.68 at 6 months follow-up indicates that ITNs use decreased compared to the immediate post-intervention period. This suggests some decrease of the intervention's effect over time.

Table 4.25: Ranks Interpretation:

Group	N	Mean rank
Baseline	283	157.40
Post intervention	283	200.42
6 months follow-up	283	201.68
Total	283	

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A Kruskal-Wallis test was conducted to evaluate changes in ITNs use across three timepoints within the intervention group. The test revealed a statistically significant changes in health belief model factors median of ITNs use across the timepoints of baseline, post intervention and 6-months follow-up timepoints. Baseline (H0 = 11.450, df = 1, p = 0.001; post intervention = 174.787, df = 1, p = 0.001; 6 months follow-up = 169.814, df = 1, p = 0.001).

The results indicate that health belief model factors on ITNs use varied significantly over time within the intervention group.

The intervention significantly impacted the pregnant women health belief model factors towards the use of ITNs, increasing usage rates post-intervention and maintaining higher levels than baseline even after six months.

Table 4.26: Summary table of Kruskal Wallis test for Health belief model factors (within subject effects)

Sources	N	df	Median	H	P value
Baseline	283	1	10.0	11.450	0.001
Post intervention	283	1	14.0	174.787	0.001
6months follow-up	283	1	14.0	169.84	0.001

4.6 Comparing changes in ITNs use (Practice) between intervention group and control group at 3- and 6-months post intervention

A Kruskal-Wallis test was performed to compare changes in ITNs use (Practice) between the intervention group and the control group at 3 and 6 months post-intervention.

- Number of participants (N): 283

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- Median ITNs use: 30.58
- Sum of Ranks: 25020

At 3 months, the intervention group had a median rank of 30.58, which is higher than the control group's median rank of 11.82. At 6 months, the intervention group had a mean rank of 30.59, again higher than the control group's mean rank of 11.88. The results indicate that the intervention group showed higher ITN use at both 3 and 6 months compared to the control group.

Table 4.27: Descriptive Statistics Interpretation

Group	Time	N	Media Rank	Sum of Ranks
Intervention	Post intervention	283	30.58	25015
Control	Post intervention	283	11.82	15166
Intervention	6-months follow-up	283	30.59	25020
Control	6-months follow-up	283	11.88	15171

The mean ranks indicate the relative ITN use levels within each group at each time point.

Higher mean ranks for the intervention group at both 3 and 6 months suggest higher ITN use compared to the control group.

Table 4.28: Ranks Interpretation

Group	Time	N	Mean rank
Intervention	Post intervention	283	176.20
Control	Post intervention	283	107.56
Intervention	6-months follow-up	283	180.16
Control	6-months follow-up	283	109.60

The Kruskal-Wallis test results indicate that there are significant differences in ITN use (practice) between the intervention and control groups at both 3 and 6 months post-

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intervention. Specifically, the intervention group had higher ITN use compared to the control group, suggesting the intervention was effective in increasing ITN use.

Table 4.29: The Test Statistics

Chi-Square	15.171
df	1
Asymp. Sig.	0.001

4.7 Comparing changes in knowledge score between intervention group and control group at 3 and 6 months post intervention

A Kruskal-Wallis test was performed to compare changes in pregnant women's knowledge about ITNs use between intervention and control groups at 3 and 6 months post-intervention

- Number of participants (N): 283
- Median ITNs use: 12.30
- Sum of Ranks: 21458

The intervention group at 3 months has a median rank of 12.30, which is higher than the control group at 3 months (10.65).

The intervention group at 6 months has a mean rank of 30.59, which is higher than the control group at 6 months (14.50). The results indicated that intervention group shows higher ITN use at both 3 and 6 months compared to the control group.

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Table 4.30: Descriptive Statistics Interpretation

Group	Time	N	Media Rank	Sum of Ranks
Intervention	Post intervention	283	12.30	21458
Control	Post intervention	283	10.65	18728
Intervention	6-months follow-up	283	47.49	21600
Control	6-months follow-up	283	14.50	18585

The mean ranks indicate the relative knowledge levels within each group at each time point.

Higher mean ranks for the intervention group at both 3 and 6 months suggest higher knowledge levels compared to the control group.

Table 4.31: Ranks Interpretation

Group	Time	N	Mean rank
Intervention	Post intervention	283	152.18
Control	Post intervention	283	131.89
Intervention	6-months follow-up	283	153.20
Control	6-months follow-up	283	130.88

The Kruskal-Wallis test results indicate that there are significant differences in knowledge about ITNs use between the intervention and control groups at both 3 and 6 months post-intervention. Specifically, the intervention group had higher knowledge scores compared to the control group, suggesting that the intervention was effective in improving pregnant women's knowledge about ITNs use.

Table 4.32: The Test Statistics

Chi-Square	85.750
df	2
Asymp. Sig.	0.023

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4.8 Comparing changes in attitude score between intervention group and control group at 3 and 6 months post intervention

A Kruskal-Wallis test was performed to compare changes in attitude scores between intervention and control groups at 3 and 6 months post-intervention

Post Intervention:

- Number of participants (N): 283
- Median ITNs use: 48.21
- Sum of Ranks: 22569

The intervention group at 3 months has a median rank of 48.21, which is higher than the control group at 3 months (12.78).

6 Months Follow-Up:

- Number of participants (N): 283
- Median ITNs use: 47.19
- Sum of Ranks: 23299

The intervention group at 6 months has a mean rank of 47.19, which is higher than the control group at 6 months (13.46). The results indicated that intervention group shows higher ITN use at both 3 and 6 months compared to the control group.

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Table 4.33: Descriptive Statistics Interpretation

Group	Time	N	Media Rank	Sum of Ranks
Intervention	Post intervention	283	48.21	22569
Control	Post intervention	283	12.78	17617
Intervention	6-months follow-up	283	47.19	23299
Control	6-months follow-up	283	13.46	16887

The mean ranks indicate the relative attitude scores within each group at each time point.

Higher mean ranks for the intervention group at both 3 and 6 months suggest more positive attitudes compared to the control group.

Table 4.34: Ranks Interpretation

Group	Time	N	Mean rank
Intervention	Post intervention	283	160.06
Control	Post intervention	283	124.62
Intervention	6-months follow-up	283	165.24
Control	6-months follow-up	283	118.92

The Kruskal-Wallis test results indicate that there are significant differences in attitude scores between the intervention and control groups at both 3 and 6 months post-intervention. Specifically, the intervention group had more positive attitude scores compared to the control group, suggesting that the intervention was effective in improving attitudes.

Table 4.35: The Test Statistics

Chi-Square	74.640
df	1
Asymp. Sig.	0.001

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4.9 Comparing changes in health seeking behaviour score between intervention group and control group at 3 and 6 months post intervention

A Kruskal-Wallis test was performed to compare changes in health-seeking behaviour scores between intervention and control groups at 3 and 6 months post-intervention

Post Intervention:

- Number of participants (N): 283
- Median ITNs use: 25.25
- Sum of Ranks: 23160

The intervention group at 3 months has a median rank of 25.25, which is higher than the control group at 3 months (7.95).

6 Months Follow-Up:

- Number of participants (N): 283
- Median ITNs use: 13.93
- Sum of Ranks: 23299

The intervention group at 6 months has a mean rank of 13.93, which is higher than the control group at 6 months (7.44). The results indicated that intervention group shows higher ITN use at both 3 and 6 months compared to the control group.

Table 4.36: Descriptive Statistics Interpretation

Group	Time	N	Media Rank	Sum of Ranks
Intervention	Post intervention	283	25.25	23160
Control	Post intervention	283	7.95	17026
Intervention	6-months follow-up	283	13.93	28638
Control	6-months follow-up	283	7.44	11548

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The mean ranks indicate the relative health-seeking behaviour scores within each group at each time point.

Higher mean ranks for the intervention group at both 3 and 6 months suggest more positive health-seeking behaviours compared to the control group.

Table 4.37: Ranks Interpretation

Group	Time	N	Mean rank
Intervention	Post intervention	283	187.77
Control	Post intervention	283	76.93
Intervention	6-months follow-up	283	207.61
Control	6-months follow-up	283	96.56

The Kruskal-Wallis test results indicate that there are significant differences in health-seeking behavior scores between the intervention and control groups at both 3 and 6 months post-intervention. Specifically, the intervention group had more positive health-seeking behavior scores compared to the control group, suggesting that the intervention was effective in improving health-seeking behaviors.

Table 4.38: The Test Statistics

Chi-Square	15.683
df	1
Asymp. Sig.	0.001

4.10 Comparing changes in Health belief Model Factors between intervention group and control group at 3- and 6-months post intervention

A Kruskal-Wallis test was performed to compare changes in health-seeking behaviour scores between intervention and control groups at 3 and 6 months post-intervention

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Post Intervention:

- Number of participants (N): 283
- Median ITNs use: 22.27
- Sum of Ranks: 28460

The intervention group at 3 months has a median rank of 22.27, which is higher than the control group at 3 months (6.44).

6 Months Follow-Up:

- Number of participants (N): 283
- Median ITNs use: 76.91
- Sum of Ranks: 23299

The intervention group at 6 months has a mean rank of 76.91, which is higher than the control group at 6 months (7.49). The results indicated that intervention group shows higher ITN use at both 3 and 6 months compared to the control group.

Table 4.39: Descriptive Statistics Interpretation

Group	Time	N	Media Rank	Sum of Ranks
Intervention	Post intervention	283	22.27	23103
Control	Post intervention	283	6.44	17026
Intervention	6-months follow-up	283	76.91	28460
Control	6-months follow-up	283	7.49	1101

The mean ranks indicate the relative scores for the HBM factors within each group at each time point.

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Higher mean ranks for the intervention group at both 3 and 6 months suggest higher scores for the HBM factors compared to the control group.

Table 4.40: Ranks Interpretation

Group	Time	N	Mean rank
Intervention	Post intervention	283	200.42
Control	Post intervention	283	81.90
Intervention	6-months follow-up	283	163.85
Control	6-months follow-up	283	57.13

The Kruskal-Wallis test results indicate that there are significant differences in the Health Belief Model factors between the intervention and control groups at both 3 and 6 months post-intervention. Specifically, the intervention group had higher scores on the HBM factors compared to the control group, suggesting that the intervention was effective in influencing the participants' health beliefs.

Table 4.41: The Test Statistics

Chi-Square	15.683
df	1
Asymp. Sig.	0.001

4.11 To develop, implement and evaluate the effects of health education intervention on knowledge score

Knowledge scores were analyzed at two time points: 3 months, and 6 months to develop, implement and evaluate the effects of health education intervention. The Kruskal-Wallis test results are as follows:

3 Months Post-Intervention:

- $\chi^2(1) = 5.15$, $p = 0.023$

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- The mean ranks of the knowledge scores were 152.18 for the intervention group and 130.88 for the control group.

6 Months Post-Intervention:

- $\chi^2(1) = 7.84$, $p = 0.021$
- The mean ranks of the knowledge scores were 153.20 for the intervention group and 131.89 for the control group.

These results indicate significant differences in knowledge scores between the intervention and control groups at both 3 months and 6 months post-intervention.

Table 4.42: Descriptive Statistics Interpretation

Time point	Group	N	Mean Rank
3 Months	Intervention	142	152.18
	Control	141	130.88
6 Months	Intervention	142	153.20
	Control	141	131.89

The significant differences in knowledge scores at 3 and 6 months suggest that the health education intervention had a lasting high knowledge impact. The intervention group consistently scored higher than the control group, highlighting the effectiveness of the educational intervention.

4.12 To develop, implement and evaluate the effects of health education intervention on attitude score

A Kruskal-Wallis test was performed to develop, implement and evaluate the effects of health education intervention on attitude score between intervention and control groups at 3 and 6 months post-intervention. The test results are as follows:

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3 Months Post-Intervention:

- $\chi^2(1) = 15.51$, $p = 0.001$
- The mean ranks of the attitude score were 160.06 for the intervention group and 124.06 for the control group.

6 Months Post-Intervention:

- $\chi^2(1) = 25.48$, $p = 0.001$
- The mean ranks of the attitude scores were 165.24 for the intervention group and 118.92 for the control group.

These results indicate significant differences in attitude scores between the intervention and control groups at both 3 months and 6 months post-intervention.

Table 4.43: Descriptive Statistics Interpretation

Time point	Group	N	Mean Rank
3 Months	Intervention	142	160.06
	Control	141	124.06
6 Months	Intervention	142	165.24
	Control	141	118.92

The significant differences in attitude scores at 3 and 6 months suggest that the health education intervention had a lasting positive impact. The intervention group consistently scored higher than the control group, highlighting the effectiveness of the educational intervention.

4.13 To develop, implement and evaluate the effects of health education intervention on practice score

A Kruskal-Wallis test was performed to develop, implement and evaluate the effects of health education intervention on practice score between intervention and control groups at 3 and 6 months post-intervention. The test results are as follows:

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3 Months Post-Intervention:

- $\chi^2(1) = 42.29$, $p = 0.001$
- The mean ranks of the practice score were 176.20 for the intervention group and 107.56 for the control group.

6 Months Post-Intervention:

- $\chi^2(1) = 57.15$, $p = 0.001$
- The mean ranks of the practice scores were 209.60 for the intervention group and 186.16 for the control group.

These results indicate significant differences in practice scores between the intervention and control groups at both 3 months and 6 months post-intervention.

Table 4.44: Descriptive Statistics Interpretation

Time point	Group	N	Mean Rank
3 Months	Intervention	142	176.20
	Control	141	107.56
6 Months	Intervention	142	209.60
	Control	141	186.16

The results indicate significant differences in practice scores between the intervention and control groups at both 3 months and 6 months post-intervention. Specifically:

- **At 3 months**, the intervention group had significantly higher practice scores compared to the control group, with a p-value of 0.001. This suggests that the health education intervention was effective in improving health practices shortly after the intervention.
- **At 6 months**, the difference in practice scores remained significant, with a p-value of 0.001. The higher mean rank for the intervention group indicates that the positive effects of the health education intervention were sustained over time.

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4.14 To develop, implement and evaluate the effects of health education intervention on health seeking behavior score:

The Kruskal-Wallis test was conducted to develop, implement evaluate the effects of a health education intervention on health-seeking behaviour scores between an intervention group and a control group at 3 months and 6 months post-intervention:

3 Months Post-Intervention:

- The Kruskal-Wallis test revealed a significant difference in health-seeking behaviour scores between the intervention and control groups at 3 months, $\chi^2(1) = 21.56$, $p = 0.001$.
- The mean ranks of the health-seeking behaviour scores were 164.27 for the intervention group and 119.90 for the control group.

6 Months Post-Intervention:

- The Kruskal-Wallis test indicated a significant difference in health-seeking behaviour scores between the intervention and control groups at 6 months, $\chi^2(1) = 38.29$, $p = 0.001$.
- The mean ranks of the health-seeking behaviour scores were 192.30 for the intervention group and 173.86 for the control group.

Table 4.45: Descriptive Statistics Interpretation

Time point	Group	N	Mean Rank
3 Months	Intervention	142	164.27
	Control	141	119.90
6 Months	Intervention	142	192.30
	Control	141	173.86

The results indicate significant differences in health-seeking behaviour scores between the intervention and control groups at both 3 months and 6 months post-intervention. Specifically:

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- **At 3 months**, the intervention group had significantly higher health-seeking behaviour scores compared to the control group, with a p-value of 0.001. This suggests that the health education intervention was effective in improving health-seeking behaviours shortly after the intervention.

- **At 6 months**, the difference in health-seeking behaviour scores remained significant, with a p-value of 0.001. The higher mean rank for the intervention group indicates that the positive effects of the health education intervention were sustained over time.

4.15 To develop, implement and evaluate the effects of health education intervention on Health belief model factors (such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers).

The Kruskal-Wallis test was conducted to develop, implement evaluate the effects of a health education intervention on Health belief model factors (such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers) between an intervention group and a control group at 3 months and 6 months post-intervention:

Susceptibility

3 Months Post-Intervention:

- The Kruskal-Wallis test revealed a significant difference in susceptibility scores between the intervention and control groups at 3 months, $\chi^2(1) = 17.78$, $p = 0.001$.
- The mean ranks of the susceptibility scores were 200.68 for the intervention group and 81.90 for the control group.

6 Months Post-Intervention:

- The Kruskal-Wallis test indicated a significant difference in susceptibility scores between the intervention and control groups at 6 months, $\chi^2(1) = 29.81$, $p = 0.001$.
- The mean ranks of the susceptibility scores were 201.42 for the intervention group and 83.16 for the control group.

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Severity

3 Months Post-Intervention:

- The Kruskal-Wallis test revealed a significant difference in severity scores between the intervention and control groups at 3 months, $\chi^2(1) = 10.45$, $p = 0.001$.
- The mean ranks of the severity scores were 197.77. for the intervention group and 96.56 for the control group.

6 Months Post-Intervention:

- The Kruskal-Wallis test indicated a significant difference in severity scores between the intervention and control groups at 6 months, $\chi^2(1) = 10.67$, $p = 0.001$.
- The mean ranks of the severity scores were 189.70 for the intervention group and 95.62 for the control group.

Benefit:

3 Months Post-Intervention:

- The Kruskal-Wallis test revealed a significant difference in benefit scores between the intervention and control groups at 3 months, $\chi^2(1) = 19.35$, $p = 0.001$.
- The mean ranks of the benefit scores were 205.42. for the intervention group and 76.93 for the control group.

6 Months Post-Intervention:

- The Kruskal-Wallis test indicated a significant difference in benefit scores between the intervention and control groups at 6 months, $\chi^2(1) = 22.59$, $p = 0.001$.
- The mean ranks of the benefit scores were 206.61 for the intervention group and 78.13 for the control group.

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Barriers

Months Post-Intervention:

- The Kruskal-Wallis test revealed a significant difference in barrier between the intervention and control groups at 3 months, χ^2 (1) = 51.47, p = 0.001.
- The mean ranks of the barriers scores were 173.96 for the intervention group and 107.80 for the control group.

6 Months Post-Intervention:

- The Kruskal-Wallis test indicated a significant difference in barriers scores between the intervention and control groups at 6 months, $\chi^2(1) = 56.47$, p = 0.001.
- The mean ranks of the barriers scores were 175.32 for the intervention group and 104.45 for the control group.

CDITNs

Months Post-Intervention:

- The Kruskal-Wallis test revealed a significant difference in CDITNs scores between the intervention and control groups at 3 months, $\chi^2(1) = 3.12$, p = 0.001.
- The mean ranks of the CDITNs scores were 155.54. for the intervention group and 128.37 for the control group.

6 Months Post-Intervention:

- The Kruskal-Wallis test indicated a significant difference in CDITNs scores between the intervention and control groups at 6 months, $\chi^2(1) = 8.27$, p = 0.001.
- The mean ranks of the CDITNs scores were 149.86 for the intervention group and 134.08 for the control group.

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Table 4.46: Descriptive Statistics Interpretation

Susceptibility Score			
Time point	**Group**	**N**	**Mean Rank**
3 Months	Intervention	142	200.68
	Control	141	81.90
6 Months	Intervention	142	201.42
	Control	141	83.16
Severity Score			
Time point	**Group**	**N**	**Mean Rank**
3 Months	Intervention	142	197.77
	Control	141	96.56
6 Months	Intervention	142	189.70
	Control	141	95.62
Benefit Score			
Time Point	**Group**	**N**	**Mean Rank**
3 Months	Intervention	142	205.42
	Control	141	76.93
6 Months	Intervention	142	206.61
	Control	141	78.13
Barrier Score			
Time Point	**Group**	**N**	**Mean Rank**
3 Months	Intervention	142	173.96
	Control	141	107.80
6 Months	Intervention	142	175.32
	Control	141	104.45
CDITNS			
Time Point	**Group**	**N**	**Mean Rank**
3 Months	Intervention	142	155.54
	Control	141	128.37
6 Months	Intervention	142	149.86
	Control	141	134.08

The results indicate significant differences in health-seeking behaviour scores between the intervention and control groups at both 3 months and 6 months post-intervention. Specifically:

- **At 3 months**, the intervention group had significantly higher health-seeking behaviour scores compared to the control group, with a p-value of 0.001. This suggests that the health education intervention was effective in improving health-seeking behaviours shortly after the intervention.
- **At 6 months**, the difference in health-seeking behaviour scores remained significant, with a p-value of 0.001. The higher mean rank for the intervention group indicates that the positive effects of the health education intervention were sustained over time.

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4.16 Effectiveness of Health Education Intervention on Practice towards ITNs use

4.16.1 Comparison of Practice towards ITNs use between Groups (intervention and control) and Time Points (baseline, post- intervention and follow up) respectively

Generalized estimating equation (GEE) was used to assess the level of practice of the respondents after the Health Education Intervention between groups (intervention and control) and time points (baseline, post-intervention and follow up)respectively.

Table 4.22 shows that respondents in the intervention group were more likely to have good Practice compared to respondents in the control group (AOR = 8.434, 95% CI: 5.032 – 14.135, p <0.001). Respondents at post-intervention and follow up were more likely to have good Practice compared to respondents at baseline respectively (AOR = 0.127, 95% CI: -2.479 – -1.652, p <0.001; AOR = 14.993, 95% CI: -3.275 – 3.275, p < 0.001).

Table 4.47: Comparison of Practice towards ITNs between Groups (intervention and control) and Time Points (baseline to post-intervention and follow up) respectively using GEE

	B	SE	Crude odd ratioExp (B)	Wald chi-square	95% CI		p-value
					Lower bound	Upper bound	
Groups							
Control	Ref						
Intervention	2.132	0.2635	8.434	65.487	5.032	14.135	<0.001*
Timepoints							
Baseline	Ref						
Post-intervention	-2.065	0.209	0.127	95.894	-2.479	-1.652	<0.001*
Follow up	3.080	1.670	14.993	165.012	-3.275	3.275	<0.001*

*Significant <0.05; SE = Standard error; CI = Confidence Interval; Ref = Reference category; B = Unstandardized beta.

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4.17 Effectiveness of Health Education Intervention on Practice towards ITNs use between Groups (interventionand control) and Time Points (baseline, post-intervention and followup) adjusted with Covariates

GEE was used to assess the effectiveness of Health Education Intervention on Practice towards ITNs from baseline to post-intervention and follow up adjusted with covariates. Factors with $p < 0.25$ at a univariate level were tested as the covariates in the final model.

Table 4.17 shows the Practices of respondents towards ITNs between intervention and control group from baseline to post-intervention and follow up, adjusted with covariates. There was no significant difference between intervention and control group for Practice (AOR = 1.552, 95% CI: 0.900– 1.901, p = 2.676). Respondents at post-intervention and follow up were more likely to have good Practice compared to respondents at baseline respectively (AOR = 4.164, 95% CI: 6.273 – 3.165, p <0.001; AOR = 4.164, 95% CI: 6.273 – 3.165, p <0.001).

There was a significant interaction at post-intervention and follow up, respondents at post intervention and follow up were more likely to have good Practice compared to respondents in the control group at baseline respectively (AOR = 0.002, 95% CI: 3.088 – 9.034, p < 0.001; AOR = 0.002, 95% CI: 3.985 – 22.471, p < 0.001).

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Table 4.48: Effectiveness of Health Education Intervention on Practice towards ITNs use between Groups (intervention and control) and Time Points (baseline, post-intervention and follow up) adjusted with Covariates using GEE

Variables	B	SE	Adjustedodds ratio Exp (B)	WaldChi-square	95% CI		p-value
					Lower bound	Upperbound	
Intercept	-0.381	0.510					
Groups							
Control	Ref						
Intervention	0.440	0.278	1.552	2.503	0.900	2.676	0.114
Timepoints							
Baseline	Ref						
Post-intervention	6.134	4.455	4.164	3.985	6.273	3.165	<0.001*
Follow up	6.134	4.455	4.164	8.985	6.273	3.165	<0.001*
Interaction							
Control *baseline	Ref						
Intervention *post-intervention	-6.140	0.921	0.002	12.929	3.088	9.034	<0.001*
Intervention*follow up	-6.140	0.982	0.002	25.212	3.985	22.471	<0.001*
Age							
18-22	Ref						
23-27	-0.622	0.9181	0.537	0.828	0.141	2.689	0.363
28-32	-0.055	0.9260	0.057	0.017	0.461	2.050	0.896
33-37	0.079	0.6260	1.082	0.024	0.398	2.422	0.878
38 & above	0.634	0.4472	1.885	1.585	0.703	5.057	0.208
Ethnicity							
Ibibio	Ref						
Efk	1.998	0.9181	7.374	4.736	1.220	44.582	0.030
Hausa	-0.255	0.9260	0.775	0.076	0.126	4.759	0.783
Igbo	-0.664	0.6208	0.515	1.145	0.152	1.738	0.285
Yoruba	-0.100	0.4472	1.105	0.050	0.460	2.656	0.823
Place of Residence							
City	Ref						
Village	0.394	0.3927	1.484	1.009	0.687	3.203	0.315
Marital Status							
Single	Ref						
Married	0.889	0.8155	2.432	1.188	0.492	12.028	0.276
Widowed	0.941	0.5571	2.561	2.850	0.859	7.633	0.091
Divorced	0.870	0.6438	2.386	1.824	0.676	8.428	0.177

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Table 4.48: Continued

Level of education[a]							
Non-formal	Ref						
Primary	-2835	0.7172	6.028	13.563	1.478	2.458	<0.001*
Secondary	-2.527	0.8688	3.018	32.266	5.497	1.656	<0.001*
Tertiary	2.091	0.3370	1.715	6.746	8.861	3.321	<0.001*
Monthly income							
#10,000-#50,000	Ref						
#51,000-#100,000	0.445	0.0919	1.560	23.410	1.303	1.868	<0.001*
#101,000-#200,000	0.397	0.2911	1.487	1.857	0.840	2.631	0.173
#201,000 & Above	0.831	0.6944	2.296	1.433	0.589	8.954	0.231
Knowledge Score[a]							
Low	Ref						
High	0.938	0.2682	2.555	2.241	1.511	4.322	<0.001*
Attitude Score[a]							
Negative	Ref						
Positive	-2.063	0.2618	0.127	6.123	0.076	0.212	<0.001*
Susceptibility[a]							
Low	Ref						
High	-2.029	0.3283	0.131	3.189	0.069	0.250	<0.001*
Severity[a]							
Low	Ref						
High	0.982	0.2859	2.670	11.804	1.525	4.676	<0.001*
Benefits[a]							
Bad	Ref						
Good	0.940	0.270	2.561	2.129	1.509	4.348	<0.001*
Barriers[a]							
Bad	Ref						
Good	-1.760	0.2956	0.172	5.441	0.096	0.307	<0.001*
CDITNs[a]							
Bad	Ref						
Good	1.281	0.2844	3.599	2.274	2.061	6.285	<0.001*

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CHAPTER 5

DISCUSSION

5.1 Socio-demographic Characteristics among Intervention and Control at Baseline

This chapter presents the results of the study, provides reasons for the findings, and compares these findings with results from other studies.

The findings reveal that the mean age of the respondents is 2.61 years. The study showed no significant difference in the age of respondents between the intervention and control groups, similar to studies in Nigeria and southwest Ethiopia (Balami et al., 2019; Gunn et al., 2015). These studies, which focused on pregnant women, involved similar age ranges due to biological and social factors influencing childbearing age, typically spanning from late teens to early adulthood. Conducted in regions with similar levels of healthcare access and utilization, these studies showed comparable age distributions among pregnant women accessing services, with no significant difference in age.

The ethnicity of respondents showed no significant difference between the intervention and control groups, consistent with a study in Nigeria (Balami et al., 2021). Both studies were conducted in the same country with similar geopolitical and social structures, producing comparable results. In Nigeria, where efforts are made to include various ethnic groups in public health interventions, similar outcomes are often reported.

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Marital status and monthly income of the respondents also showed no significant difference between the intervention and control groups, agreeing with a study in Nigeria (Amoran et al., 2012). Additionally, there was no significant difference between the groups in employment status, education status, and place of residence, aligning with studies from Iran and Nigeria (Ghahremani et al., 2014; Balami et al., 2021). Methodological rigor, representative sampling, and the socio-demographic characteristics of the study populations contribute to balanced demographic variables across intervention and control groups, leading to consistent results across different studies.

The study reveals no significant differences in sociodemographic characteristics between the intervention and control groups at baseline, indicating the groups are comparable due to effective randomization.

5.2 Knowledge, Attitude and Practice among Intervention and Control at Baseline

5.2.1 Knowledge of respondents towards Insecticide treated nets use between intervention and control

This study hypothesized that there were no significant differences in knowledge about insecticide-treated nets (ITNs) use between the intervention and control groups at baseline. This aligns with other studies on ITNs use (Balami et al., 2019; Fatungase et al., 2012; Amoran et al., 2012), which found similar baseline knowledge across different groups before interventions. Poor knowledge about ITNs use may be due to a lack of awareness about malaria's impact during pregnancy, including low birth weight, preterm birth, intrauterine growth restriction, and stillbirth. Public health

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campaigns promoting ITNs use might not have been widespread or effective enough to reach both groups. Additionally, some pregnant women may not have been exposed to health education programs or interventions about ITNs, resulting in similar levels of poor knowledge.

This study further reveals that the mean ± SD knowledge score of respondents in the intervention group (12.35 ± 2.5) was higher than that of the control group (12.30 ± 2.04). High scores were observed for the following knowledge statements: malaria is not an infectious disease (112.4%), malaria is spread by mosquito bites (141.5%), malaria can be prevented by cleaning the house and its environment (139.5%), fever and loss of appetite are common symptoms (141.0%), sleeping under ITNs prevents mosquito bites (136.0%), ITNs need regular re-treatment to remain effective (118.9%), ITNs are one of the most effective tools to prevent malaria in pregnant women (126.9%), and pregnant women should attend programs for malaria prevention (132.5%). This aligns with a study conducted in Mali on ITNs use following a malaria education intervention (Rhee et al., 2005), which reported increased knowledge and use of ITNs post-intervention. Similar findings include high awareness about ITNs preventing mosquito bites and the need for regular re-treatment, as well as studies in Nigeria (Balami et al., 2019; Fatungase et al., 2012; Amoran et al., 2012), emphasizing the importance of education in improving knowledge and practices related to ITN use.

5.3 Attitude of Respondents towards Insecticide Treated Nets Use Between Intervention and Control

This study hypothesized no significant difference in the attitude of respondents towards ITNs use between the intervention and control groups at baseline. Similarities

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were observed in intervention studies conducted in Nigeria on the impact of health education interventions on ITNs uptake (Amoran, 2012), emphasizing the effectiveness of communication strategies for enhancing ITNs utilization in Sudan (Elmosaad et al., 2016) and Nigeria (Amoran, 2013).

5.4 Practice of Respondents towards Insecticide treated nets use Between Intervention and Control

The study's results revealed no significant difference between the intervention and control groups at baseline in practices towards malaria preventive measures. This includes how often respondents received ITNs from their health center, forgot to use their ITNs, washed their mosquito nets, checked for holes in their mosquito nets, and ensured other household members slept under mosquito nets. The overall practice at baseline showed no significant difference between the groups, aligning with other studies on ITNs practice (Amoran et al., 2012) and recommendations in Northern Nigeria (Solanke et al., 2023).

5.5 Health Seeking Behaviour Towards ITNs use between intervention and control group at Baseline

The health-seeking behaviour of respondents was similar between the intervention and control groups at baseline. More than half of the respondents indicated that their family members had developed malaria, with the majority seeking treatment from medicine shops and only seeking treatment when malaria occurred. Most respondents reported that it took 30 minutes to 2 hours to reach the hospital/clinic, often using public transport. In the intervention group, respondents reported good health services from their hospitals (84, 77.8%) but cited high costs as a reason for not seeking treatment at health facilities (Yewhalaw et al., 2010).

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5.6 Health Belief Model Factors between intervention and control at baseline

There was no significant difference in Health Belief Model constructs between the intervention and control groups at baseline. This aligns with studies reporting no significant difference in perceived susceptibility, severity, benefits, and barriers between groups at baseline in Vanuatu (Watanabe et al., 2014). These constructs influence practice towards ITNs use and knowledge about malaria, reducing disease burden (WHO, 2022). Compliance with ITNs use was assessed, with the majority reporting having 2 bed nets at home, although some respondents were not shown how to hang the nets and had not used them in the past four weeks. Frequent travel also impacted ITNs use (Yirsaw et al., 2021).

This study hypothesized no significant differences in knowledge, attitude, practice, health-seeking behaviour, and compliance/adherence towards ITNs between the intervention and control groups at baseline. This reduces information bias, supporting the interpretation of post-intervention differences. Any improvement in the intervention group could be attributed to the Health Education Intervention, indicating balanced and comparable groups at baseline.

5.7 Effectiveness of Health Education Intervention on Knowledge, Attitude and Practice

5.7.1 Effectiveness of Health Education Intervention on Practice towards Insecticide treated nets use

The study reveals a statistically significant difference between the intervention and control groups for practice ($p < 0.001$). There was a significant improvement in

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practice towards ITNs use at post-intervention ($p < 0.001$) and follow-up ($p < 0.001$). The significant increase post-intervention and follow-up compared to baseline may be attributed to the Health Education Intervention module. The findings support the effectiveness of Health Education Intervention in improving ITNs use among pregnant women attending antenatal clinics at the University of Nigeria Teaching Hospital (UNTH) Enugu, Nigeria.

The effectiveness of the Health Education Intervention in this study is supported by similar educational interventions in Pakistan ($p < 0.05$), Ethiopia ($p < 0.001$), South Africa ($p < 0.001$), Nigeria ($p < 0.05$), and Ghana ($p < 0.001$) (Cox et al., 2018; Kebede et al., 2020; Amoran, 2013; Ayi et al., 2010).

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CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The World Health Organization has acknowledged the importance of using insecticide-treated nets (ITNs) among pregnant women. They stated that over the last two decades, ITNs have significantly contributed to the progress seen in reducing malaria cases worldwide. A 2015 modelling analysis published in Nature suggested that ITNs drove most of the declines in malaria seen from 2005–2015, especially in moderate-to-high transmission areas. However, progress since 2015 has slowed (WHO, 2023). In 2021, there were 43 countries with ITN campaigns planned, including 14 countries that planned to distribute only ITNs carried over from 2020.

In conclusion, the findings from the study show that the Health Education Intervention module was effective in improving practice (primary outcome), knowledge, attitude, health-seeking behaviour, and health belief model constructs (secondary outcomes) of pregnant women towards the use of insecticide-treated nets, as supported by the statistical evidence discussed in the previous chapter. Based on these findings, it can be concluded that improvements in knowledge, attitude, practice, and health-seeking behaviour were associated with the quality of the Health Education Intervention module and the methodology of its delivery among pregnant women.

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These findings suggest that interactive lectures, group discussions, brainstorming, throw ball question time, role play, and practical demonstrations are useful in disseminating health education information to this target group, thereby increasing their level of practice with minimal human and economic resources. Furthermore, it is important for governments and practitioners to include the needs of distributing ITNs among high-risk groups, especially pregnant women, in their promotion programs. Follow-up studies should also be conducted to determine the effectiveness of teaching the modules over several clinic visits, covering one module at each visit. If effective, this approach would eliminate the need for additional clinic visits while still achieving the desired outcome. A tracking system for participants should also be implemented to minimize loss to follow-up.

6.2 Social Determinants

Insecticide-treated nets (ITNs) are one of the most effective tools for preventing malaria, especially in regions where the disease is endemic. However, the use of ITNs is influenced by various social determinants of health (SDH), which are the conditions in which people are born, grow, live, work, and age. These determinants significantly impact health outcomes, including the adoption and proper use of ITNs. This thesis explores how SDH such as socioeconomic status, education, cultural beliefs, gender dynamics, and healthcare infrastructure influence ITN use, providing a comprehensive understanding supported by in-text references and academic literature.

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6.3 Socioeconomic Status

6.3.1 Income and Affordability

Income levels directly impact the ability of individuals and households to acquire and use ITNs. Although many ITN distribution programs provide nets for free or at subsidized prices, there are often hidden costs associated with obtaining and maintaining them. For instance, transportation costs to distribution points or markets can be prohibitive for low-income families (Eisele et al., 2011). Moreover, when nets need replacement or repair, those with limited financial resources may prioritize other immediate needs over purchasing new ITNs.

6.3.2 Employment and Occupation

Employment type and working conditions can also affect ITN usage. Individuals working in agriculture, particularly in rural areas, are more likely to be exposed to malaria-carrying mosquitoes due to their work environments. However, these same individuals often have irregular incomes and may struggle to afford ITNs. Seasonal workers who migrate for employment may not carry ITNs with them, leading to inconsistent protection (Tusting et al., 2015).

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6.4 Education

6.4.1 Awareness and Knowledge

Education plays a crucial role in understanding the importance of ITNs and how to use them correctly. Higher educational attainment is generally associated with better knowledge of malaria transmission and prevention strategies, including the use of ITNs. Educated individuals are more likely to recognize the benefits of ITNs and ensure their consistent use within the household (Noland et al., 2014).

6.4.2 Health Literacy

Beyond general education, health literacy—the ability to obtain, read, understand, and use healthcare information to make appropriate health decisions—is vital. Communities with higher health literacy levels are more likely to effectively utilize ITNs. Health literacy can influence not only the initial uptake of ITNs but also their proper maintenance and use, ensuring long-term efficacy (Nutbeam, 2016).

6.5 Cultural Beliefs and Practices

6.5.1 Perceptions of Malaria

Cultural beliefs about the causes and transmission of malaria can significantly impact ITN use. In some cultures, malaria may not be recognized as a mosquito-borne disease but rather attributed to spiritual causes or other non-scientific explanations. These misconceptions can reduce the perceived importance of ITNs (Sagna et al., 2020).

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6.5.2 Traditional Practices

Traditional sleeping arrangements and practices can also influence ITN usage. In some cultures, sleeping outdoors or in communal areas without proper net coverage is common, reducing the effectiveness of ITNs. Moreover, certain traditional beliefs might discourage the use of ITNs, especially if they are perceived as incompatible with cultural norms (Winch et al., 2012).

6.6 Gender Dynamics

6.6.1 Women's Empowerment

Gender dynamics within households and communities can affect ITN use. Women, who often bear the primary responsibility for childcare and household health, may not have the autonomy to make decisions about purchasing or using ITNs. Empowering women through education and economic opportunities can lead to better health outcomes, including increased ITN use (Seymour et al., 2017).

6.6.2 Gender Roles

Traditional gender roles can also influence sleeping arrangements and, consequently, ITN use. In some cultures, men, women, and children may sleep in separate areas, with different access to ITNs. Ensuring equitable distribution and use of ITNs within households requires addressing these gender-specific barriers (Hill et al., 2016).

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6.7 Healthcare Infrastructure

6.7.1 Access to Healthcare

Access to healthcare services, including malaria prevention programs, is a critical determinant of ITN use. In areas with limited healthcare infrastructure, distribution and education efforts may be insufficient. Strengthening healthcare systems and ensuring that ITNs are readily available and accessible can enhance their use (Korenromp et al., 2013).

6.7.2 Community Health Workers

Community health workers (CHWs) play a vital role in promoting ITN use, particularly in remote or underserved areas. CHWs can provide education, distribute ITNs, and follow up with households to ensure proper use and maintenance. Supporting CHW programs can bridge gaps in healthcare access and improve ITN coverage (Hamer et al., 2012).

6.8 Case Studies

6.8.1 Sub-Saharan Africa

In Sub-Saharan Africa, where the malaria burden is highest, socioeconomic disparities, educational gaps, and cultural beliefs significantly impact ITN use. Programs that integrate community engagement and education have shown promise. For instance,

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the use of CHWs to distribute ITNs and provide malaria education has improved uptake and adherence in several countries (WHO, 2021).

6.8.2 Southeast Asia

In Southeast Asia, mobile and migrant populations pose unique challenges for ITN use. Innovative approaches, such as providing portable ITNs and integrating malaria prevention into broader health services for migrants, have been effective. Addressing the specific needs of these populations requires a nuanced understanding of their living and working conditions (Smith Gueye et al., 2014).

6.9 Policy Implications

6.9.1 Multisectoral Approaches

Effective malaria prevention requires multisectoral approaches that address the broader SDH. Policies that improve education, economic opportunities, and healthcare access can create an enabling environment for ITN use. Collaboration between health, education, and social services is essential to address the root causes of health disparities (Bhutta et al., 2013).

6.9.2 Community Engagement

Engaging communities in malaria prevention efforts is crucial. Participatory approaches that involve community members in designing and implementing ITN distribution programs can enhance their relevance and acceptability. Community-led

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initiatives can also foster a sense of ownership and responsibility for health outcomes (Ridde et al., 2014).

6.9.3 Gender-Sensitive Strategies

Implementing gender-sensitive strategies that empower women and address gender-specific barriers to ITN use is essential. Programs that promote women's education, economic participation, and decision-making power can improve health outcomes for entire communities (Dillon et al., 2020).

The use of ITNs is a key component of malaria prevention, but its effectiveness is influenced by a complex interplay of social determinants of health. Addressing these determinants requires a holistic approach that goes beyond simply providing ITNs. By improving socioeconomic conditions, education, healthcare access, and gender equity, we can create an environment where ITNs are more likely to be used effectively, ultimately reducing the burden of malaria. Sustainable and equitable malaria control efforts must consider these broader social factors to achieve a lasting impact.

6.10 Strength and Limitation of the Study

6.10.1 Strength

One of the strengths of this study is that it was a randomized control trial with a two-arm, double-blind design and a validated questionnaire. The study design and tools allowed the assessment of knowledge, attitude, practice, and health-seeking behavior using the Health Belief Model as the theoretical framework.

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To the best of our knowledge, there was no previous research among pregnant women aged 18 years on knowledge, attitude, and practice in the eastern part of Nigeria. Additionally, there was no previous research available among these age groups using a randomized controlled trial based on the Health Belief Model. This was the first intervention module on insecticide-treated nets developed based on the HBM model. Consequently, findings from this study can be used as fundamental data for future studies in Enugu State, the eastern part of Nigeria, and Nigeria at large.

Moreover, significant improvements have been observed in knowledge, attitude, and practice towards insecticide-treated nets, accomplished with a low-intensity intervention that can be implemented within existing patient care settings in the hospital.

6.10.2 Limitation

The study included pregnant women from government hospital, which does not represent all pregnant women in Enugu State (comprising 27 districts). As a result, the findings may not be a true representation of pregnant women in Enugu State, since some of the communities are urban, while others are semi-urban and rural. Limitations of the intervention include the non-inclusion of pregnant women in their third trimester and those already diagnosed with malaria. The study relied on self-reported questionnaires, which can introduce bias. Other limitations include limited time and lack of funding.

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6.11 Recommendations for Future Studies

With limited research on insecticide-treated nets programs using the Health Belief Model for pregnant women, especially in Nigeria, this study provides important findings that significantly add to the literature on the role of health education interventions in improving knowledge, attitude, practice, and health-seeking behavior towards ITNs use in Enugu Metropolitan Council, Enugu State, Nigeria. However, further research is needed to address certain areas, including:

1. Including pregnant women attending private hospitals.
2. Conducting both community-based and facility-based (clinic) interventions to capture pregnant women at all levels, especially those who do not attend antenatal clinics or use traditional practitioners for delivery.
3. Involving tertiary institutions or colleges in future studies to educate about ITNs using the Health Belief Model theory. Introducing interventions early in life, by raising awareness among students, teachers, and parents, can mitigate the risk of non-use of ITNs among the populace.
4. Exploring the use of social media and mass media, such as reality shows involving pregnant women. Given that social media is the fastest form of communication among these age groups globally, utilizing electronic media can increase awareness effectively.

6.11.1 Recommendations for Stakeholders

The Health Education Intervention module has successfully improved knowledge, attitude, practice, and health-seeking behaviour among pregnant women, reducing the risk of non-use of ITNs. Stakeholders should create awareness among pregnant and non-pregnant women about effective preventive measures. They can adapt the Health Education Intervention module and make it available to Nigerian women, especially pregnant women. Utilizing this education intervention module can promote healthy

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living, encourage antenatal attendance, and empower women to take charge of their health, thereby reducing the risk of non-use of ITNs among pregnant women and the general population.

The Nigeria National Malaria Strategic Plan (NMSP) outlines strategies such as mass distribution campaigns, continuous distribution through antenatal and immunization services, and community-based channels. Regular monitoring and evaluation are integral to these efforts to ensure ITNs remain effective and widely used. The plan also highlights the importance of community engagement and education to encourage proper and consistent use of ITNs.

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Section A: Socio Demographic Profile			
Instruction: Please answer all questions. Kindly tick [√] your appropriate answer and/or fill in the blank			
1.	Date of birth: (DD/MM/YY)	…….	
2.	Ethnicity:	Ibibio [ ] Hausa [ ] Yoruba [	Efik [ ] Igbo [ ] Others (please specify):
3.	Place of residence:	City [ ]	village[ ]
4.	Marital status:	Single [ ] Widowed [ ]	Married [ ] Divorced [ ]
5.	Level of Education	Non – formal [ ] Primary [ ]	Secondary [ ] Tertiary [ ] Others [ ]
6.	Monthly household income	#10,000 – 50,000 [ ] #101,000 – 200,000 [ ]	#51,000 - 100,000 [ ] #201,000 and above [ ]
7.	Employment status	Employed [ ]	Unemployed [ ]
Please turn to the next page			

Section B: Knowledge on Malaria and ITNs				
INSTRUCTION: For each statement, please tick ✓ **"True", "False", or "I don't know".** If you do not know, please do not guess; instead, please tick "Don't Know."				
Statement		**True**	**False**	**I don't know**
1.	Malaria is not an infectious disease			
2.	Malaria is been spread by mosquito bites			
3.	Malaria can be prevented by cleaning the house and environment			
4.	Fever and loss of appetite are the most common symptoms of malaria			
5.	Mosquitoes are most likely to bite during the night			
6.	Sleeping under insecticide treated nets prevent mosquito bites			
7.	Insecticide treated nets can only be purchased at the health centre			
8.	Torn insecticide-treated are no longer effective			
9.	Insecticide-treated nets need regular re-treatment to remain effective			
10.	Pregnant women will develop cough while sleeping under insecticide treated nets			
11.	The use of insecticide treated nets reduce complication during pregnancy			
12.	Insecticide treated nets should be given to only pregnant women			
13.	Insecticide treated nets is one of the most effective tools to prevent malaria in pregnant women			
14.	Pregnant women show sign and symptoms of malaria more than the general population			
15.	Pregnant women showing signs and symptoms of malaria illness should be treated before a diagnosis can be made			
16.	Pregnant women do not suffer from malaria			
17.	Malaria causes complications during pregnancy			
18.	Pregnant women should attend programs for prevention of malaria using insecticide treated nets			

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SECTION C: ATTITUDE TOWARDS MALARIA AND INSECTICIDE TREATED NETS (ITNS)

INSTRUCTION: please **tick (√)** only one answer for each statement. Each statement is answered based on a 5point scale which is

1. Strongly disagree
2. Disagree
3. Don't know
4. Agree
5. Strongly agree

Section C: Attitude towards Malaria and ITNs						
Instruction: Please read each statement and kindly circle one best answer from the scale of answers provided below.						
	Statement	**Strongly disagree**	**Disagree**	**Unsure**	**agree**	**Strongly agree**
1.	People should avoid having close contact with someone that has malaria.	1	2	3	4	5
2.	I think that one can recover spontaneously from malaria without any treatment	1	2	3	4	5
3.	I am sure that I can treat myself if I get malaria	1	2	3	4	5
4.	I think malaria can be transmitted from one person to another like the common cold	1	2	3	4	5
5.	I think I can buy anti-malaria drugs from the drug shop/pharmacy to treat myself when I get malaria	1	2	3	4	5
6.	I think the best way to prevent myself from getting malaria is to avoid getting mosquito bites	1	2	3	4	5
7.	I think I should seek for advice or treatment when I get malaria	1	2	3	4	5
8.	I believe sleeping under a mosquito net during the night is one way to prevent myself from getting malaria	1	2	3	4	5
9.	In my opinion, I think children and pregnant women are at risk of malaria more than other groups.	1	2	3	4	5
10.	I might be at a greater risk of getting malaria if I work or sleep overnight in the garden or forest	1	2	3	4	5
11.	I am sure that anyone can get malaria	1	2	3	4	5
12.	I think it is dangerous when malaria medicine dose is not taken completely	1	2	3	4	5
13.	I think that I should go to the health centre/clinic to have my blood tested as soon as I suspect that I have symptoms of malaria	1	2	3	4	5

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14.	I think that malaria is a serious and life-threatening disease	1	2	3	4	5
15.	I believe that using mosquito nets is the best way for prevention against malaria	1	2	3	4	5
16.	In my opinion, people prefer using a mosquito net than mosquito repellent spray to prevent mosquitoes	1	2	3	4	5
17.	I believe it is more difficult to use a mosquito net than taking drugs when you suffered from malaria	1	2	3	4	5
18.	In my opinion, insecticide treated nets prevent women from complication during pregnancy	1	2	3	4	5

SECTION D: Practices About Malaria Preventive Measures

INSTRUCTION: Please choose one appropriate answer for the statement below

a. Never

b. Rarely

c. Every Once in A While

d. Sometimes

e. Almost Always

Section D: Practices about malaria preventive measures						
Instruction: Please tick only one box for each question						
Statement		**Never**	**Rarely**	**Every once in a while**	**sometimes**	**Almost always**
1.	How often do you receive insecticide treated net from the health centre?	1	2	3	4	5
2.	How often do you forget to use your insecticide treated nets?	1	2	3	4	5
3.	How often do you wash your mosquito nets?	1	2	3	4	5
4.	How often do you check for holes in your mosquito nets?	1	2	3	4	5
5.	How often do you repair your mosquito nets?	1	2	3	4	5
6.	How often do you use anti-mosquito spray in your house?	1	2	3	4	5
7.	How often do you clean/cut bushes around your house?	1	2	3	4	5
8.	How often do you remove stagnant water near your house?	1	2	3	4	5
9.	How often do you use mosquito repellent on your body?	1	2	3	4	5

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10.	How often do you use mosquito coils in your house?					
11.	How often do you visit health centre when you develop malaria?	1	2	3	4	5
12.	How often do other members of your household sleep under mosquito nets?	1	2	3	4	5

SECTION E: Health seeking behaviors questions. Please, choose the right answer

1. How is your health in general? (**tick off appropriately)**

a. Very good ☐
b. Good ☐
c. Moderate ☐
d. Bad ☐
e. Very bad ☐

2i. Have any of your family member develop malaria? _____

2ii. **If yes**, where do you seek treatment when you develop malaria?

a. Did not seek for treatment ☐
b. Government hospital ☐
c. Private hospital ☐
d. Medicine shop ☐
e. Traditional practitioner ☐

3. What time do you take to seek treatment?

a. 1 day (24hours) ☐
b. 2 days (more than 24hours) ☐
c. 3 days (more than 48hours) ☐

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d. 4 days ☐

e. any time it occurs ☐

4. How long do you take to reach the Hospital/Clinic? **(please tick one)**

a. 30mins – 2 hours ☐

b. 3 – 4 hours ☐

c. 5 – 6 hours ☐

d. 7 – 8 hours ☐

e. More than 8 hours ☐

5. How do you go to the hospital/clinic? **(you can choose more than one answer)**

a. Walking ☐

b. Public transport ☐

c. Private car ☐

d. Motorcycle ☐

e. Bicycle ☐

6. How are the health services that you receive at the hospital? **(please tick one)**

a. Very good ☐

b. Good ☐

c. Moderate ☐

d. Bad ☐

e. Very bad ☐

7. What are the reasons for not going to health facilities? **(you can choose more than one answer)**

a. The health facility is too far away ☐

b. The health facility is too expensive ☐

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c. The health facility lacks medical expertise ☐
d. I do not trust those people ☐
e. I haven't been sick but I would consider going there ☐

8. Do you think people always first seek health care in the hospital? **(please tick one)**

a. Never ☐
b. Rarely ☐
c. Every once in a while ☐
d. Sometimes ☐
e. Almost always ☐

9. What do you think about the staff attitude towards pregnant women? **(please tick one)**

a. Very good ☐
b. Good ☐
c. Moderate ☐
d. Bad ☐
e. Very bad ☐

10. What do you think about ITNs usage to prevent complication during pregnancy? **(please tick one)**

a. Very good ☐
b. Good ☐
c. Moderate ☐
d. Bad ☐
e. Very bad ☐

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11. If you would go to a health facility, what are the characteristics that made you to choose that particular health facility? **(please tick one)**

a. Cheap ☐
b. Services ☐
c. Moderate ☐
d. Expensive ☐
e. Very expensive ☐

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SECTION F: QUESTIONS ON CONSTRUCTS OF HEALTH BELIEF MODEL
INSTRUCTION: please tick **(√)** the appropriate answer for each statement/option.

Section B: Questions on constructs of Health Belief Model						
Instruction: Please read each statement and kindly circle one best answer from the scale of answers provided below.						
Statement		**Strongly disagree**	**Disagree**	**Unsure**	**Agree**	**Strongly agree**
Susceptibility						
1.	My chances of getting malaria are high.					
2.	My physical health makes it more likely that I will get malaria.					
3.	I feel that my chances of getting malaria in the future are good.					
4.	There is a good possibility that I will get malaria.					
5.	I worry a lot about getting malaria.					
6.	Within the next year I will get malaria.					
Severity		**Strongly disagree**	**Disagree**	**Unsure**	**Agree**	**Strongly agree**
1.	The thought of malaria scares me.					
2.	When I think about malaria, I feel nauseous.					
3.	If I had malaria, my career would be affected					
4.	When I think about malaria, my heart beats faster.					
5.	I think malaria is a hopeless disease.					
6.	Malaria would endanger my unborn baby					
7.	My feelings about myself would change if I got malaria.					
8.	I am afraid to even think about malaria during pregnancy					
9.	My financial security would be affected if I got malaria during the pregnancy					
10.	I think the problems I would experience from malaria would last a long time.					
11.	I think if I develop malaria, it would be more serious than other diseases.					
12.	If I had malaria, my whole life would change.					
Benefits		**Strongly disagree**	**Disagree**	**Unsure**	**Agree**	**Strongly agree**
1.	I think doing malaria test every month prevents future problems for me.					
2.	I have a lot to gain by buying drugs from pharmacy when I have malaria.					

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3.	Sleeping under ITNs can help me prevent complications in pregnancy					
4.	I would not be so anxious about malaria if I did monthly test					
Barriers		**Strongly disagree**	**Disagree**	**Unsure**	**Agree**	**Strongly agree**
1.	It is embarrassing for me to do monthly malaria test.					
2.	Conducting a malaria test every month will make me spend a lot of money.					
3.	Doing malaria examination test during pregnancy can be painful.					
4.	Malaria examination tests are time-consuming.					
5.	Sleeping under insecticide treated nets causes heat/ discomfort to me and my unborn baby					
6.	I am afraid to sleep under insecticide treated net because it is treated with chemicals					

SECTIONS G: COMPLIANCE/ADHERENCE TO THE USE OF INSECTICIDE-TREATED BED NETS

INSTRUCTION: Please tick only one answer for each question unless 'tick all that apply' is written

1. How many treated bed nets do you own?

____ 1 ☐
____ 2 ☐
____ 3 ☐
____ 4 or more ☐

2. Were you shown how to hang the insecticide treated nets when you received it? **(please tick one)**

Yes ☐
No ☐

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3. Did you sleep under any treated bed net last night? **(please tick one)**

Yes ☐

No ☐

4. How often did you sleep under a treated bed net at night in the past one week? **(please tick one)**

____ Never ☐

____ 1 – 3 times ☐

____ 4 – 6 times ☐

____ 7 times ☐

5. How often did you sleep under a treated bed net in the past four weeks? **(please tick one)**

____ Never ☐

____ Every night ☐

____ 2 – 7 times per week ☐

____ every day ☐

6. Is there any time when treated bed net is not used in the past one week?

Yes ☐

No ☐

7. How often do you travel out of your home?

____ Never ☐

____ 2 – 7 times per week ☐

____ every day ☐

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8. Do you use insecticide treated nets when travel?

Yes ☐

No ☐

Appendix 2

Face validity

Training time table

S/N	Topics	Methodology	Time
	Day 1		
1.	Self-introduction	-	9.00 - 9.20 am
2.	Setting of ground rules	Participatory discussion	9.20 - 9.25 am
3.	Objectives of the training and training schedule Rules	Discussion	9.25 - 9.35 am
4.	Going through the health education module	Individual	9.35 - 9.45 am
5.	Lecture on the use of insecticide treated nets	Brainstorming, discussion	9.45 - 10.45 am
6.	Break and refreshment	-	10.45 - 11.00 am
7.	Lectures on the objectives of the research	Brainstorming, discussion	11.00 – 12.00 pm
8.	Practical's in pairs of two	Practical's	12.00 – 1.45 pm
9.	Wrap up/closing	-	12.45 – 1.00 pm
	Day 2		
10.	Reminding ourselves of the set ground	Discussion	9.00 – 9.10 am
11.	Revision session	Discussion, brainstorming	9.00 – 9.40 am
12.	Field practical's	Pairs	9.40 - 12.30 pm
13.	Refreshment/break	-	12.30 – 12.45 pm
14.	Wrap up/closing remark	-	12.45 – 1.00 pm

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Health intervention Module

HEALTH EDUCATION INTERVENTION MODULE



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2023/2024

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Dedication

This module is dedicated to my late mother, Mrs. Augustine Nnenna Opara, and to all pregnant women in Nigeria, as well as all women trusting God for pregnancy.

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EFFECTS OF HEALTH EDUCATION INTERVENTION ON INSECTICIDE TREATED NETS USE AND ITS PRACTICES AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC IN UNIVERSITY OF NIGERIA TEACHING HOSPITAL (UNTH) ENUGU, NIGERIA

Intervention Guidelines for Research Assistants

August-February 2023

Session 1: Health Education

Objective: To provide trainees with a basic understanding of health education

Activities

Important notes: The Nurses first introduces herself, and ask the participants (the pregnant women) to introduce themselves, then the Nurses will explain to the participants the purpose for having this programme, and the very need for participants to be actively involved in the discussion.

Method: The Nurses goes through the material, while actively involving the participants, especially during evaluation at the end of the course.

Learning Objectives: At the end of the module the participants should be able to:

1. Definition of health education
2. Types of health education
3. Importance of health education
4. Health education materials

Brainstorming: Discussion on health education (30 minutes).
Presentation: Definition of health education, types of health education, importance of health education and health education materials. (45 minutes).
Group activity: Role play and group discussion on health education. (30 minutes).
Review. 15 minutes.
Total: 2 hours

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Materials and Method: Power point presentation, flip charts, posters

Health Education

Definition

Health education has been defined as a systematic experience in which a combination or varieties of methods are used. These might include the provision of information and advice and behaviour modification techniques, which influence the way the patient experiences his/her illness and/or his/her knowledge and health behaviour, aimed at improving or maintaining or learning to cope with a condition, usually a chronic one (Engers et al., 2008).

- Health education is a significant component of modern health care and can be divided into two large categories—clinical health education (or clinical teaching and learning) and health education.
- **Health education** is also a teaching and learning process which is also similar to patient education. However, it concentrates mostly on wellness, prevention, and health promotion. Additionally, health education can be provided to individuals, groups, and communities. **The basic focus of health education is to change and improve the societal health behaviors**.
- Health Education is a planned process of **learning** experiences that enable people to make **voluntary** adaptations in their **behavior** in order to improve and maintain their **health**.



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Types of Health education

There are at least three types of health education.

- The first and most common is education about the body and how to look after it. The provision of information and advice on human biology and hygiene is vital for each new generation.

- The second is about health services-information about available services and the 'sensible' use of health care resources.

- The third is about the wider environment within which health choices are made, which is relatively neglected. It is concerned with education about national, regional, and local policies, which are too often planned and implemented without taking account of their consequences for health. This third type is part of the currently declining public health tradition. At a time when many are trying to improve methods of health education at least equal attention should be paid to its content.



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The importance of health education can be summarized as follows:

- Improved understanding of medical condition, diagnosis, disease, or disability.
- Improved understanding of methods and means to manage multiple aspects of medical condition.
- Improved self-advocacy in deciding to act both independently from medical providers and in interdependence with them.
- Increased Compliance – Effective communication and patient education increases patient motivation to comply.
- Patient Outcomes – Patients more likely to respond well to their treatment plan – fewer complications.
- Informed Consent – Patients feel you've provided the information they need.
- Utilization – More effective use of medical services – fewer unnecessary phone calls and visits.
- Satisfaction and referrals – Patients more likely to stay with your practice and refer other patients.
- Risk Management – Lower risk of malpractice when patients have realistic expectations.

Health Education Materials

Choosing effective health education materials

Your patient's preferences can guide your choice of education materials and method.

- Find out how your patient likes to learn.
- Be realistic. Focus on what your patient needs to know, not on what is nice to know.
- Pay attention to the patient's concerns. The person may have to overcome a fear before being open to teaching.
- Respect the patient's limits. Offer the patient only the amount of information they can handle at one time.
- Organize the information for easier comprehension.

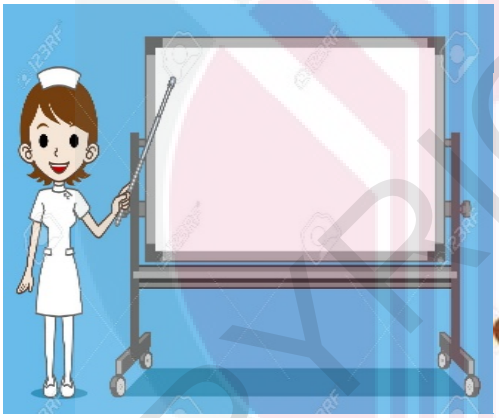
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Be aware that you may need to adjust your education plan based on the patient's health status and environmental factors.

Basic Priorities

From the health education, you will likely need to cover:

- What your patient needs to do and why
- When your patient can expect results (if applicable)
- Warning signs (if any) your patient should watch for
- What your patient should do if a problem occurs
- Who your patient should contact for questions or concerns?







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[Source: Malaria free Zone project, 2017]

When selecting materials:

- The type of resources that a patient or support person responds to varies from person to person. Using a mixed media approach often works best so we will be using power point presentation, flip clips and poster on health education for this module.
- Keep your assessment of the patient in mind. Consider factors such as literacy and culture as you develop a plan.
- Avoid fear tactics. Focus instead on the benefits of education. Tell your patient what to pay special attention to.
- Be sure to review any materials you plan to use before sharing them with the patient. Keep in mind that no resource is a substitute for one-on-one patient teaching.

Health learning materials are those teaching aids that give information and instruction about health specifically directed to a clearly defined group or audience. The health learning materials that can be used in health education are usually broadly classified into four categories: printed materials, visual materials, audio and audio-visual materials but we will be using printed materials for this module which includes Posters, flip clips and Power point presentation.

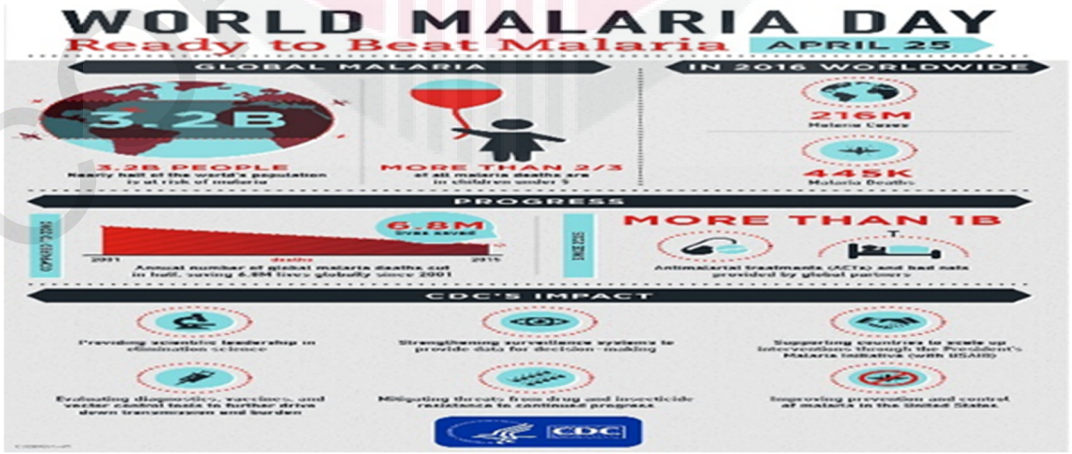
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Posters

In recent years, the use of posters in communicating health messages has increased dramatically. Since a poster consists of pictures or symbols and words, it communicates health messages both to literate and illiterate people. It has high value to communicate messages to illiterate people because it can serve as a visual aid.

The main purposes of posters are to reinforce or remind people of a message received through other channels, and to give information and advice — for example to advise people to learn more about malaria. They also function to give directions and instructions for actions, such as a poster about practical malaria prevention methods by use of insecticide treated nets. Posters can also serve to announce important events and programmes such as World Malaria Day.

Visual aids like posters explain, enhance, and emphasize key points of your health messages. They allow the audience to see your ideas in pictures and words.



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[Source: Malaria free Zone project, 2017]

Flip chart

Flip charts are useful to present several steps or aspects that are relevant to a central topic, such as, demonstration of the proper use of mosquito nets or how Malaria is transmitted. When you use the flip chart in health education you must discuss each page completely before you turn to the next and then make sure that everyone understands each message. At the end you can go back to the first charts to review the subject and help people remember the ideas.



[Source: 2014 JHUCCP/USAID COMMIT Project]

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Power Point Presentation



Learning Methods

Group discussion involves the free flow of communication between a Nurses and two or more participants. Group discussion will be done after use of Power point presentation. This type of teaching method is characterized by participants having an equal chance to talk freely and exchange ideas with each other. In most group discussions the subject of the discussion can be taken up and shared equally by all the members of the group. In the best group discussions, collective thinking processes can be used to solve problems. These discussions often develop a common goal and are useful in collective planning and implementation of health plans. Group discussions do not always go smoothly and sometimes a few people dominate the discussion and do not allow others to join in. Your job as the Nurse is to establish ground rules and use strategies to prevent this from happening.

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[Source: UNICEF Ethiopia/Indrias Getachew]

Role play is usually a spontaneous or unrehearsed acting out of real-life situations where others watch and learn by seeing and discussing how people might behave in certain situations. Learning takes place through active experience; it is not passive. It uses situations that the members of the group are likely to find themselves in during their lives. You use role playing because it shows real situations. It is a very direct way of learning; participants are given a role or character and have to think and speak immediately without detailed planning, because there is usually no script. In a role-playing situation people volunteer to play the parts in a natural way, while other people watch carefully and may offer suggestions to the players. Some of the people watching may decide to join in with the play.

The purpose of role play is that it is acting out real-life situations in order that people can better understand their problems and the behaviour associated with the problem.

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Role play can give people experiences in communication, planning and decision making. For example, it could re-evaluate their attitudes towards the use of insecticide treated nets by hearing from other participants.



[Source: UNICEF Ethiopia/Indrias Getachew]

Evaluation:

Game evaluation using Big orange marble twenty-sided dice: The participants will make a cycle using their chairs and each participant will randomly pick number from the big orange marble dice then the nurse will hold hands with participants while singing a song and after each song, the nurse will throw the dice on the table and the person with the correct number will be asked a question from what has been discussed during the power point presentation.

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1. Definition of health education
2. Types of health education
3. Importance of health education
4. Health education materials



Session 2: Basic Facts on Malaria and Insecticide Treated Nets Among Pregnant Women

Objective: To train the nurses on the knowledge of Malaria and insecticide treated nets and to provide basic understanding of the challenges of Malaria in pregnancy, the burden of malaria and public health challenges posed by malaria, the transmission of malaria, maternal malaria, symptoms of malaria, diagnosis of malaria, treatment of malaria during pregnancy and postpartum, prevention of malaria during pregnancy and compliance to the use of ITNs.

Activities

1. **Brainstorming:** The nurse goes through the material, while actively involving the participants through brainstorming, especially during evaluation at the end of the course. Game on impact of malaria on immune system of pregnant women, and discussion on compliance to ITNs (30 minutes).

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2. **Learning Objectives:** At the end of the section the participants should be able to state:

    i. Overview of malaria in pregnancy

    ii. Complications of malaria during pregnancy

    iii. Consequences of malaria in pregnancy

    iv. The goals of ITNs

    v. Barriers to the use of ITNs

    vi. Overview of compliance of ITNs and its importance

    vii. The benefits of compliance to ITNs

    viii. Consequences of poor compliance

    ix. Forms of non-compliance (45 minutes).

3. Group activity: Discuss strategies to promote ITNs (30 minutes).

4. Review. 15 minutes.

Total: 2 hours

Materials and Method: Power point presentation, game, flip charts

Overview of Malaria in Pregnancy

Malaria is a life-threatening disease caused by the protozoan plasmodium that is transmitted to people through the bites of infected Anopheles mosquitoes, called "malaria vectors" which bite mainly between nightfall and dawn.

There are four protozoan species that cause malaria in humans: Plasmodium falciparum Plasmodium vivax, Plasmodium malariae and Plasmodium ovale.

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Plasmodium falciparum and Plasmodium vivax are the most common. Plasmodium falciparum is the mostly deadly. Some of human cases of malaria have also occurred with Plasmodium knowlesi in forested areas of South-East Asia.



The Burden of Malaria in Pregnancy

Globally, an estimated 3.2 billion people in 97 countries are at risk of being infected with malaria and developing the disease, of which 1.2 billion are at high risk (WHO 2014).

Malaria primarily affects low and lower income countries and within endemic countries, the poorest and most marginalized communities. Most of malaria cases and deaths occur in Sub-Saharan Africa, but Asia, Latin America and to a lesser extent the Middle East and part of Europe are also affected. Approximately 25 million pregnant women are at risk of infection by P. falciparum annually in Africa (WHO 2014).

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Complications of Malaria During Pregnancy

Parity and age are important determinants of risk of infection among pregnant women. Primigravidae and younger maternal age (adolescents) have poorer immunity to malaria compared to their older and multiparous counterparts. The risk of infection is also highest during the second trimester.

In Africa, a quarter of cases of severe anemia in pregnancy are attributable to malaria. The percentage of maternal deaths attributed directly or indirectly to malaria is approximately 10% in both hospital studies (0.5% to 23.0%) and community-based studies (2.9% to 17.6 %). This does not differ much from estimates in low-transmission regions outside Africa (0.6 to 12.5%).

Placental malaria doubles the risk of low birth weight. Compared to multiparous women, primigravid women have a two- to seven times the risk of low birth weight deliveries. Low birth weight in itself is a major risk factor for neonatal mortality but

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Malaria-induced low birth weight is estimated to be responsible for 3 to 17 deaths per 1000 live births.

It is also estimated that 11.4% of neonatal deaths and 5.7% of all infant deaths in malaria- endemic areas of Africa may be caused by malaria in pregnancy-associated low birth weight.

Malaria may lead to low birth weight through causation of fetal growth restriction or preterm delivery. In high-transmission areas, malaria-related fetal growth restriction may be twice as high as malaria-related preterm delivery. Contrastingly, in low-transmission settings, the predominant cause of low birth weight is preterm delivery.



Consequences of Malaria in Pregnancy

Stillbirths, spontaneous abortions, fetal anaemia may also be consequences of maternal parasitaemia.

Placental malaria diminishes fetal cellular and antibody response to P. falciparum making the infant susceptible to malaria.

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Transplacental antibody transfer is also compromised, increasing susceptibility to other pathogens such as tetanus and Streptococcus pneumonia.

HIV increases the risk of placental malaria infection, high density parasitemia, febrile illness and worsens severe anaemia and low birthweight.

HIV also eliminates the gravidity specific pattern of malaria in areas with stable transmission from paucigravid to all pregnant women.



The Goals of Insecticide Treated Nets

WHO recommends the use of insecticide treated nets (ITNs) for malarial control in Africa, especially all people at risk in the areas targeted for malaria. It is currently projected that one ITNs should be distributed for every two people. This method may require refinement for implementation at household level: for example, one option is to distribute to each household one ITN for every two members of the household, rounding up in households with an odd number of members. ITNs should be either

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provided freely. Cost should not be a barrier to making them available to all people at risk of malaria, especially those at greatest risk such as pregnant women and children under the age of five years (WHO, 2011).

Universal coverage with ITNs is best achieved and maintained by a combination of delivery systems: a mass distribution campaigns can achieve rapid initial coverage, but need to be supplemented by routine delivery to pregnant women through antenatal service (WHO, 2011). In order to be protected, households must not only own ITNs but also use them. Behaviour change interventions including information, education, communication (IEC) campaigns and post-distribution "hang-up campaigns" are strongly recommended (WHO, 2011).

Only ITNs recommended by the WHO Pesticide Evaluation Scheme (WHOPES) should be obtained by national malaria control programmes and partners for malaria control. These nets are designed to maintain their biological efficacy against vector mosquitoes for at least three years in the field under recommended conditions of use, preventing the need for regular insecticide treatment (WHO, 2009). Using the same insecticide for multiple successive Indoor Residual Spraying (IRS) cycles is not recommended; instead, it is preferable to use a system of rotation with a different insecticide class being used each year (WHO, 2017). In areas where IRS is the main vector control intervention, this rotation system may include a pyrethroid. In areas with high ITN coverage, pyrethroids should not be used for IRS.

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Barriers To the Use of ITNS

i. Affordability (sometimes referred to as financial access) and includes the costs of seeking care and ability to cope;

ii. Availability (also known as physical access), referring to the geographical location of health care services in relation to the clients and;

iii. Acceptability, referring to the nature of service provision and how individuals and communities perceive it. Acceptability includes the social and cultural aspects of access.



[Source: UNICEF, 2018]

Overview Of Compliance of ITNs and Its Importance

- Compliance refers to 'the act of conforming, yielding or acquiescing' which implies a lack of patient participation.
- By compliance, it is meant that the patient did not play more active role in following the instruction provided by the health practitioner. Compliance portrays the patient's behaviour of not using his/her bed nets – at the right time, with the right insecticide treated nets and the right frequency.

Does compliance differ from 'Adherence'?

Adherence is defined as 'the act or quality of sticking to something — to adhere to something'. From the perspective of treatment with medications, adherence is explained as a more concerted process between the patient and provider.

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What does 95% compliance translate into?

Supposedly, if the patients should sleep under the bed nets every day or twice in a week over month (30days). To achieve 95% compliance would require that a patient sleep under bed nets at least twice in a week and if the patient misses sleeping under the nets, that would result in less 95% compliance. To achieve a successful treatment outcome, the patient requires to obtain a prefect compliance levels greater than 95%. In order to obtain the full benefits of ITNs, it is critical to adhere to treatment regimen.

The benefits of compliance to ITNs include;

- the health of the pregnant woman, her fetus and the newborn infant
- effectiveness against mosquitoes that carry malaria and other diseases
- reduces the prevalence of low birth weight by as much as a third in the first two pregnancies
- promotion of immune reconstitution and slowed disease progression.

It has been established that **compliance greater than 95%** is needed to achieve a successful ITNs use, especially for pregnant women in their early pregnancies (Paterson et al., 2000).

Consequences of poor compliance include;

- Low birth weight
- Premature birth
- Anaemia
- Maternal and neonatal mortality
- Malaria progression

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Forms of non-compliance

- Not sleeping under the treated bed nets
- Not sleeping under the treated bed nets at night for the past one week
- Not observing the holes in the treated bed nets
- Not re-treating the bed nets when worn out

Activity: Discuss factors affecting compliance to ITNs
Factors affecting compliance to ITNs

- **Socio-demographic factors** (age, gender, place of residence – rural or urban, ethnicity, marital status, level of education, monthly household income and employment status)
- **Biological factors** (vectors behavior; most effect of ITN on a vector's lifespan and population numbers can be expected with species that are highly endophagic, anthropophilic and bite mostly during the time when people are under nets. In Nigeria, there are no species that consistently combine all these favourable characteristics and hence these factors are very important to consider in the context of ITN application.
- **Patient-related factors** (reasons for non-use)
- **Health care team factors** (appointment scheduling, compliance counselling & monitoring)

Measuring Compliance

Measuring compliance is problematic as there is no single method use to assess the compliance accurately. There is no "Gold Standard". Therefore, multiple approaches are used to assess compliance.

- **Self-reports**: This is one of the methods of assessing and monitoring compliance in ITNs program. Self-report as a measure of compliance which entails asking patients to report on how often they use or forgotten to use ITNs over a given period of time.
- **Treated nets use:** Treated nets use are form of personal protection that has been shown to reduce malaria illness, severe disease, and death due to malaria

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in endemic regions. This method has been found to be cost effective. However, bed nets treated with insecticide are more effective than those ones not been treated.

Early ITN projects

ITN projects have been implemented in many countries since the 1980s. These projects, and the degree to which they have been successful, have varied in ways that include:

- rationale for the geographical area of implementation (e.g. organizational mandate, historical presence);
- transmission intensities and vectors in the implementation area;
- indicators for monitoring and evaluation;
- target group or population;
- type and variety of nets and insecticide supplied;
- distribution mechanism for nets and/or insecticide;
- outlet for delivery of nets and/or insecticide;
- pricing policy for nets and insecticide;
- methods used to promote ITNs;

Re-treatment rates were high initially when the service was provided at no charge, but fell dramatically when fees for re-treatment were introduced.

Enhancing Compliance can be done through;

Counselling: Counselling forms the mainstay of any treatment program. Counseling aims to improve patient knowledge about the disease and also have knowledge about ITNs use and side effects of malaria in pregnancy. Counselling helps the patient to set

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goals, to develop positive beliefs and perceptions and to increase self-efficacy. In addition to counselling, patients often need other forms of support to be able to follow to treatment.



Listening is almost a forgotten art. There is a lot to be said for just talking to the patient, finding out a bit more about the barriers/reasons of not using ITNs always. Our widening role enables us to have conversations and gain a better understanding of our patients and be able to explain to them the complications of malaria pregnancy if ITNs is not been used often to prevent mosquitos' bites.



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Antenatal/ITNs diaries: These are diaries where the patients record the time and date she uses ITNs, when she forgot to use and her reasons for not using the bed net. These can serve as useful records of side effect or other problems patients may experience during this intervention. This is a great useful took to identify patterns of use and reasons for missing out.



Physical activities related to transporting and distributing ITNs to individuals, and the demand-side activities include education and behavior change campaigns to promote "net cultures" in malaria susceptible regions, pricing schemes, and interventions to assist in effective use of ITNs. Successful ITN delivery requires effective ITNs; therefore, there is an important role that should be play by the "pre-supply" activities that involve developing novel insecticides, netting, and other innovations that improve ITNs themselves. The important concept here is that successful delivery of ITNs for malaria prevention involves both getting effective ITNs out to prospective users (supply-side) and ensuring that ITNs are used once they are available (demand-side).

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Evaluation

Evaluation will be done by number tags e.g (1-10) on a piece of paper, folded and placed inside a basket, where the numbers will be used to asked questions, the nurse will hold the basket and pass it to all participant, then ask them to pick randomly from the basket. The questions will be asked based on the number tags and those that picked tags without a number on it will not answer any question. That is how it goes until all questions are exhausted with the tags serving as a link to all participant. The questions will be based on:

1. Overview of malaria in pregnancy
2. Complications of malaria during pregnancy
3. Consequences of malaria in pregnancy
4. The goals of ITNs
5. Barriers to the use of ITNs
6. Overview of compliance of ITNs and its importance
7. The benefits of compliance to ITNs

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8. Consequences of poor compliance
9. Forms of non-compliance

Session 3: The Ways of Improving Pregnant Women's Knowledge, Attitude and Practice

Objective: To educate the trainees about the ways of improving the respondents' knowledge, attitude and practice towards insecticide treated nets

Activities

1. Presentation: The power point presentation base on KAP (20 minutes).
2. Group activity: Role play and questions and answers on how to acquire knowledge, attitude and practice on malaria on ITNs (10 minutes).
3. Review. 10 minutes.

Total: 40 minutes

Important notes: Brainstorming: The nurse goes through the materials, while actively involving the participants through brainstorming, especially during evaluation at the end of the course. Game (little drama) on impact of ways of improving participants' knowledge, attitude and practice towards the use of ITNs. Questions and answers and also discussion will follow immediately (30 minutes).

Learning Objectives: At the end of the section the participants should be able to have:

i. Knowledge on malaria and ITNs
ii. Their attitudes towards malaria and use of ITNs
iii. Practices towards the use of ITNs to prevent malaria

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Materials And Method: A power point presentation

Knowledge About Malaria and ITNS

Malaria knowledge is regarded as a multidimensional phenomenon determined by the interplay of five factors (or dimensions): cause of the disease; transmission or how the disease is spread; effective prevention strategies; current treatment regimen; and, vulnerability to the disease.

Participants should be aware that malaria is caused by mosquito bites as exemplified in the following quote. Participants should be aware that mosquitoes feed on human blood and malaria is transmitted by mosquito bites during the process of feeding among pregnant woman.

In addition, participants could recognize the signs and symptoms of malaria, as they listed some in the questionnaire or all as signs and symptoms of malaria as given in the narrative: Infestation with malaria is associated with fever, shivering, joint pains, body weakness, body pain, dizziness, vomiting, and loss of appetite, sour mouth and sores in the mouth.

The participants should have knowledge on malaria and also ITNs. The benefits use of ITNs to prevent malaria and to understand the risk of not using ITNs during pregnancy. The appropriate time when mosquito's bites and if they will develop cough while using the bed nets.

Knowledge is typically measured using term of "True", "False" and "I don't know"

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Attitude Towards Use of ITNS

Attitudes are generally understood to be formed through a process of individual subjective evaluation (involving a rational assessment of costs and benefits), but also influenced by affective and emotional responses and related beliefs.

Participants should know that majority of the homes that use ITNs rarely fall sick because of malaria. Attitude refers to participants feeling about the use of insecticide treated nets and malaria. Respondents should give varied explanations on how they used the ITNs and what they did to ensure effective use. They should also know that use of ITNs improved health status not only preventing malaria but also protect people from other insect bites and socio-economic wellbeing of the patients. They should also believe that it is more difficult to use a mosquito net than taking drugs when you suffered from malaria so the early they use ITNs to prevent malaria the better for mother and the unborn child. Insecticide treated nets also prevent women from complication during pregnancy.

Attitudes are typically measured using two main types of scales: either Likert Scales, where there are five response categories ranging between two extreme positions, e.g. strongly agree and strongly disagree, or using semantic differential questions, which contain a set of opposites, e.g. easy – difficult, and the space between the opposites is graded from 0 expressing the lowest evaluation to 6 representing the highest evaluation.

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Practices About Preventive Measures

A best practice is commonly defined as a technique or method that, through experience and research, has proven reliably to lead to the desired result. These practices need to be shared and adopted to benefit more people. In the context of health programmes and services, a practical definition of a best practice is knowledge about what works in specific situations and contexts, without using inordinate resources to achieve the desired results, and which can be used to develop and implement solutions adapted to similar health problems in other situations and contexts. The term best practice has been referred to as good practices in other literature.

The practice in this study refers to respondents' practices regarding the use of insecticide treated nets. The nurses should find out where the participants often receive their insecticide treated net and how often do you forget to use your insecticide treated nets.

Evaluation:

Game evaluation using throw ball: The participants will make a cycle, the nurse holding the ball will sing a song while the participants dance round the cycle. The nurse will randomly throw the ball to the participant and the person with the ball will be asked a question from what has been discussed during the class.

1. What she understands by having knowledge on malaria and ITNs
2. What their attitude will be towards the use of ITNs
3. What do they use by practice?

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Session 4: The Intervention

Objective: To educate the trainees about the theoretical concept of the intervention (health education) and the intervention protocol.

Activities

1. **Presentation:** The intervention based on HBM model (30 minutes).
2. **Group activity:** Role play on how to carry out health education (30 minutes).
3. **Review.** 15 minutes.

Total: 1 hour 15 minutes

Materials and Method: flip charts, pamphlets, posters, pictograms and pill boxes.

The intervention is based on the **health belief model (HBM)** Adapted from Rosenstock, (1974). The Health Belief Model (HBM) is a psychological model that attempts to explain and predict health behaviours. This is done by focusing on the attitudes and beliefs of individuals. Accordingly, the following concepts are identified and discussed:

Perceived susceptibility: perceived susceptibility is one of the influential factors that motivate people to practice healthier behaviours. It refers to individuals' own beliefs regarding the risk of contracting an illness; the greater the perceived susceptibility, the greater the likelihood of engaging in behaviours to decrease the susceptibility.

Perceived severity: This refers to individuals' beliefs about the severity or the consequences the disease might have on her if actions are not taken. Perceived severity

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is also shaped by the previous experiences with the illness and can include assessment of the health, social and economic consequences of acquiring the disease. In this study, people seemed to need to perceive serious negative consequences from malaria for them to opt for health seeking behaviour and continue with care.

Perceived benefits: Perceived benefit signifies an individual's own judgment on the advantages of adopting and continuing with the proposed actions in order to reduce the severity or consequences of the illness. In this context, people with malaria needed to feel that the benefits of using insecticide treated nets were greater than if they did not use; they needed to feel certain that adopting ITNs practices would have a favourable outcomes.

Perceived barriers: This refers to an individual's evaluation as to what would stop her from adopting the new behaviour. If people perceived obstacles to use ITNs to prevent malaria. it was less likely that a decision for ITNs usage would be made.

Self-efficacy: is realized when perceived benefits outweigh the perceived barriers. People are normally hesitant to attempt new behaviour unless they believe they can do it.

Cues to action: relate to information and ideas about malaria that people have and the sources thereof, whether internal (symptoms, past experiences) or external (health care workers, friends, relatives, mass media), which influence their health seeking behaviour and continuity with care.

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Methods in which the intervention will be carried out:

Health education intervention in addition to routine clinic care will be used in this RCT as a means for improving ITNs use among mothers in the intervention group, while the control group will be left to receive their normal routine clinic care only.

The numbers generated from the randomization list will be inserted into the opaque sealed envelopes as unique codes. The codes will be for instance "AX" for first control group participant and "BX" for the second participant of the intervention group, these codes will be maintained throughout the study for each participant and will be used to know participants that left the study. The envelops will be rendered impermeable to intense light with an aluminium foil placed inside the envelope; this is to prevent subversion of the allocation sequence. The participant's name and date of birth will be written on the envelope and recorded on a separate sheet of paper. The information containing the allocation codes will be made visible only after the corresponding envelopes are opened at the time of consultation, and this is only after the enrolled participants complete all baseline assessments. The allotted treatment is given as stated by the information in the envelop. The envelop will be kept in the participant's folder for subsequent follow-up and the participants ante-natal visit will be rescheduled to minimize cross-contamination.

Role play by two trainees illustrating a health education session, then review and make corrections where necessary.

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What should be done before the recruitment begins?

Before the recruitment of study participants, four research assistant who are willing to abide by the study instructions will be employed into the study to serve as research assistants. They will be responsible for administering health education to the intervention group members as well as assist the researcher in the collection of data from the study participants.

The research assistant

What should be done after selection of Research Assistants

The research assistants will be having a two-day training session with the researcher, an overview of health education on insecticide treated nets, objectives of the research and study protocol will be discussed. The training manual will also be given to the research assistants as well and a flip card will also be given to them to make it so simple and easy for them to use and teach the participants.

Role of the Research Assistants

- Delivering health education to each member of the intervention group
- Recruiting study participants and guiding them to their assigned groups.
- Answering FAQs by participants during the study period.
- Distribution of questionnaires to the participants as well as guiding them through the filling of questionnaires.
- Overseeing the entire intervention process in the clinic.
- Assessing the clinic attendance and recording any participant default.

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Allocation into groups

After random selection of study participants, the research assistants will inform the enrolled participants about the study and seek informed consent. Using opaque envelopes, the study group (coded inscription) will be written, placed in the envelop and sealed. The codes will be for instance "AX" for first control group participant and "BX" for the second participant of the intervention group. The envelopes will be prepared by an independent person from the pharmacy department, who is not aware of the study. Each of the participant will randomly pick an envelope while in the doctor's office and hand it to the research assistant without opening it. The research assistant will open the envelop and record the study group of the participant. The study participants will be blinded from knowing their study groups.

The intervention group: The intervention group will be given one-on-one health education by the research assistants at every appointment visit for three months. The health education will be done in the counseling room within 30 minutes. Materials to be used for the education include pamphlets, posters, pictograms and flipcharts. The pregnant mothers will be given a small pocket booklet for putting down how many times she uses the bed nets and when she forgot to use it, and will be taught how to keep the records. Advise pregnant mothers not to share the pocket booklet with anybody and should use frequently. Each session should be documented for record purpose. The pregnant mothers will also receive the routine care offered by the clinic in addition to the health education.

The control group: The control group will receive only the routine care offered by the clinic and health education on breastfeeding at the end of the research as part of saying say thank you for participating.

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Data collection

The questionnaire

What should be done before distribution of baseline questionnaires?

The participants should be informed about the study. The respondent information sheet should be read to the participant. The participant should be given an informed consent form to sign. The questionnaires should be labelled with the participant's coded number.

What does informed consent mean?

Informed consent refers to the respondent's agreement to partake in a study. This means that the respondent understands what the study entails and what it is for, thus qualifies it to be valid. This is to ensure that no one is compelled to participate in any research unwillingly.

Why is informed consent important?

The informed consent is essential because the respondent needs to clearly understand what this study is entails and that they are liberty to quit this study at any time without any penalties or negative consequences. Ethically, it is not right to obtain information from an individual without prior knowledge and understanding of the study and where the information obtained will be processed and presented.

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What will be the consequences if they choose to stop before completing?

Failure to complete this study will attract no penalties or negative consequences. Nonetheless, it should be known by the respondent that failure to complete the questionnaire will attract no incentive. It is important to state this clearly to the respondents.

How do I prepare the participant to answer the questionnaire?

To start, the questionnaires should be labelled with the participant's coded number. Next, the research assistant should ask the participants if it is their first time of filling a questionnaire, so that proper guidance can be accorded to such individuals. Nevertheless, all participants should be carefully monitored to ensure they are filling the questionnaires correctly. After which they should be allowed some privacy to complete the questionnaire.

What should I do after they finish answering the questionnaires?

Ensure that the completed questionnaire is put in a sealed envelope before they submit it to you. Questionnaires should be carefully collected, labelled and counted to ensure no loss and securely kept for the researcher.

What do I do if I encounter any problems during data collection?

Any problems encountered should be communicated to the researcher immediately; solution to the problem will be sought as soon as possible.

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Post survey procedures

How do I deal with non-response from participants?

If there is any non-response from a participant by missing appointments or from the hospital records, the person should be called on phone and encouraged to resume for appointments or remain to fill her small pocket booklet. Details of such persons should be recorded and monitored for further observation. The concept of intention-to-treat will be used for data analysis.

Tracking defaulters

A Defaulter is a patient who has missed one or more scheduled clinic appointment, for any reason(s). Such patients should receive telephone call reminders EVERY TUESDAY and THURSDAY until they return for treatment or remind them to always mark their record in the booklet.

Where a patient could not pick up her calls after 4 consecutive telephone call reminders, an attempt should be made to visit the patient in their homes, where feasible, in order to address their concerns and bring them back on treatment or check if they are actually marking their booklet.

Lost-to-follow-up (LTFU) – a person is said to be lost to follow up if she refuses to show up for scheduled clinic visit for 3 consecutive months, after 3 consecutive attempts to track the client and bring them back on treatment.

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Section 5

Preventive measures, community norms, and how best they continue with what they have learnt spreading the information to their peers.

Time: 1 hour.

Materials: flip chart.

Method: This section will be participants centred fully. Participants will give their feedback for each question asking about knowledge, attitude, practice, preventive measures

Asking participants to ask questions, and those asking for advice based on a given scenario, participants together with the nurse should brain-storm to arrive at reasonable conclusions.

General brainstorming questions

i. What are the causes of malaria in your community?
ii. What are the Consequences of malaria in pregnancy?
iii. What are the complications of malaria during pregnancy?
iv. Ways of preventing malaria in pregnancy?
v. What are the barriers to the use of ITNs?
vi. Good knowledge, attitude and practice towards ITNs use in determinant of the future health of our pregnant mothers (special attention).
vii. What are the ways of improving pregnant women's knowledge, attitude and practices?
viii. What are the ways of improving the distribution of ITNs to pregnant mothers?

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Appendix 3

Dairies for keeping records of how many time ITNs was use



A pocket booklet for giving feedback based on ITNs usage

Name of patient	Phone number	Date	Time	feedback on use and non- use of ITNs		Remarks
				Yes	No	

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LIST OF PUBLICATIONS

Onyinyechi, O. M., Nazan, A. I. N. M., & Ismail, S. (2023). Effectiveness of health education interventions to improve malaria knowledge and insecticide-treated nets usage among populations of sub-Saharan Africa: systematic review and meta-analysis. *Frontiers in Public Health*, 11.

Onyinyechi, O. M., Ismail, S., & Nashriq Mohd Nazan, A. I. (2024). Prevention of malaria in pregnancy through health education intervention programs on insecticide-treated nets use: a systematic review. *BMC Public Health*, 24(1), 755.

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