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Factors associated with the non-use of insecticide-treated bed nets among pregnant women in Zambia

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CANDIDATE'S DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the Master of Science in Epidemiology (implementation science) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Signature: ________ Date: 18th November 2021

DEDICATION

To my mother, Susan Lungowe Mulife. May your soul continue resting in peace.

ABSTRACT

Introduction

Malaria is still a major cause of morbidity and mortality among pregnant women. In addition, malaria in pregnancy causes maternal anaemia and negative birth outcomes. In malaria-endemic areas, such as Zambia, the World Health Organisation (WHO) advocates the use of insecticide-treated nets (ITNs). ITNs have been proven to reduce the incidence of malaria during pregnancy. However, despite the Zambian government's efforts to ensure 80% use of ITNs among pregnant women, ITN use remains critically low. Only 49% of pregnant women reported sleeping in an ITN in 2018, suggesting an urgent need to establish factors associated with the non-use of ITNs among pregnant women.

Aim

This study aimed to determine the prevalence of the non-use of ITNs, and the factors associated with the non-use of ITNs among pregnant women in Zambia in 2018.

Objectives

The first objective was to determine the prevalence of the non-use of ITNs among pregnant women in Zambia. The second objective was to determine the factors associated with the non-use of ITNs among pregnant women in Zambia.

Methods

This study was a secondary data analysis of the data collected during the 2018 Zambian Demographic and Health Survey. The software used to analyse the data was STATA SE version 16. One thousand one hundred thirty-eight (1 138) pregnant women were included in this study. Descriptive statistics were used to compute the prevalence of the non-use of ITNs. Univariable and multivariable logistic regression models were then fitted to determine the factors associated with the non-use of ITNs.

Results

Most of the pregnant women (47.5%) were aged between 15 and 24 years, 36.9% were aged between 25 and 34 years, 15.3% were aged between 35 and 44 years, and only 0.3% were 45 years of age or older. Regarding residency, 63.9% of the pregnant women resided in rural areas, and 36.1% resided in urban areas. About 8.6% of the pregnant women had no education, 48.5% had attained a primary education, 37.6% had a secondary education, and only 5.3% had a tertiary education.

Overall, the study found that 570 (50.1%) pregnant women reported not using an ITN the night before the survey. Furthermore, concerning residency, the non-use of ITNs was higher among pregnant women from urban areas (54.4%). Regarding educational attainment, pregnant women who had no education had the lowest prevalence of ITN non-use (34.4%). The non-use of ITNs decreased from the low to high malaria prevalence provinces (67.2% to 35.8%, respectively).

The results of the multivariable logistic regression indicated that the number of household members (OR = 1.52, 95% CI: 1.386–1.677), educational attainment (i.e., primary school education, OR = 2.51, 95% CI: 1.371–4.583) and religion (OR = 4.88, 95% CI: 1.625–14.650) were positively associated to the non-use of ITNs among pregnant women. However, the number of ITNs in the household (OR = 0.30, 95% CI: 0.231–0.378) , parity (OR = 0.77, 95% CI: 0.616–0.955), moderate malaria prevalence provinces (OR = 0.28, 95% CI: 0.186–0.418), high malaria prevalence provinces (OR = 0.22, 95% CI: 0.141–0.336) and marital status (i.e., currently in a union, OR = 0.51, 95% CI: 0.281–0.926) were negatively associated with the non-use of ITNs among pregnant women.

Conclusion

The study shows a moderately high prevalence of the non-use of ITNs among pregnant women in Zambia. To increase and sustain the use of ITNs among pregnant women, the number of ITNs in the household, the number of household members, parity, educational attainment, religion, province, and marital status should be considered when implementing and designing ITN intervention programmes. Particularly interventions need to target pregnant women who are not in a union and ensure that households own sufficient nets to cover each household member including

pregnant women. However, all pregnant women should be targets for malaria health education this will help ensure that knowledge, practices and attitudes about ITN use are improved, the incidence of malaria is reduced and ITN use is increases and sustained.

Keywords: Zambia, Zambian Demographic and Health Survey (ZDHS), non-use of ITNs, Prevalence, Factors associated with, Pregnant women

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GLOSSARY/DEFINATION OF TERMS

Enumeration area: This is a geographical area assigned to an enumerator for the purpose of conducting a census count.

Insecticide-Treated Net: This is a factory treated net that does not require any further treatment, also known as a Long-lasting Insecticide-Treated Net (LLITN). The definition also includes a net soaked with an insecticide within the past 12 months.

Malaria: This is a severe febrile disease that is preventable and curable. Plasmodium parasites cause malaria and are spread to humans through the bite of a female Anopheles mosquito that has been infected with the parasite.

Social behaviour change communication: This is the science of changing and sustaining health behaviours in theoretically, culturally, and contextually relevant ways.

LIST OF ACRONYMS

CI:	Confidence Intervals
IPTp:	Intermittent Preventive Treatment in Pregnancy
ITN:	Insecticide-Treated Net
MiP:	Malaria in Pregnancy
OR:	Odds Ratios
SBCC:	Social Behaviour Change Communication
WHO:	World Health Organisation
ZDHS:	Zambian Demographic and Health Survey
ZMIS:	Zambia Malaria Indicator Survey

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter begins with the definition and cause of malaria and then gives an overview of the global, African, and Zambian trends in the burden of malaria. The chapter further outlines the consequences of Malaria in Pregnancy (MiP) and the burden of MiP in sub-Saharan Africa and Zambia. Also highlighted in this chapter is the use of insecticide-treated nets (ITNs) in Zambia. The chapter then leads to the problem statement, aim, objectives and the justification of the research. Finally, it concludes with a review of significant literature.

1.2 Background

1.2.1 Definition and Cause of Malaria

According to the World Health Organisation (WHO) (2021), malaria is a severe febrile disease that is preventable and curable. Plasmodium parasites cause malaria and are spread to humans through the bite of a female Anopheles mosquito that has been infected with the parasite. There are five species of plasmodium parasites. The five species are *Plasmodium Vivax*, *Plasmodium Falciparum*, *Plasmodium Malariae*, *Plasmodium Knowlesi* and *Plasmodium Ovale*. Among the five species of plasmodium parasites, *Plasmodium Vivax* and *Plasmodium Falciparum* are the world's largest threats (WHO, 2021).

1.2.2 Global, African and Zambian Trends in the Burden of Malaria

The WHO 2020 global health estimates indicate that malaria still contributes to mortality and morbidity in low-income countries. Global malaria infections increased from 228 million cases to 229 million cases between 2018 and 2019. The global number of fatalities from malaria also increased from 405 000 to 409 000 between 2018 and 2019 (WHO, 2019; 2020).

In 2018 and 2019, Africa had the highest number of malaria cases globally (213 million and 215 million, respectively) (WHO, 2019; 2020). The fatalities from malaria in Africa also increased from 380 000 to 386 000 between 2018 and 2019 (WHO, 2019; 2020). Furthermore, the estimated malaria cases in countries with high malaria transmissions in East and Southern Africa increased from 52.2 million to 59 million between 2018 and 2019 (WHO, 2019; 2020).

Zambia falls in the high transmission areas in East and Southern Africa. Among the countries with high malaria transmissions in East and Southern Africa, 5.2% of the malaria cases in 2018 and 5.3% in 2019 were in Zambia. Local statistics show that Zambia experienced an increase in reported malaria cases from 4 989 824 to 5 068 876 between 2018 and 2019 (WHO, 2020). Furthermore, the number of malaria deaths increased from 1 209 to 1 339 between 2018 and 2019 (WHO, 2020).

1.2.3 Malaria in Pregnancy

Malaria affects pregnant women disproportionately and remains one of the most preventable causes of negative birth outcomes (Desai et al., 2007; Taylor and Kuile, 2017). The negative outcomes can include low birth weight, fetal loss, retarded growth, and premature birth (Desai et al., 2007; Taylor and Kuile, 2017). In malaria-endemic countries, malaria is a major cause of maternal anaemia, which has been associated with obstetric haemorrhage and maternal mortality (WHO, 2019). Malaria-endemic countries are also disproportionately affected by iron deficiency anaemia, helminths infections and the human immunodeficiency virus, which exacerbates clinical outcomes of malaria infection in pregnancy (WHO, 2019).

1.2.4 Malaria in Pregnancy in Sub-Saharan Africa and Zambia

Malaria continues to affect pregnant women in areas of sub-Saharan Africa that experience moderate to high transmissions of malaria (WHO, 2019; 2020). Malaria infections in pregnancy were estimated to be highest in Central and West Africa in 2018 and 2019 (WHO, 2019; 2020). In the moderate to high transmission areas of sub-Saharan Africa, 29% (11.2 million) of pregnant women had malaria infections in 2018 (WHO, 2019), and in 2019, the number increased to 11.6 million (WHO, 2020). Furthermore, because of malaria infections during pregnancy, 872 000 children were born with low birth weight in 2019 (WHO, 2020).

Concerning antenatal malaria in Zambia, Inambao et al. (2017) reported that laboratory-confirmed malaria cases increased from 45 per 1 000 pregnant women in 2013 to 64 per 1 000 pregnant women in 2015. Furthermore, Luapula province, a province with a high malaria prevalence in Zambia, recorded the highest incidence rate (177 per 1 000 pregnant women) of malaria among pregnant women in 2015 (Inambao et al., 2017).

1.2.5 Insecticide-Treated Nets as a Preventive Measure in Zambia

In malaria-endemic regions, like Zambia, the WHO advocates using ITNs to prevent malaria (WHO, 2019). ITNs have been proven to reduce the incidence of malaria during pregnancy (Feleke et al., 2020; Gontie, Wolde, and Baraki, 2020; Touré et al., 2019).

Zambia implemented the policy for mass ITN distribution in 2005 (Masaninga et al., 2018). The policy entails routinely distributing ITNs to pregnant women and under-five children (Nawa et al., 2019). The 2018 Zambian Demographic and Health Survey (ZDHS) reports that 78% of surveyed households owned at least one ITN (Ministry of Health, 2020). However, the night before the ZDHS, only 58% of household members and 49% of pregnant women slept under an ITN. The reported utilisation levels of ITNs were still below the ministry of Health operational target of 80% (Ministry of Health, 2011).

Several studies have also shown discrepancies between ITN ownership and ITN use (Kanmiki et al., 2019; Pinchoff et al., 2015; Nkoka et al., 2018; Macintyre et al., 2012). The discrepancies show that increasing the ownership of ITNs may not always guarantee the use of ITNs (Inungu et al., 2017). Other factors that determine the non-use of ITNs may need to be considered to increase ITN utilisation levels. (Nkoka et al., 2018; Yaya et al., 2018; Ankomah et al., 2014; Muhumuza et al., 2016). Hence, determining the factors associated with the non-use of ITNs among pregnant women in Zambia is important.

1.3 Problem Statement

Malaria significantly contributes to mortality and morbidity in Zambia (Nawa et al., 2019). In addition, MiP is a significant public health concern in Zambia (Inambao et al., 2017). In areas where malaria is endemic, including Zambia, the WHO advocates the use of ITNs. ITNs have been proven to reduce the incidence and consequences of malaria during pregnancy (Touré et al., 2019; Gontie, Wolde, and Baraki, 2020; Feleke et al., 2020; Eisele et al., 2012; Gamble et al., 2007). However, despite the Zambian government's efforts to ensure continual distribution of ITNs to pregnant women, ITN use among pregnant women remains critically below the 80% target set in 2011 (Ministry of Health, 2011).

The ZDHS in 2002, 2007 and 2014 reported low usage levels (Central Statistical Office, 2003; 2007; Ministry of Health, 2015). The surveys reported that only 8.9%, 32.7% and 41%, respectively, of the pregnant women reported using an ITN. The most recent ZDHS in 2018 indicates that there is still a gap between overall ITN use and ownership (Ministry of Health, 2020). Seventy-eight percent (78%) of households surveyed reported owning at least one net. However, only 58% of household members and 49% of pregnant women slept under an ITN the night before the ZDHS.

Estimates from the 2018 ZDHS indicates that 51% of pregnant women did not sleep under an ITN the night before the ZDHS, putting them at risk of contracting malaria. Had the women been infected, this could have been detrimental, as MiP is known to cause maternal anaemia and negative birth outcomes (Desai et al., 2007; Taylor and Kuile, 2017; Yaya et al., 2018). The negative birth outcomes include low birth weight, fetal loss, retarded growth, and premature births. Therefore, determining the factors associated with the non-use of ITNs among pregnant women in Zambia is important for preventing malaria in this group of women, given that malaria affects pregnant women disproportionately (Desai et al., 2007; Taylor and Kuile, 2017).

1.4 Research Question

What are the factors associated with the non-use of ITNs among pregnant women in Zambia?

1.5 Aim

To determine the prevalence of the non-use of ITNs and the factors associated with the non-use of ITNs among pregnant women in Zambia in 2018

1.6 Objectives

i. To determine the prevalence of the non-use of ITNs among pregnant women aged 15–49 years in Zambia.
ii. To determine the factors associated with the non-use of ITNs among pregnant women aged 15–49 years in Zambia.

1.7 Justification

Zambia implemented the policy for mass ITN distribution in 2005 (Masaninga et al., 2018). The policy entails routinely distributing ITNs to pregnant women and under-five children (Nawa et al., 2019). Several studies in Zambia have reported factors associated with ITN use among different household members (Boulay, Lynch, and Koenker, 2014; Macintyre et al., 2012; Pinchoff et al., 2015). Wealth, education, knowledge, household size and climatic season are all related to ITN use (Boulay, Lynch, and Koenker, 2014; Macintyre et al., 2012; Pinchoff et al., 2015). Nevertheless, the studies focus was not on pregnant women or the factors that influence ITN non-use among pregnant women. Hence, this study seeks to contribute to the existing knowledge base on this topic. This study hopes to motivate and guide implementation programmes that deal with the treatment and prevention of MiP. In addition, this study hopes to provide information that will help reach the Zambian national goal of ensuring 80% use of ITNs. On a broader aspect, the knowledge from this study may contribute to the accomplishment of Sustainable Development Goal 3. Goal 3 aims to ensure healthy lives and well-being for everyone and involves ending all endemics, such as malaria, by 2030.

1.8 Literature Review

1.8.1 Introduction

This section highlights the burden of Malaria in Zambia and the importance of ITNs and their recommended use. The chapter then ends with an overview of the factors that influence ITN use among pregnant women.

1.8.2 Malaria in Zambia

Malaria remains endemic across all ten provinces of Zambia, and its entire population is at risk of contracting malaria (United States President's Malaria Initiative, 2020). The risk of malaria is most significant among those living in provinces that usually experience a wetter climate, are rural or are impoverished (United States President's Malaria Initiative, 2020). Efforts to sustain a reduction in malaria cases are still a significant challenge in Zambia (Jumbam et al., 2020). Zambia has shown an increase in reported malaria cases from 4 989 824 cases in 2018 to 5 068 876 cases in 2019. Moreover, the number of reported deaths increased from 1 209 to 1 339 in the same period. (WHO, 2020).

According to the Ministry of Health (2017), malaria incidence varies between 50 to over 500 cases per 1 000 persons in Zambia. The general incidence of malaria in Zambia was 386 per 1 000 persons in 2013, 409 per 1 000 persons in 2014, and 335 per 1 000 persons in 2015 (Inambao et al., 2017). Concerning pregnant women, the incidence of laboratory-confirmed malaria cases was 45 per 1 000 persons in 2013, 69 per 1 000 persons in 2014, and 64 per 1 000 persons in 2015. The Luapula province recorded the highest incidence rate of malaria among pregnant women (177 per 1 000 pregnant women) (Inambao et al., 2017).

1.8.3 Importance of ITNs and Recommended Delivery and Use

ITNs are a significant vector control method in malaria-endemic areas. The WHO recommends mass distribution campaigns of free ITNs, which should also be supported by the routine distribution of ITNs before, during and after the campaigns. The WHO additionally recommends at least one ITN for every two persons at risk of malaria (WHO, 2017). Governments distribute ITNs through various channels in order to maximise access and ownership of ITNs. The various channels include antenatal clinics, schools, expanded programmes on immunisation, faith-based institutions and private or commercial sector channels (WHO, 2017).

ITNs are an essential preventive intervention that has proven to reduce the incidence and consequences of malaria during pregnancy (Eisele et al., 2012; Touré et al., 2019; Gontie, Wolde, and Baraki, 2020; Feleke et al., 2020; Gamble et al., 2007). In addition, several studies found that pregnant women who sleep under an ITN have lower odds of contracting malaria when compared to those who do not sleep under an ITN (Feleke et al., 2020; Gontie, Wolde, and Baraki, 2020; Touré et al., 2019). Even when adjusting for other associated factors such as educational status, parity, number of antenatal visits, number of IPTp doses and age, pregnant women who do not sleep under an ITN are more likely to get malaria (Feleke et al., 2020; Gontie, Wolde, and Baraki, 2020; Touré et al., 2019).

Evidence has shown that sleeping under an ITN is beneficial to the health of a pregnant woman and her unborn child (Njagi et al., 2003; Gamble et al., 2007; Ter Kuile et al., 2003). For instance, in Kenya, Ter Kuile et al. (2003) found that using an ITN during pregnancy reduced the incidence of severe maternal anaemia by 47%, low birth weight by 28% and maternal malaria parasitemia by 38%. A systematic review in Africa showed that the use of ITNs decreased low birth weight by 23% and reduced fetal loss by 33% (Gamble et al., 2007). The findings were similar to a meta-analysis by Eisele et al. (2012) on 25 countries in Africa. The meta-analysis assessed the efficacy of IPTp and the use of ITNs in pregnancy. Eisele et al. (2012) found that using IPTp or ITNs during pregnancy reduced the incidence of neonatal mortality and low birth weight in newborns by 82% and 79.2%, respectively. They concluded that the use of both these preventive methods helps reduce the incidence of MiP.

1.8.4 Factors Influencing ITN Use Among Pregnant Women

Residence and region/province

Several studies have shown that the type of residency and region influences the use of ITNs (Nkoka et al., 2018; Ankomah et al., 2012; Inungu et al., 2017). For example, Ankomah et al. (2012) in Nigeria found that the odds of using an ITN among pregnant women who lived in urban areas were 1.87 (95% CI: 1.284–2.712) times the odds of using an ITN among pregnant women who lived in rural areas. Similarly, Nkoka et al. (2018) in Malawi and Inungu et al. (2017) in Congo found that pregnant women from urban areas had a higher odds of using an ITN compared to those in rural areas (OR = 1.63; 95% CI: 1.04–2.55 and OR = 1.24; 95% CI: 1.049–1.48, respectively).

Residing in a particular geographical region of the country was associated with ITN use (Nkoka et al., 2018). Nkoka et al. (2018) found that the odds of using an ITN among pregnant women who resided in the northern region of Malawi were 1.66 (95% CI: 1.12–2.45) times the odds of using an ITN among pregnant women who resided in the central region. Endo and Eltahir (2016) state that the risk of contracting malaria may vary geographically. The variation lies in the fact that some regions may have a higher malaria parasite prevalence than others and therefore individuals residing in these regions are more likely to use ITNs than those from low malaria parasite prevalence regions (Atieli et al., 2011).

Parity

Parity influences the use of ITNs by pregnant women (Muhumuza et al., 2016; Nkoka et al., 2018). For example, in Uganda, Muhumuza et al. (2016) found that pregnant women who had three to five deliveries had higher odds of using an ITN when compared to those who had fewer than three deliveries (OR = 1.71; 95 % CI: 1.01–1.29). The authors suggested that this could be because women who had less than three deliveries had insufficient knowledge about the risks that malaria poses (Muhumuza et al., 2016). Similarly, in Malawi, Nkoka et al. (2018) found that pregnant women who had two deliveries had higher odds of using an ITN than women who had only one delivery (OR = 1.79; 95% CI: 1.23–2.62). Additionally, Nkoka et al. (2018) found that pregnant women who had more than two deliveries had higher odds of using an ITN than women who had only one delivery (OR = 1.97; 95% CI: 1.28–3.28).

Number of household members and the availability of ITNs in the household

Nkoka et al. (2018) also found that the number of members in a household influences ITN use among pregnant women. They found that pregnant women from households with less than five members had higher odds of using an ITN than those from households with at least five household members (OR = 2.33; 95% CI: 1.74–3.11). Similarly, in Mali, Hill et al. (2014) stated that a high household member to ITN ratio resulted in a low ITN use. Hill et al. (2014) found that pregnant women from households with more than four people per ITN had lower odds of using an ITN than pregnant women from households with less than two people per ITN (OR = 0.16; 95% CI: 0.04–0.55).

A household needs to own enough ITNs to cover all household members to ensure full ITN coverage and usage (Nkoka et al., 2018; Babalola et al., 2016). For instance, in Malawi, it was discovered that the odds of using an ITN among pregnant women from areas with a high ITN coverage were 1.47 (95% CI: 1.05–2.06) times the odds of using an ITN among pregnant women from areas with a low ITN coverage (Nkoka et al., 2018). In addition, Nkoka et al. found that pregnant women that had at least two ITNs in their households had higher odds of using an ITN than those from households with less than two ITNs (OR = 4.25; 95% CI: 3.19–5.64).

Age

Two studies found that age influences ITN use by pregnant women (Mbengue et al., 2017; Choonara, Odimegwu, and Elwange, 2015). In Senegal, Mbengue et al. (2017) found that during pregnancy, women aged 35–49 years were more likely to use preventive measures like ITN use than women younger than 20 years (RRR = 1.62; 95% CI: 1.04–2.52). Choonara, Odimegwu, and Elwange (2015) in Kenya found that pregnant women aged 25–34 years were more likely to sleep under an ITN than pregnant women aged 15–29 years (OR = 1.52; 95% CI: 1.04–2.21). However, two other studies found no association between age and ITN use among pregnant women (Ezire et al., 2015; Nkoka et al., 2018).

Religion

Choonara, Odimegwu, and Elwange (2015) found that pregnant Muslim women were more likely to use ITNs than pregnant Christian women (OR = 2.26; 95% CI: 1.35–3.76). However, Nkoka et al. (2018) found no association between religion and ITN use among these women.

Marital status

Regarding marital status, the odds of using an ITN among married pregnant women were 2.29 (95% CI: 1.28–4.07) times the odds of using an ITN among unmarried pregnant women (Choonara, Odimegwu, and Elwange, 2015). Similarly, in Congo, Song et al. (2016) found that married pregnant women had higher odds of using an ITN than unmarried pregnant women (OR = 3.09; 95% CI: 1.43–6.63). Conversely, Inungu et al. (2017) found no association between using an ITN and marital status among pregnant women in Congo. These findings could be because married women may be influenced by their partner's decision to practice malaria prevention behaviours (Aberese-Ako et al., 2019).

Education

Several studies found that education influences ITN use among pregnant women (Muhumuza et al., 2016; Belay and Deressa, 2008; Inungu et al., 2017; Ezire et al., 2015). For instance, a study in Nigeria by Ezire et al. (2015) found that pregnant women with a secondary or tertiary education had higher odds of using an ITN than those with a primary or Quranic education (OR = 1.496; 95% CI: 0.926–2.415). Similarly, ITN use among pregnant women who attained a tertiary education was 1.3 times as likely as ITN use among those with a primary education (95% CI: 1.085–1.611) (Inungu et al., 2017).

Further evidence on how education influences ITN use among pregnant women is provided by Muhumuza et al. (2016). They found that pregnant women with a secondary education had higher odds of using an ITN than those with a level of education below secondary (OR = 2.03 95 % CI: 1.09–3.78). In addition, the study by Muhumuza et al. suggested that this was because pregnant women who were more educated have better knowledge about the risks malaria poses, hence their odds of using an ITN was higher. They further concluded that women with a level of education below secondary must be informed about the risks of malaria. However, despite the above findings, two studies found that education does not significantly affect ITN use among pregnant women (Ankomah et al., 2014; Nkoka et al., 2018).

Employment status and household wealth

Two studies found an association between the household wealth index and ITN use among pregnant women (Choonara, Odimegwu, and Elwange, 2015; Wafula et al., 2021). For example, Choonara, Odimegwu, and Elwange (2015) found that the odds of using an ITN among pregnant women from wealthier households were 1.83 (95% CI:1.17–2.83) times the odds of using an ITN among pregnant women from poorer households. Wafula et al. (2021) found that women belonging to the fifth wealth quintile had higher odds of using an ITN in pregnancy than pregnant women in the lowest quintiles (APR = 1.08, 95% CI: 1.02–1.15). Nonetheless, one study by Inungu et al. (2017) did not find an association between ITN use among pregnant women and household wealth.

Leonard et al. (2016) found that a pregnant woman's employment status was associated with the use of malaria prevention methods, such as ITN use. Leonard et al. (2016) found that pregnant women in Cameroon who were students or unemployed had lower odds of using an ITN than those who were homemakers or farmers (OR = 0.25; 95 % CI: 0.07–0.95). Nonetheless, two studies found no association between employment status and ITN use (Inungu et al., 2017; Belay and Deressa, 2008)

Accessibility of ITNs

In Uganda, Muhumuza et al. (2016) researched the factors that affect the use of interventions that prevent malaria among pregnant women. They found the following three reasons why pregnant women could not access ITNs easily: The demand for money from health workers, a shortage of ITNs, and long waiting queues at the antenatal clinic. Muhumuza et al. also found that pregnant women who reported that they could access ITNs with ease at antenatal clinics were more likely to use an ITN than those who reported that they could not access ITNs with ease at the antenatal clinics (OR = 2.74 95 % CI: 1.65–4.52).

Knowledge about malaria and social behaviour change communication

Increasing the ownership of ITNs does not always guarantee ITN use (Inungu et al., 2017). Efforts to increase ITN ownership must be accompanied by disseminating the correct knowledge about preventing and treating malaria (Yaya et al., 2018). The correct knowledge about the prevention and treatment of malaria may then influence malaria prevention behaviours such as ITN use.

Several studies found that the correct knowledge about malaria determined the use of ITNs (Ankomah et al., 2014; Inungu et al., 2017; Ezire et al., 2015). For example, In Nigeria, the odds of using an ITN among pregnant women who knew that sleeping under an ITN prevents malaria were 3.2 (95% CI: 2.28–4.33) times the odds of using an ITN among pregnant women who did not know that sleeping under an ITN prevents malaria (Ankomah et al., 2014). Similarly, Ezire et al. (2015) found that knowing about the protective effects of ITNs increased the likelihood of ITN use among pregnant women (OR = 1.813; 95% CI: 1.142–2.877). Their findings suggest that health promoting messages on the advantages of using ITNs may increase ITN use.

Apart from knowing that ITNs prevent malaria, a study in Congo reported that pregnant women who knew that a mosquito bite caused malaria were more likely to use an ITN when compared to pregnant women who lacked this knowledge (OR = 1.378; 95% CI: 1.09–1.742) (Inungu et al., 2017).

The Health Communication Capacity Collaborative report (2017, p. 6) states that social behaviour change communication (SBCC) is “the science of changing and sustaining health behaviours in theoretically, culturally and contextually relevant ways”. Therefore, SBCC is a vital communication aspect for increasing knowledge about malaria (Roll Back Malaria Partnership, 2017).

A few studies specifically looked at the impact that SBCC had on ITN use among pregnant women (Balami et al., 2019; Ankomah et al., 2014). For instance, Ankomah et al. (2014) in Nigeria found that pregnant women exposed to SBCC messages on the radio had higher odds of using an ITN than pregnant women who were not exposed to the SBCC messages (OR = 1.53; 95% CI: 1.07–2.17). Furthermore, in Nigeria, a randomised control trial was conducted to evaluate the impact of SBCC on pregnant women (Balami et al., 2019). The intervention arm received a four-part malarial training on knowledge, motivation, and behavioural skills, and the control arm received health education on breastfeeding. As a result, the intervention group achieved a 6.350% ($p<0.001$) higher score on behaviour skills such as ITN use than the control group. Thus, the study provided evidence that SBCC interventions can improve malaria-related behavioural skills among pregnant women (Balami et al., 2019).

1.9 Analytical Framework

Figure 1 shows the analytical framework with the pathways to ITN non-use. The factors in the pathways were identified based on this study's literature review. Additionally, the identified factors were used to guide the selection and extraction of the study variables from the ZDHS dataset.

The analytical framework helps visualise the three possible pathways to the non-use of ITNs. The first pathway is through the social-demographic factors (age, parity, number of household members, educational attainment, residency, wealth index, employment status, religion, marital status, province). The second pathway is through the availability factor (number of ITNs in the household). Finally, the third pathway is through a possible interaction between socio-demographic factors and the availability factor. Regarding the third pathway, Inungu et al. (2017) reported that socio-demographic and availability factors may be related because having ITNs in the household may not be enough to ensure their use.

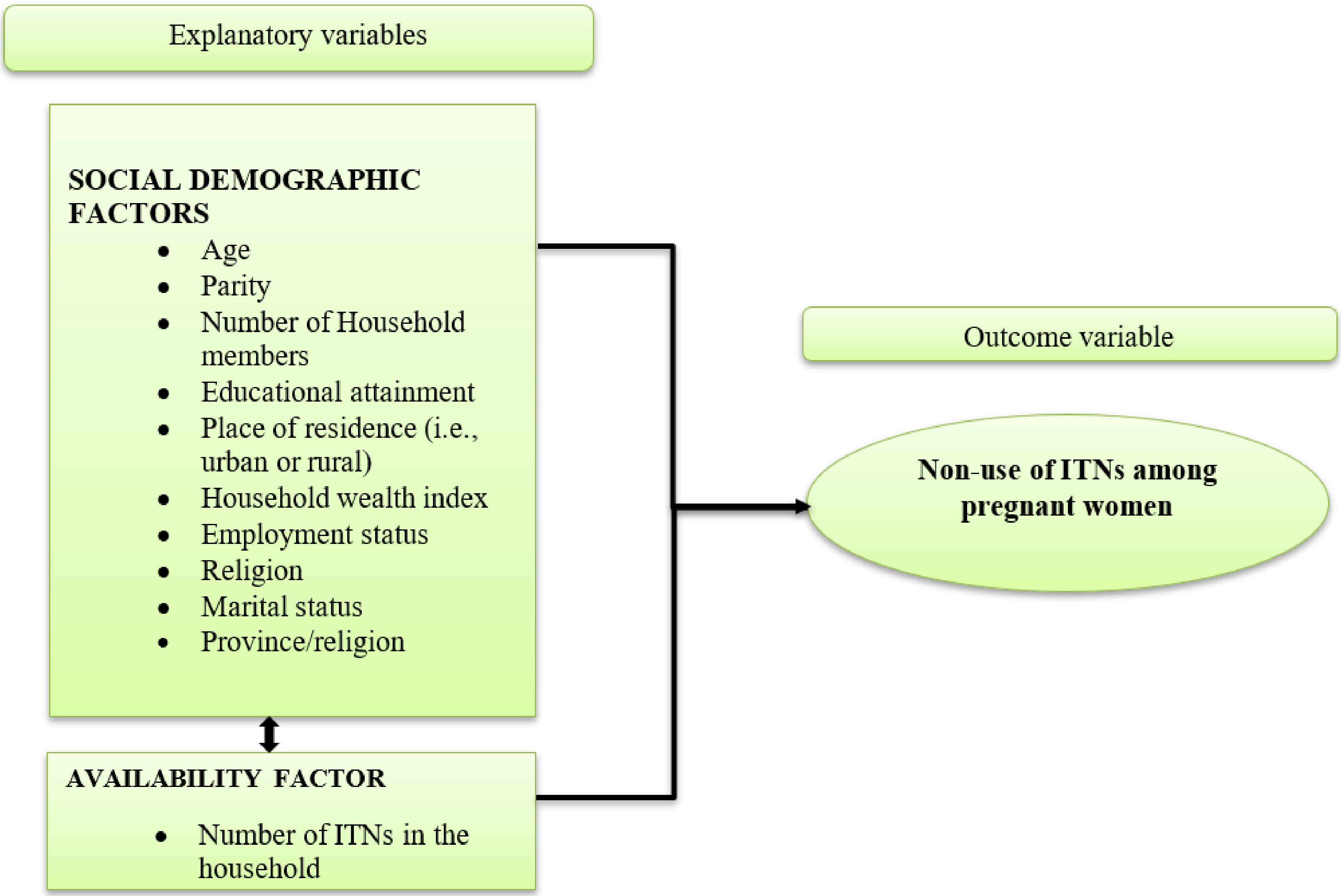

Figure 1. Analytical framework of the non-use of ITNs among pregnant women.

CHAPTER 2: METHODS

2.1 Introduction

Presented in this chapter is an overview of the study site and a description of the ZDHS. After that, the details regarding the study population, sample size, study variables and data management are given. The chapter then describes the statistical analysis, and lastly, the ethical considerations and limitations of the study are stated.

2.2 Description of Primary Study

This study used the data collected by the 2018 ZDHS to answer the research question. The ZDHS occurred from 18 July 2018 to 24 January 2019. The purpose of the ZDHS was to give recent estimates of demographic and health indicators. This is done to assist programme managers and policymakers in evaluating and creating strategies and programmes concerned with improving the quality of health in Zambia.

2.2.1 ZDHS Study and Sampling Design

The 2018 ZDHS used a cross-sectional study design. The population and housing census conducted in 2010 was the sampling frame for the 2018 ZDHS. The sampling method used for the ZDHS was a stratified cluster sampling method conducted in two stages. The first stage was selecting 545 clusters or sample points that consisted of enumeration areas. According to the Ministry of Health (2020) "an enumeration area is a geographical area assigned to an enumerator for the purpose of conducting a census count". Enumeration areas were selected using proportional allocation within each sampling stratum.

The second stage consisted of systematically sampling households. Firstly, a household listing procedure was done and produced an average of 133 households in every cluster. After that, a selection of 25 households per cluster produced a representative national sample size of 13 625 households. The selection process was an equal probability systematic procedure.

Individuals eligible for the survey were men aged 15–59 years and women aged 15–49 years. Additionally, the women and men had to be regular members of the chosen households or in the selected households the night before the survey. Twelve thousand two hundred nineteen (12 219) women and 1 1043 men were scheduled for interviews. In the end, 13 683 women and 12 132 men were interviewed.

2.3 Study Population

Pregnant women in the childbearing age group (15–49 years) that were interviewed during the 2018 ZDHS were included in this study.

2.4 Study Sample

The ZDHS dataset had 1 138 pregnant women in their childbearing age group who were interviewed. Therefore, the 1 138 pregnant women were considered as this study's sample.

2.5 Study Site

Zambia is a country in Southern Africa that is divided into ten provinces: The Lusaka, Luapula, Muchinga, Copperbelt, Central, Eastern, Southern, Northern, North-Western and Western provinces (Figure 2). The estimated total population in 2019 was 17.3 million people. Of the 17.3 million people, 57.2% lived in rural areas, and 48.2% lived in urban areas (Zambia Statistics Agency, 2019).

Zambia's weather is tropical with three seasons: A dry winter season, a dry, hot season, and a warm, rainy season (Central Statistical Office, 2009). The dry winter is between May and August, the dry, hot season is between September and October, and the warm, rainy season is between November and April (Central Statistical Office, 2009). Malaria transmissions in Zambia are highly seasonal. The rainy season (December to April) gives rise to malaria transmission peaks between January and April. The malaria parasite prevalence peak is towards the end of the transmission period, i.e., between April and May (Ministry of Health, 2017).

Malaria in Zambia is usually prevalent in the provinces that receive the most rainfall (Nawa et al., 2019). The northern areas of Zambia, namely the North-Western, Luapula, Northern and Muchinga provinces, have the highest rainfall of up to 1 200mm yearly. The central parts of Zambia, the Western, Central, Copperbelt, and Eastern provinces receive between 800mm and

1 000mm of rainfall yearly. While the southern parts of Zambia, the Lusaka and Southern provinces, and the southern parts of the Western province, receive less than 800mm of rainfall annually (Nawa et al., 2019).

Due to the differences in the weather patterns of each province, the burden of malaria in Zambia follows regional trends (Nawa et al., 2019). The Luapula, Muchinga, Northern and North-Western provinces had a high malaria prevalence (11–30% malaria parasite prevalence in 2018), and the Lusaka, Central, and Southern provinces had a low malaria prevalence (0–1.7% malaria parasite prevalence in 2018). The provinces that had a moderate malaria prevalence (7–10.4% malaria parasite prevalence in 2018) were the Copperbelt, Eastern and Western provinces. (Ministry of Health, 2018; United States President's Malaria Initiative, 2020).

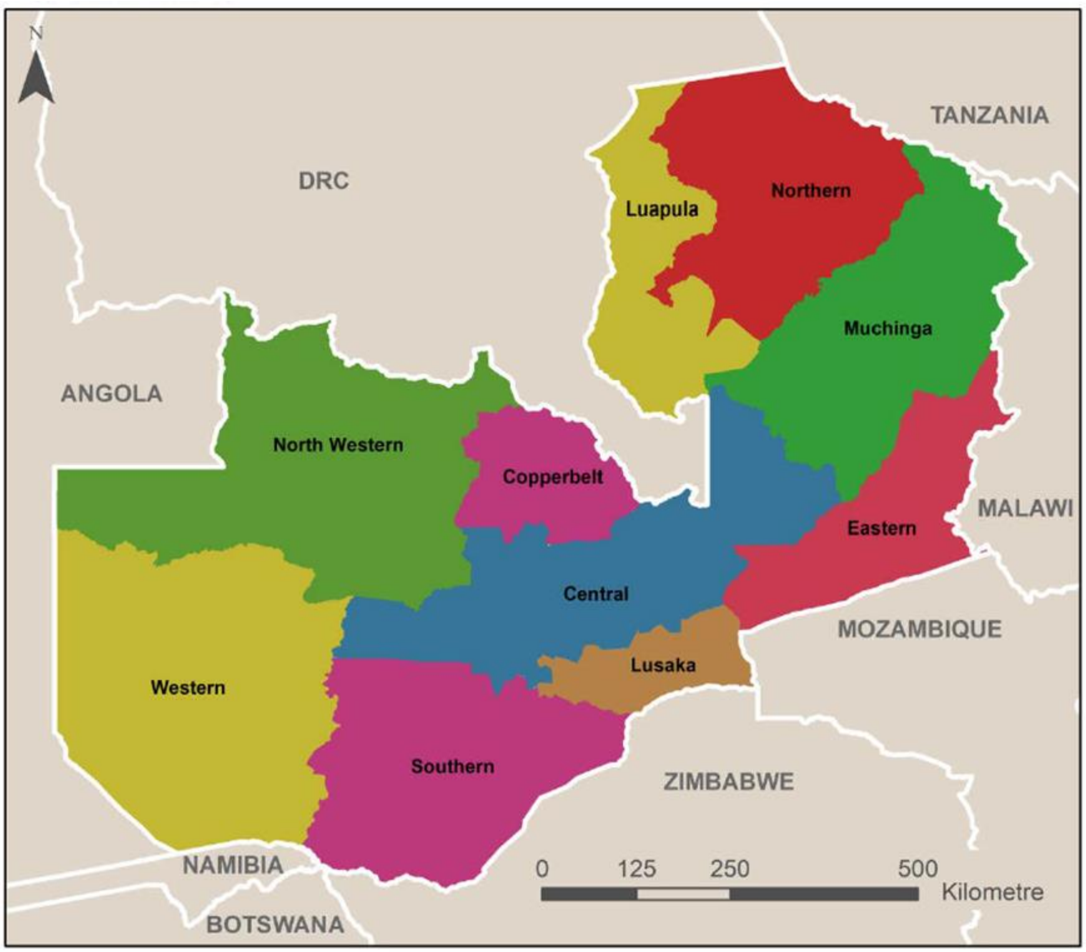

Figure 2. Map of Zambia (Source: Ministry of Health, 2020)

2.6 Data Management

The 2018 ZDHS data was taken from the Demographic and Health survey website in STATA format. STATA SE version 16.1 was used for the data management. The first stage of the data management was merging the women's record data set with the household member data set. The merging was done to include the number of ITNs in the household to this study's data set because the number of ITNs in the household is a variable collected at the household level.

The second stage was the extraction of a data set that contains only women who were pregnant. The third stage (aided by literature) involved removing variables that were not going to be used in this study's analysis. Additionally, some of the considered variables were coded differently from how they had been coded in the primary study. Table 1 provides a detailed description of the variables, codes, and reclassifications for this study. The fourth stage involved checking for duplicate observations and missing values; there were no duplicate observations, and none of the variables had missing entries.

2.7 Variables

2.7.1 Outcome Variable

In this study, the outcome variable is binary. If a pregnant woman slept under an ITN the night before the ZDHS, the code assigned was zero (0) for yes. If a pregnant woman did not sleep under an ITN the night before the ZDHS, the code assigned was one (1) for no.

2.7.2 Explanatory Variables

The explanatory variables are age, employment status, number of ITNs in the household, residency, parity, educational attainment, religion, marital status, number of household members, wealth index and province.

A detailed description of variables, codes, and reclassifications for this study is presented in Table 1.

2.8 Statistical Analysis

This study used the data collected during the 2018 ZDHS to conduct a secondary data analysis. This study's analysis used sampling weights and survey estimation commands to ensure that this study's results were representative at a national level. Additionally, sampling weights and survey estimation commands were used to account for the stratification and clustering in the ZDHS data.

For this study, all statistical tests were done at alpha 0.05 and 95% confidence intervals. The software used to analyse the data was STATA SE version 16.

Analysis of Objective 1: To determine the prevalence of the non-use of ITNs among pregnant women aged 15–49 years in Zambia.

In order to achieve this objective, frequencies and proportions were first computed to present the characteristics of pregnant women in this study. Additionally, a cross-tabulation of each explanatory variable and outcome variable was performed. The cross-tabulation output presented the frequencies, proportions, and the Pearson's chi-square test p-value.

For this part of the analysis, continuous variables (the number of ITNs in the household, age, parity and the number of household members) were categorised based on how they are distributed. The categorisation was done to get the prevalence based on the assigned categories. Details of the categorisations are provided in Table 1.

Analysis of Objective 2: To determine the factors associated with the non-use of ITNs among pregnant women aged 15–49 years in Zambia.

In order to achieve this objective, the association between the explanatory variables and the non-use of ITNs was determined by fitting univariable and multivariable logistic regression models. The univariable regressions computed the unadjusted odds ratios, while the multivariable regression computed the adjusted odds ratios. All the explanatory variables from the analytical framework (Figure 1) were included in the logistic regressions. The literature review aided in the variable selection. To prevent the loss of power for the explanatory variables and to prevent inflating the type-I error rate (Austin and Brunner, 2004), continuous variables (the number of

ITNs in the household, age, parity and the number of household members) were not categorised for this part of the analysis.

2.9 Ethical Considerations

1. The Human Research Ethics Committee at the University of the Witwatersrand gave the ethical clearance to conduct this study (certificate number M210139). A copy of the ethics certificate is attached in Appendix A.
2. The ZDHS data are annonymised, and authorisation to use the 2018 ZDHS data set was granted through the Demographic and Health Surveys Programme website. The data authorisation letter is attached in Appendix B.

2.10 Limitations

It is important to note that there are several limitations to this study. Firstly, this study used data from the ZDHS. The ZDHS is a cross-sectional survey; hence this did not allow for any cause-effect relationships to be inferred between the explanatory variables and outcome variable. Secondly, the ZDHS collected data on ITN use the night before the survey occurred; this may have introduced a recall bias. Lastly, only some of the important variables identified in the literature review were included in the analysis. This was because the 2018 ZDHS data does not have variables relating to the knowledge and beliefs about malaria, the seasonality of malaria transmissions and weather conditions in Zambia. Chapter 4 elaborates how the limitations could have affected this study's results.

Table 1. Description of variables, codes, and reclassifications

Variable	ZDHS description	Code in the original data set	How the variable is coded/used in this study
Outcome variable			
ITN use	Whether or not a pregnant woman slept under an ITN the night before the ZDHS	Yes = 1; No = 0	Yes = 0; No = 1
Explanatory variables			
Number of ITNs in the household (hml1)	Number of ITNs in the household	Continuous	[a] 0 = No ITN in the household 1 ≥ = Had at least one ITN in the household
Number of household members (v136)	The overall number of household members is the number of usual residents plus the number of visitors who slept in the house the previous night listed in the household schedule.	Continuous	[a] <6 household members = 1; ≥6 household members = 2 The average number of household members was (6 members) used to split the data into two categories.
Age (v012)	Age at last birthday	Continuous	[a] 15–24 = 1; 25–34 = 2; 35–44 = 3; ≥45 = 4
Parity (v201)	Total number of children ever born	Continuous	[a] 0 = nulliparous; 1 = primiparous; 2–4 = multiparous; ≥5 = grand multiparous (Bigelow et al., 2019; Çevik et al., 2020)
Residency (v205)	Place of residence, either urban or rural area	Urban = 1; Rural = 2	Urban = 1; Rural = 2
Educational attainment (v106)	The highest level of education attained	No education = 0; Primary = 1; Secondary = 2; Higher = 3	No education = 0; Primary = 1; Secondary = 2; Tertiary = 3
Religion (v130)	The respondent's religion	Catholic = 1; Muslim = 2; Protestant = 3; Other = 96	Muslim and other = 0; Catholic and Protestant = Christians=1

Key: [a] categorised to analyse objective one (1) only.

Table 1 (Continued)

Variable	ZDHS description	Code in the original data set	How the variable is coded/used in this study
Wealth index (v190)	The wealth index is a composite measure of a household's cumulative living standard. The index calculation uses data of a household's ownership of assets, such as televisions and bicycles, materials used for housing construction, and types of water access and sanitation facilities. Using a statistical procedure known as principal components analysis, it then places each household on a continuous scale. The ZDHS then grouped these households into five wealth quintiles and reported the index as a background characteristic.	Lowest = 1; Second = 2; Middle = 3; Fourth = 4; Highest = 5	Poor (1 & 2) = 1; Middle (3) = 2; Rich (4 & 5) = 3
Employment status (v717)	Whether an individual has been employed in the last 12 months.	Not working = 0; Professional/technical/managerial = 1; Clerical = 2; Sales = 3; Agricultural or self-employed = 4; Household and domestic = 5; Services = 6; Skilled manual = 7; Unskilled manual = 8	Employed (1–7) = 1; Unemployed = 0
Marital status (v502)	Whether the respondent is currently in a union, was formerly in a union, lived with a man, or has never been in a union. The category *currently in a union* includes married women and women living with a partner. *Formerly in a union/lived with a man* includes widowed, divorced, and separated women and women who have lived with a partner but are not now living with a partner.	Never in union = 0; Currently in union/living with a man = 1; Formerly in union/formerly lived with a man = 2	Never in union = 0; Currently in union/living with a man = 1; Formerly in union/formally lived with a man = 2
Provinces (v024)	Administrative divisions of Zambia.	Central = 1; Copperbelt = 2; Eastern = 3; Luapula = 4; Lusaka = 5; Muchinga = 6; Northern = 7; North-Western = 8; Southern = 9; Western = 10	Low malaria prevalence provinces (1, 4 & 9) = 0; Moderate malaria prevalence provinces (2, 3 & 10) = 1; High malaria prevalence (1, 4, 6, 7 & 8) = 2

CHAPTER 3: RESULTS

3.1 Introduction

The descriptive statistics and the results from the univariable and multivariable logistic regression models are presented in this chapter. In addition, this chapter presents the characteristics of the pregnant women in the study, the prevalence of the non-use of ITNs, and the factors associated with the non-use of ITNs among pregnant women in Zambia.

3.1.1 Characteristics of Pregnant Women in the Study

Table 2 shows that most (77.9%) pregnant women had at least one ITN in their household, while 22.1% did not have an ITN in their household. Regarding the number of household members, 57.3% of the pregnant women belonged to households with less than six household members, and 42.7% belonged to households with at least six household members.

Most of the pregnant women (47.5%) were aged between 15 and 24 years, 36.9% were aged between 25 and 34 years, 15.3% were aged between 35 and 44 years, and only 0.3% were 45 years of age or older. Pertaining to parity, 21.7% of the pregnant women were nulliparous, 24% were primiparous, 38.6% were multiparous, and 15.7% were grand multiparous.

Table 2 shows that 8.6% of the pregnant women had no education, 48.5% had attained a primary education, 37.6% had a secondary education, and only 5.3% had a tertiary education. With respect to residency, 63.9% of the pregnant women resided in rural areas, and 36.1% resided in urban areas.

Regarding employment status, 49.1% of the pregnant women were employed, while 50.9% reported being unemployed. Concerning religion, 97.8% were Christians, and only 2.2% were Muslims or belonged to other religions.

Concerning the household wealth index, 44.5% of the pregnant women were in the poor category, and 36.2% were in the rich category. Table 2 also shows that 39.8% of the pregnant women were from low malaria prevalence provinces, 32.5% were from moderate malaria prevalence provinces, and 27.7% were from high malaria prevalence provinces. Finally, regarding marital status, 78.2% of the pregnant women were currently in a union, while only 15% had never been in any union.

Table 2. Characteristics of pregnant women in the study

Variables	Frequency (n)	Percentage (%)
Number of ITNs in the household		
No ITNs in the household	257	22.1
Had at least one ITN in the household	887	77.9
Number of household members		
<6	652	57.3
≥6	489	42.7
Age		
15–24	540	47.5
25–34	420	36.9
35–44	174	15.3
≥45	3	0.3
Parity		
Nulliparous	247	21.7
Primiparous	273	24.0
Multiparous	439	38.6
Grand multiparous	179	15.7
Educational attainment		
No education	98	8.6
Primary	552	48.5
Secondary	429	37.6
Tertiary	60	5.3
Residence		
Rural	727	63.9
Urban	411	36.1
Employment status		
Employed	559	49.1
Unemployed	580	50.9
Religion		
Christian	1 113	97.8
Muslims/other	25	2.2
Wealth index		
Poor	507	44.5
Middle	219	19.3
Rich	412	36.2

Key: n = total number of pregnant women, % = weighted percentage

Table 2 (Continued)

Variables	Frequency (n)	Percentage (%)
Province		
Low malaria prevalence provinces	453	39.8
Moderate malaria prevalence provinces	370	32.5
High malaria prevalence provinces	315	27.7
Marital status		
Never in union	171	15.0
Currently in union	890	78.2
Formerly in union	77	6.8

Key: n = total number of pregnant women, % = weighted percentage

3.2 Prevalence of the Non-use of ITNs Among Pregnant Women

Table 3 shows the prevalence of the non-use of ITNs among pregnant women in Zambia the night before the ZDHS. Overall, 50.1% (95% CI: 45.8–54.4) of the pregnant women did not use an ITN. Among the women who had ITNs in their household, 35.9% (95% CI: 32.5–39.4) did not use an ITN. Expectedly, all the pregnant women who did not have ITNs in their households did not use an ITN. The non-use of ITNs among those from households with less than six household members was 46.7% (95% CI: 39.9–53.6), and the non-use of ITNs among those from households with at least six household members was 54.6% (95% CI: 49.4–59.6).

With regards to age, the non-use of ITNs among those aged between 15 and 25 was 57.1% (95% CI: 51.0–63.1), among those aged between 25 and 34, it was 44.3% (95% CI: 39.9–52.0), and among those aged between 35 and 44, it was 43.9% (95% CI: 33.4–52.9). None of the pregnant women who were 45 years or older reported not using an ITN.

Table 3 and Figure 3 show, the non-use of ITNs was 59.5% (95% CI: 51.9–67.0) among nulliparous women and 49.2% (95% CI: 38.7–59.9) among primiparous women. In addition, the non-use of ITNs among multiparous women was 49.4% (95% CI: 44.1–54.8), and among grand multiparous women, it was 39.5% (95% CI: 31.9–47.6).

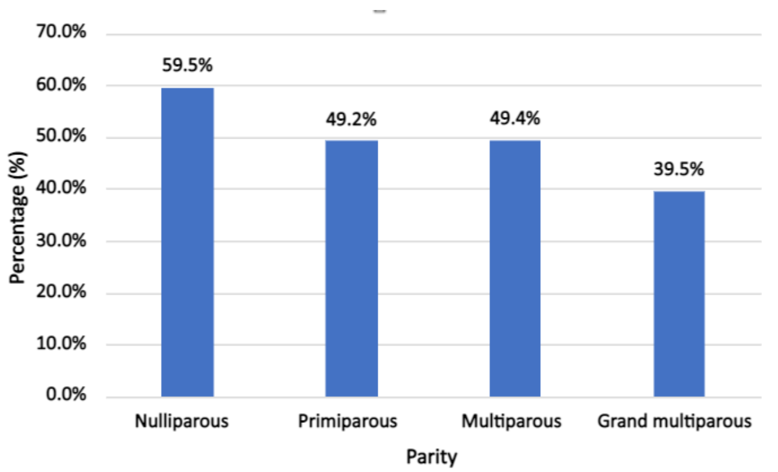

Figure 3. Prevalence of the non-use of ITNs by parity

Regarding educational attainment Figure 4 and Table 3 show that the non-use of ITNs was lowest among those who had no education (34.4%, 95% CI: 24.7–45.5). Furthermore, the non-use of ITNs among those who had a primary education was 54.3% (95% CI: 48.5–60.0), and among those with a secondary education it was 49.6% (95% CI: 44.1–55.2). Lastly, the non-use of ITNs among those with a tertiary education was 39.7% (95% CI: 24.6–57.0). Concerning residency, the non-use of ITNs among those from rural areas was 47.6% (95% CI: 43.3–52.0), and among those from urban areas it was 54.4% (95% CI: 45.9–62.7).

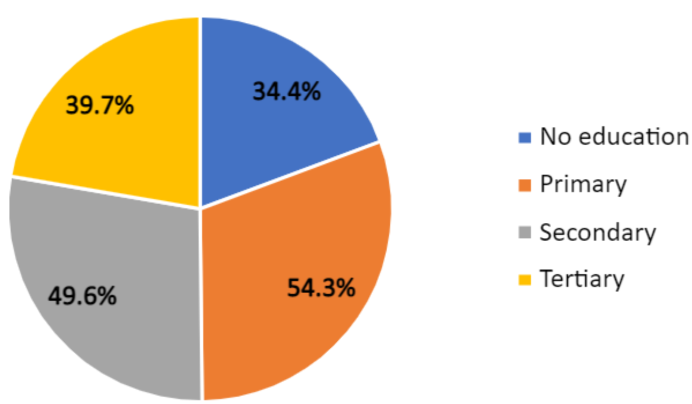

Figure 4. Prevalence of the non-use of ITNs by educational attainment

Table 3 shows that the non-use of ITNs among those who were employed and unemployed was 50.9% (95% CI: 43.7–58.0) and 49.3% (95% CI: 44.7–53.9), respectively. The results also show that among the Christian population, 50.8% (95% CI: 46.4–55.1) did not use an ITN, and among those who were Muslims or belonged to other religions, 19.3% (95% CI: 6.90–43.8) did not use an ITN. Concerning the household wealth index, the non-use of ITNs was lowest among those who belonged to poor households (45.5%, 95% CI: 40.8–50.2) and highest among those who belonged to middle-class households (57.5%, 95% CI: 46.3–68.0). On the other hand, among those who belonged to rich households, the non-use of ITNs was 51.7% (95% CI: 46.0–57.5).

Table 3 and Figure 5 shows that the non-use of ITNs was highest (67.2%, 95% CI: 60.7–72.9) among pregnant women from low malaria prevalence provinces. In addition, the non-use of ITNs was 41.3% (95% CI: 35.4–47.4), among those from moderate malaria prevalence provinces. Lastly, the non-use of ITNs was lowest (35.8%, 95% CI: 29.9–42.1), among pregnant women from high malaria prevalence provinces. Regarding marital status, out of those pregnant women that had never been in a union, 67.1% (95% CI: 57.8–75.3) reported that they did not use an ITN. Out of those currently in a union, 45.7% (95% CI: 41.7–49.8) reported not using an ITN. Lastly, among pregnant women formerly in a union, 62.3% (95% CI: 45.7–76.3) reported that they did not use an ITN.

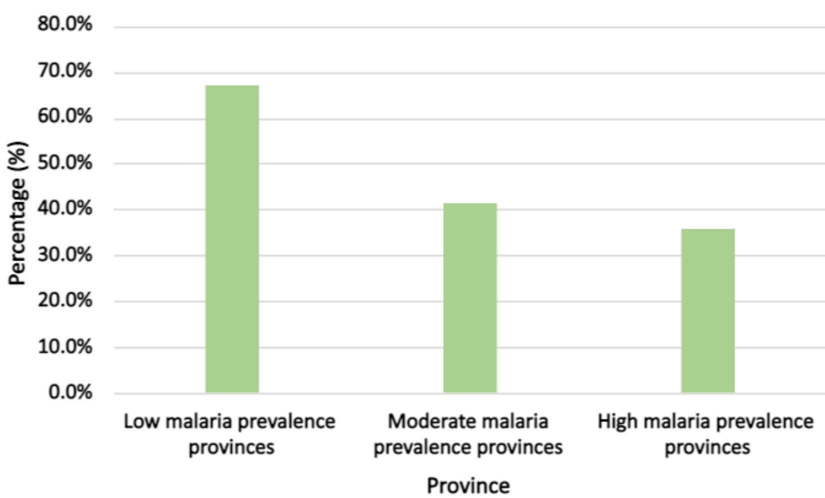

Figure 5. Prevalence of the non-use of ITNs by province

Table 3. Prevalence of the non-use of ITNs among pregnant women

Variable	ITN use				
	No n (%) 570 (50.1)	**95%CI** 45.8–54.4	**Yes n (%)** 568 (49.9)	**95%CI** 45.6–54.2	**Pearson's Chi - square test P-value**
Number of ITNs in the household					
No ITNs in the household	252 (100)	-	0 (00.0)	-	
Had at least one ITN in the household	318 (35.9)	32.5–39.4	568 (64.1)	60.6–67.5	<0.0001
Number of household members					
<6	305 (46.7)	39.9–53.6	348 (53.3)	46.4–60.1	
≥6	265 (54.6)	49.4–59.6	221 (45.4)	40.4–50.6	0.0741
Age					
15–24	309 (57.1)	51.0–63.1	232 (42.9)	36.9–49.0	
25–34	189 (44.3)	39.9–52.0	234 (55.7)	48.0–63.1	
35–44	75 (43.9)	33.4–52.9	100 (57.1)	47.1–66.6	
≥45	0 (00.0)	-	3 (100)	-	0.0065
Parity					
Nulliparous	148 (59.5)	51.9–67.0	100 (40.3)	33.0–48.1	
Primiparous	134 (49.2)	38.7–59.9	138 (50.8)	40.1–61.3	
Multiparous	217 (49.4)	44.1–54.8	222 (50.6)	45.1–55.9	
Grand multiparous	71 (39.5)	31.9–47.6	108 (60.5)	52.4–68.1	0.0232
Educational attainment					
No education	34 (34.4)	24.7–45.5	64 (65.6)	54.5–75.3	
Primary	300 (54.3)	48.5–60.0	252 (45.7)	40.0–51.5	
Secondary	213 (49.6)	44.1–55.2	216 (50.4)	44.8–55.9	
Tertiary	24 (39.7)	24.6–57.0	36 (60.3)	43.0–75.4	0.0109
Residence					
Rural	346 (47.6)	43.3–52.0	381 (52.4)	48.0–5.67	
Urban	224 (54.4)	45.9–62.7	187 (45.6)	37.3–54.1	0.1605
Employment status					
Employed	284 (50.9)	43.7–58.0	275 (49.1)	42.0–56.3	
Unemployed	286 (49.3)	44.7–53.9	294 (50.7)	46.1–55.3	0.7166
Religion					
Christian	565 (50.8)	46.4–55.1	548 (49.2)	44.9–53.6	
Muslim/other	5 (19.3)	6.90–43.8	20 (80.7)	56.2–93.7	0.0098

Key: n = total number of pregnant women, % = weighted percentage, 95% CI = 95% confidence interval

Table 3 (Continued)

Variable	**ITN use**				
	No n (%) 570 (50.1)	**95%CI** 45.8–54.4	**Yes n (%)** 568 (49.9)	**95%CI** 45.6–54.2	**Pearson's Chi -square test P-value**
Wealth index					
Poor	230 (45.5)	40.8–50.2	276 (54.5)	49.8–59.2	
Middle	126 (57.5)	46.3–68.0	93 (42.5)	32.0–53.7	
Rich	213 (51.7)	46.0–57.5	199 (48.3)	42.5–54.0	0.0661
Province					
Low malaria prevalence provinces	304 (67.2)	60.7–72.9	149 (32.8)	27.1–39.1	
Moderate malaria prevalence provinces	153 (41.3)	35.4–47.4	217 (58.7)	52.6–64.6	
High malaria prevalence provinces	113 (35.8)	29.9–42.1	203 (64.2)	57.9–70.1	<0.0001
Marital status					
Never in union	115 (67.1)	57.8–75.3	56 (32.9)	24.7–42.2	
Currently in union	407 (45.7)	41.7–49.8	483 (54.3)	50.2–58.3	
Formerly in union	48 (62.3)	45.7–76.3	29 (37.7)	23.7–54.3	0.0001

Key: n = total number of pregnant women, % = weighted percentage, 95% CI = 95% confidence interval

3.3 Unadjusted and Adjusted Odds Ratios of the Factors Associated with the Non-use of ITNs

3.3.1 Unadjusted Odds Ratios

Table 4 presents the results of the univariable logistic regressions. Table 4 indicates that the number of ITNs in the household, age, parity, the number of household members, educational attainment (i.e., primary, and secondary education), religion, wealth index (i.e., middle category), province, and marital status (i.e., currently in a union) were associated with the non-use of ITNs among pregnant women ($p < 0.05$). However, employment status and residency showed no association with the non-use of ITNs among pregnant women.

Positive associations

The number of household members was associated with the non-use of ITNs, with increasing odds of non-use for every unit (one household member) increase in the number of household members (OR = 1.09, 95% CI: 1.010–1.168).

Patterning to educational attainment, the odds of not using an ITN among pregnant women who had a primary education were 2.27 (95% CI: 1.346–3.822) times the odds of not using an ITN among pregnant women who had no education. Among those who had a secondary education, the odds of not using an ITN were 1.88 (95% CI: 1.119–3.159) times the odds of not using an ITN among those with no education. Nonetheless, there was no difference in the odds of not using an ITN among those who reported having a tertiary education and those with no education.

Regarding religion, the odds of not using an ITN among Christians were 4.30 (95% CI: 1.294–14.307) times the odds of not using an ITN among Muslims or other religions.

Negative associations

Table 4 shows that the number of ITNs in the household was associated with the non-use of ITNs, with decreasing odds of non-use for every unit (one ITN) increase in the number of ITNs in the household (OR = 0.46, 95% CI: 0.376–0.550). Age was associated with the non-use of ITNs, with decreasing odds of non-use for every year increase in age (OR = 0.96, 95% CI: 0.933–0.981).

Additionally, parity was associated with the non-use of ITNs, with decreasing odds of non-use for every unit (one-birth) increase in parity (OR = 0.89, 95% CI: 0.829–0.945).

Concerning the household wealth index, the odds of not using an ITN decreased as the household wealth index increased. The odds of not using an ITN among pregnant women in the middle category were 0.48 times the odds of not using an ITN among pregnant women in the poor category (95% CI: 0.008–0.961). However, there was no difference in the odds of not using an ITN between those in the rich and poor category.

Regarding provinces, there was a decrease in the odds of not using an ITN from the moderate to high malaria prevalence provinces. Not using an ITN among pregnant women from moderate malaria prevalence provinces was 0.34 times as likely as not using an ITN among pregnant women from low malaria prevalence provinces (95% CI: 0.238–0.497). Furthermore, not using an ITN among pregnant women from high malaria prevalence provinces was 0.27 times as likely as not using an ITN among pregnant women from low malaria prevalence provinces (95% CI: 0.186–0.399).

Lastly, the odds of not using an ITN among pregnant women who were currently in a union were 0.41 times the odds of not using an ITN among pregnant women who had never been in a union (95% CI: 0.275–0.619). There was no difference in the odds of not using an ITN among those formally in a union and those who had never been in a union.

Table 4. Unadjusted and adjusted odds ratios of the association between the explanatory variables and the non-use of ITNs

Variable	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Number of ITNs in the household	0.46 (0.376–0.550) *	0.30 (0.231–0.378) *
Number of household members	1.09 (1.010–1.168) *	1.52 (1.386–1.677) *
Age	0.96 (0.933–0.981) *	1.01 (0.937–1.090)
Parity	0.89 (0.829–0.945) *	0.77 (0.616–0.955) *
Educational attainment		
No education	1.00	1.00
Primary	2.27 (1.346–3.822) *	2.51 (1.371–4.583) *
Secondary	1.88 (1.119–3.159) *	1.25 (0.617–2.544)
Tertiary	1.26 (0.538–2.935)	1.17 (0.239–5.701)
Residence		
Urban	1.00	1.00
Rural	0.76 (0.519–1.115)	0.86 (0.499–1.496)
Employment status		
Unemployed	1.00	1.00
Employed	1.06 (0.760–1.491)	1.18 (0.860–1.618)
Religion		
Muslims/other	1.00	1.00
Christians	4.30 (1.294–14.307) *	4.88 (1.625–14.650) *
Wealth index		
Poor	1.00	1.00
Middle	0.48 (0.008–0.961) *	1.36 (0.843–2.180)
Rich	0.25 (-0.049–0.553)	1.11 (0.602–2.035)
Province		
Low malaria prevalence provinces	1.00	1.00
Moderate malaria prevalence provinces	0.34 (0.238–0.497) *	0.28 (0.186–0.418) *
High malaria prevalence provinces	0.27 (0.186–0.399) *	0.22 (0.141–0.336) *
Marital status		
Never in union	1.00	1.00
Currently in union	0.41 (0.275–0.619) *	0.51 (0.281–0.926) *
Formerly in union	0.81 (0.407–1.602)	1.01 (0.394–2.578)

Key: *p-values <0.05, 95% CI = 95% confidence interval

3.3.2 Adjusted Odds Ratios

Table 4 shows the results of the multivariable logistic regression. The number of ITNs in the household, parity, educational attainment (i.e., primary education), the number of household members, religion, province, and marital status (i.e., currently in a union) were associated with the non-use of ITNs among pregnant women ($p < 0.05$). However, secondary education, age and the household wealth index lost the significance they had in the univariable regression. Additionally, employment status and residency still showed no association with the non-use of ITNs at this stage of the analysis.

Positive associations

The number of household members was associated with the non-use of ITNs, with increasing odds of non-use for every unit (one household member) increase in the number of household members (OR = 1.52, 95% CI: 1.386–1.677).

Concerning educational attainment, the odds of not using an ITN among pregnant women who had a primary education were 2.51 times the odds of not using an ITN among pregnant women who had no education (95% CI: 1.371–4.583). Nonetheless, there was no difference in the odds of not using an ITN between those with a secondary education and those without an education. Also, there was no difference in the odds of not using an ITN between those with a tertiary education and those without an education.

Table 4 also shows that the odds of not using an ITN among Christians were 4.88 times the odds of not using an ITN among Muslims or other religions (95% CI: 1.625–14.650).

Negative associations

Table 4 shows that the number of ITNs in the household was associated with the non-use of ITNs, with decreasing odds of non-use for every unit (one ITN) increase in the number of ITNs in the household (OR = 0.30, 95% CI: 0.231–0.378). In addition, parity was associated with the non-use of ITNs, with decreasing odds of non-use for every unit (one-birth) increase in parity (OR = 0.77, 95% CI: 0.616–0.955)

Furthermore, there was a decrease in the odds of not using an ITN from the moderate to high malaria prevalence provinces. Not using an ITN among pregnant women from moderate malaria prevalence provinces was 0.28 times as likely as not using an ITN among pregnant women from low malaria prevalence provinces (95% CI: 0.186–0.418). Additionally, not using an ITN among pregnant women from high malaria prevalence provinces was 0.22 times as likely as not using an ITN among pregnant women from low malaria prevalence provinces (95% CI: 0.141–0.336).

Lastly, concerning marital status, the odds of not using an ITN among pregnant women who were currently in a union were 0.51 times the odds of not using an ITN among pregnant women who had never been in a union (95% CI: 0.281–0.926). However, there was no difference in the odds of not using an ITN among those formally in a union and those who had never been in a union.

CHAPTER 4: DISCUSSION

4.1 Introduction

The major findings of the study are presented in this chapter. The chapter discusses the prevalence of the non-use of ITNs as well as the factors associated with the non-use of ITNs. The chapter also discusses the study strengths and limitations. Lastly, it gives the conclusion and recommendations.

4.2 Major Findings

This study aimed to determine the prevalence of the non-use of ITNs and the factors associated with the non-use of ITNs among pregnant women in Zambia. Overall, the study found that 50.1% of pregnant women did not use an ITN the night before the ZDHS. Furthermore, concerning residency, the non-use of ITNs was higher among pregnant women from urban areas (54.4%). Regarding educational attainment, pregnant women who had no education had the lowest prevalence of ITN non-use (34.4%). The non-use of ITNs decreased from the low to the high malaria prevalence provinces (67.2% to 35.8%, respectively). The study identified that the number of ITNs in the household, parity, educational attainment (i.e., primary education), the number of household members, religion, province, and marital status (i.e., currently in a union) were factors associated with the non-use of ITNs among pregnant women in Zambia.

4.3 Prevalence of the Non-use of ITNs Among Pregnant Women

This study found that 50.1% of the pregnant women did not use an ITN the night before the ZDHS; conversely, the 2018 Zambia Malaria Indicator Survey (ZMIS) report documented that 29% of pregnant women did not use an ITN. Hence the estimated non-use of ITNs in this study is higher than that which was previously documented. The high proportion of non-use could be explained by the fact that the period during which the ZDHS occurred (18 July 2018–24 January 2019) was mainly outside the malaria transmission peak period (January–April) and the peak parasite prevalence period (April–May). On the other hand, the ZMIS usually occurs during the highest parasite prevalence period (April–May). Therefore, the timing of the ZDHS may not have allowed for better compliance to use ITNs as many may not have needed to protect themselves from mosquitoes or use ITNs as a preventive measure. This is supported by several studies that identified that ITN use could be seasonal and influenced by factors such as temperature (too hot to use an ITN), rain and the density of mosquitoes (Pulford et al., 2011; Pinchoff et al., 2015: Hill et al., 2013; Smithuis et al., 2013; Koenker et al., 2019).

The overall prevalence (50.1%) of the non-use of ITNs among pregnant women in this study was higher than the reported prevalence in Uganda (41.4%) and Congo (28.6%) (Muhumuza et al., 2016; Inungu et al., 2017). Conversely, this study's overall prevalence of the non-use of ITNs among pregnant women was lower than the reported prevalence in Nigeria (80.8%) and Malawi (54.1%) (Ezire et al., 2015; Nkoka et al., 2018). In sub-Saharan Africa, the barriers and facilitators of ITN uptake among pregnant women vary regionally (Hill et al., 2013). In particular, there is variability in the individual, organisational, environmental, healthcare system and social/cultural/household barriers and facilitators. The variability may explain the differences in the estimated non-use of ITNs in the compared countries.

In this study, the non-use of ITNs among pregnant women from urban areas was higher than those from rural areas. This finding is similar to studies done in Malawi (Nkoka et al., 2018) and Congo (Inungu et al., 2017). In addition, this study identified a decrease in the non-use of ITNs from the low to high malaria prevalence provinces. The reason may be that individuals at a higher risk for malaria infections are more motivated to use ITNs to protect themselves due to the high malaria parasite prevalence (Atieli et al., 2011; Pulford et al., 2011).

4.4 Factors Associated with the Non-use of ITNs Among Pregnant Women

This study found that the odds of not using an ITN decrease as the number of ITNs in the household increases. This finding is similar to the research by Nkoka et al. (2018) in Malawi. Additionally, this study found that the odds of not using an ITN increase as the number of household members increases. The finding is consistent with studies by Hill et al. (2014) in Mali and Nkoka et al. (2018) in Malawi. The findings are plausible because owning sufficient ITNs in the household may ensure that every household member, including pregnant women, are sleeping under an ITN (Hill et al., 2014; Babalola et al., 2016). In the same way, as the number of household members increases, not owning sufficient ITNs in the household may cause some household members not to sleep under an ITN (Hill et al., 2014; Babalola et al., 2016).

This study found that as parity increases, the odds of not using an ITN decrease. This finding is similar to studies by Muhumuza et al. (2016) in Uganda and Nkoka et al. (2018) in Malawi. The finding may be because pregnant women with more deliveries are more aware of the risks of malaria and the importance of ITN use (Muhumuza et al., 2016). Their level of awareness may be due to them having more pregnancy-related medical visits in the past than those with fewer deliveries. The past visits may also have resulted in pregnant women with more deliveries owning more of the free ITNs in their households (Muhumuza et al., 2016), hence increasing their chances of using ITNs.

This study found that educational attainment is associated with the non-use of ITNs. Three studies in Nigeria, Congo, and Uganda support the finding (Inungu et al., 2017; Muhumuza et al., 2016; Ezire et al., 2015). The three studies indicate that individuals with no education are less likely to use ITNs. Conversely, this study found that those with primary education had a higher odds of not using an ITN than those with no education. The findings may be different because of regional variations in individual factors relating to the knowledge, attitudes, and behaviours about malaria (Hill et al., 2013). The factors may then influence the use of ITNs differently at each educational level in each study setting. Also, heightened by education, there may be a prompt to use other protective measures such as fans, mosquito repellents, and mosquito insecticide sprays. Nonetheless, other studies have found no association between educational attainment and ITN use (Ankomah et al., 2014; Nkoka et al., 2018).

Additionally, this study found that religion is associated with the non-use of ITNs. Pregnant women who were Christians were more likely not to use an ITN than pregnant women who were Muslims or belonged to other religions. This finding is similar to that of Choonara, Odimegwu, and Elwange (2015) in Kenya. This study's finding would plausibly suggest that an individual's religious belief system may influence protective behaviours such as ITN use (Choonara, Odimegwu, and Elwange, 2015; Yaya et al., 2017). This could be because religion has been found to be associated to the knowledge about malaria, that is Christian women were less likely to have knowledge about malaria than Muslim women (Yaya et al., 2017). However, these findings do not agree with Nkoka et al. (2018), who found no association between religion and ITN use among pregnant women.

This study found that pregnant women in either moderate or high malaria prevalence provinces were less likely not to use an ITN. The finding is in line with several studies that point out the regional variability of ITN use (Endo and Eltahir, 2016; Nkoka et al., 2018; Tassembedo, Coulibaly, and Ouedrago, 2020). This study's finding could be because the prevalence of the malaria parasite may be/is influenced by aspects such as temperature, the length of the rainy season and the persistence of vector breeding pools, of which these aspects vary across different geographical locations (Endo and Eltahir, 2016). These aspects may then affect the compliance by individuals to use ITNs, which could then explain the differences in the non-use of ITNs across these provinces (Atieli et al., 2011; Pulford et al., 2011). In addition, the moderate to high prevalence provinces are the wetter provinces of Zambia (United States President's Malaria Initiative, 2020); hence, the provinces may have persistent vector breeding pools and as such, may experience higher densities of mosquitoes than other provinces. The high density of mosquitoes may also explain why pregnant women from these provinces were less likely not to use an ITN.

This study found that marital status is associated with the non-use of ITNs among pregnant women. Pregnant women that were in a union were less likely not to use an ITN than those not in a union. The result is in line with two studies by Song et al. (2016) and Choonara, Odimegwu, and Elwange (2015). The findings indicate that individuals who are not in a union may be at greater risk for malaria infections as they use ITNs at a lower rate than those in a union. This study's findings could be because individuals in a union may be influenced by their partner's decision to practise malaria prevention behaviours (Aberese-Ako et al., 2019).

In contrast to three studies (Ankomah et al., 2012; Wafula et al., 2021; Inungu et al., 2017), this study found no association between a pregnant woman's place of residency (urban or rural) and the non-use of ITNs. There was no difference in the non-use of ITNs among the residency types. The difference in the findings could be because the individual, organisational, environmental, and health care system barriers and facilitators of ITN access, delivery and use vary in sub-Saharan Africa (Hill et al., 2013).

This study did not find any association between occupation or wealth and the non-use of ITNs among pregnant women. This was contrary to studies by Mbengue et al. (2017) in Senegal and Leonard et al. (2016) in Cameroon. This study's findings could be related to the fact that 97% of the Zambian population in 2018 obtained free nets through mass distribution campaigns, antenatal care clinics, and distribution in schools and only 3% of the population reported sourcing their ITNs from a shop or market (Ministry of Health, 2020). Therefore, this may suggest that pregnant women may have not needed any form of job or profession to get or buy an ITN. The difference in the findings could further be explained by the variability in the factors that affect ITN ownership or the differences in individual level factors such as the knowledge, attitudes, and behaviours about malaria in these countries (Hill et al., 2013).

Lastly, in contrast to prior studies (Choonara, Odimegwu, and Elwange, 2015; Mbengue et al., 2017). This study found no association between a pregnant women's age and the non-use of ITNs. Mbengue et al. (2017) argue that older women are more exposed to information about the risks of malaria and the importance of ITN use because of their previous pregnancies. Nonetheless, the knowledge, attitudes, and behaviours about malaria vary regionally (Hill et al., 2013). Hence this could be the reason why the study findings differ.

4.5 Strengths

This study used a nationally representative sample of pregnant women. Therefore, the study findings may be generalised to pregnant Zambian women. Additionally, the study was able to account for the complex nature of the ZDHS sample design by using survey estimation commands in STATA. Therefore, accurate point estimates were obtained.

4.6 Discussion of Study Limitations

Firstly, the non-use of ITNs the night before the ZDHS survey might have been overestimated or underestimated in this study. This study relied on self-reported non-use, and pregnant women may have given responses that they felt were generally acceptable but may not reflect the actual ITN use or non-use.

Secondly, approximately six months of the 2018 ZDHS occurred outside the malaria transmission peak period in Zambia. Studies have shown that ITN use is influenced by the seasonality of malaria transmissions and weather conditions (Pulford et al., 2011; Pinchoff et al., 2015; Koenker et al., 2019). Hence, it is possible that some of the pregnant women may have chosen not to use ITNs at the time of this survey. Unfortunately, this study was not able to analyse the non-use of ITNs adjusted for the seasonality of malaria transmissions or the different weather conditions across Zambia. Additionally, the possibility of an overestimation of the non-use of ITNs could have been because of the use of other preventive measures such as fans, mosquito repellents, and mosquito insecticide sprays, which this study did not adjust for.

Thirdly, not all of the variables that needed to be adjusted for were included in the analysis. The 2018 ZDHS did not collect data on variables such as knowledge and beliefs about malaria, which have been shown to influence ITN utilisation (Ankomah et al., 2014; Inungu et al., 2017; Balami et al., 2019; Ezire et al., 2015). Additionally, the ZDHS data set did not have variables related to the seasonality of malaria or weather conditions in Zambia. This limitation could have led to the overestimation or underestimation of the odds ratios presented in this study.

Lastly, this study used data from the ZDHS, which uses a cross-sectional study design. Therefore, establishing a definite cause and effect relationship between the explanatory variables and the non-use of ITNs was not permitted. For this reason, this study could only determine the factors associated with the non-use of ITNs.

4.7 Conclusion

This study shows a moderately high prevalence of the non-use of ITNs among pregnant women in Zambia. Five hundred and seventy (570; 50.1%) of the pregnant women did not sleep under an ITN the night before the ZDHS. The factors associated with the non-use of ITNs include the number of ITNs in the household, the number of household members, parity, educational attainment, religion, province, and marital status. This study’s findings suggest that it is essential to consider these factors in the Zambia National Malaria Elimination plan. This consideration will contribute to ensuring that ITN use among pregnant women is increased and sustained. Moreover, as Zambia works towards being a malaria-free country, the findings of this study could help ensure that the occurrence of malaria is reduced. Additionally, the findings may also help ensure that the re-emergence of malaria infections is avoided.

4.8 Recommendations

Policy

1. Efforts to increase ITN use among pregnant women in Zambia may need to consider addressing the effect of the factors associated with the non-use of ITNs found in this study. Particular attention should be given to pregnant women who are not in a union or have only attained a primary school education although all pregnant women should be targets for malaria related health education.
2. The Zambia National Malaria Elimination plan needs to consider the factors associated with the non-use of ITNs found in this study as target areas for optimizing malaria prevention efforts such as the distribution of ITNs and malaria social behaviour change communication among pregnant women.
3. The Zambia National Malaria Elimination plan could use the factors associated with the non-use of ITNs as areas for monitoring and evaluation to track the progress of malaria prevention interventions among pregnant women in Zambia. The continual monitoring of progress will ensure that the occurrence of malaria is reduced, and the re-emergence of malaria infections is avoided.
4. The Zambia National Malaria Elimination ITN distribution system needs to consider the number of household members or the number of available sleeping spaces in the household. This will ensure that households own sufficient nets to cover each household member and that the occurrence of malaria is reduced.

Research

5. Future research concerning the non-use of ITNs among pregnant women in Zambia could consider using data from the ZMIS, which usually occurs during the period with the highest parasite prevalence (April–May) (Ministry of Health, 2018). This will be good for determining the reasons why individuals are not using ITNs at a time when there is a high malaria parasite prevalence.

6. Furthermore, the ZMIS data set has a more exhaustive list of variables which would allow for the adjustment of variables such as the use of other preventive measures, the seasonality of malaria, weather conditions, knowledge, beliefs and practices about malaria, which have all been shown to influence ITN utilisation (Ankomah et al., 2014; Inungu et al., 2017; Balami et al., 2019; Ezire et al., 2015; Pulford et al., 2011; Pinchoff et al., 2015; Koenker et al., 2019). The knowledge, practices and beliefs will further give insight as to why pregnant women may own ITNs but are not using them. Unfortunately, because of time constraints, access to the ZMIS data set could not be attained in time for this study.
7. The reason why religious affiliation is associated with the non-use of ITNs is not clear. This calls for further examination of the effect of religion on the non-use of ITNs. In particular, insight is needed into each religion's knowledge, beliefs, and practices about malaria prevention methods.

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APPENDICES

APPENDIX A: Ethics certificate

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

R14/49 Miss Luwi Mwangu

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M210139

NAME: (Principal Investigator)	Miss Luwi Mwangu
DEPARTMENT:	Epidemiology and Biostatistics School of Public Health
PROJECT TITLE:	Factors associated with the non-use of insecticide-treated bed net among pregnant women in Zambia
DATE CONSIDERED:	29/01/2021
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Mrs R. Mapuroma and Prof L. Ibisomi
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	09/03/2021

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions.Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **January** and will therefore be due in the month of **January** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX B: Demographic and Health Survey data authorisation letter

ICF

Dec 17, 2020

luwi mwangu
University of witwatersand
South Africa
Phone: +2773294996
Email: 2174070@students.wits.ac.za
Request Date: 12/17/2020

Dear luwi mwangu:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Factors associated with the non-use of insecticide-treated bed net among pregnant women in Zambia":

Zambia

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

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

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

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

Sincerely,

Bridgette Wellington

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

530 Gaither Road, Suite 500, Rockville, MD 20850 USA +1.301.407.6500 +1.301.407.6501 fax icf.com

APPENDIX C: Plagiarism declaration

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I LUWI MWANGU (Student number: 2174070) am a student registered for the degree of MSc Epidemiology-implementations science in the academic year 2021.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature: ________ Date: JULY 19^{th}, 2021

APPENDIX D: Turnitin report signed by supervisor

Satisfactory.	**Latifat Ibisomi**		**16 / 07 / 2021**

2174070:Luwi-Mwangu.Research.TurnitinReport2.pdf

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