FACTORS ASSOCIATED WITH UPTAKE OF INTERMITTENT PREVENTIVE TREATMENT (IPTp-SP) FOR MALARIA AMONG PREGNANT WOMEN AGED 15 to 49 YEARS IN NIGERIA, 2018.

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Research Report Submitted to the Faculty of Health Sciences, the University of the Witwatersrand in partial fulfilment of the degree in Master of Science in Epidemiology in the field of Implementation Science.

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Declaration

I, Godwin Okeke Kalu, declare that this research report is my original unassisted work. I am submitting this work for the Master of Science in Epidemiology (Implementation Science) degree at the University of the Witwatersrand, Parktown, Johannesburg, South Africa. The research report has not been submitted before for any degree or examination at any other University.

(Candidate Signature)

I declare this on the 22th day of November 2021 in Johannesburg, South Africa.

Dedication

I dedicate this research work to my heavenly Father for His grace, wisdom and strength to accomplish this task.

Abstract

Background

Pregnancy-associated malaria is a leading public health threat that stances significant risks to pregnant women and neonates. This study aims to determine the prevalence of IPTp-SP uptake; and establish the factors associated with the uptake of at least one dose and optimal doses of IPTp-SP among pregnant women aged 15 to 49 years living in Nigeria, 2018.

Methods

The secondary data analysis used the 2018 Nigeria Demographic Health Survey (NDHS) dataset. The primary study chose 1389 clusters from a total of 74 strata formed from the urban and rural areas of the 36 States in Nigeria. Then, 30 households were selected from each cluster to form a sample size of 41,666 households. From the 41,666 households, 41,821 women aged 15 to 49 years were interviewed for the 2018 NDHS. Among the 41,821 women interviewed, only 12,742 with live births two years before or during the NDHS were included in the analysis. Descriptive analysis was carried out to determine the prevalence of IPTp-SP uptake. Multivariable logistic regression was used to establish the factors associated with receiving IPTp-SP during pregnancy, adjusting for possible confounding factors. The study looked at IPTp-SP uptake as two outcomes variables (uptake of at least one dose and optimal doses). Then, fitted a separate multivariable model for each outcome variable using a four-step approach for modelling survey data as recommended by Heeringa et al., 2017. Given the complex survey design, all analyses adjusted for sampling weight, stratification and clustering. The p-value of <0.05 was considered significant.

Results

The study included 12,742 women aged 15 to 49 years with live births living in Nigeria. The mean age ± SD of the selected women was 28.3 ± 6.7 years old. In 2018, the overall prevalence of at least one dose of IPTp-SP was 63.6% (95% CI:62.0–65.1), and optimal doses of IPTp-SP were 16.8% (95% CI:15.8–17.8) during pregnancy. Women aged 30 years or older had 31% increased odds to receive at least one SP dose (cOR:1.31; 95% CI:1.08 - 1.58). And pregnant women in the Southwestern region were 50% less likely to initiate IPTp-SP therapy (aOR: 0.50; 95% CI:0.39 - 0.65). In addition, women in the wealthiest households whose husbands had secondary education predicted a four-fold increase in uptake of at least one IPTp-SP dose (aOR:4.17; 95% CI:1.11–8.85).

Pregnant women in the poorer and richer households were 35% (aOR: 0.65; 95% CI:0.52–0.81) and 19% (aOR:0.81; 95% CI:0.64–1.03) less likely to receive optimal doses of IPTp-SP respectively. Moreover, attending four or more ANC visits predicted a 58% higher odds of completing at least three doses of IPTp-SP during pregnancy (aOR:1.58; 95% CI:1.31–1.88).

Conclusion

The low prevalence of region-specific IPTp-SP uptake implies that most pregnant women in Nigeria remain at substantial risk of pregnancy-associated malaria. Therefore, stakeholders should explore context-specific strategies such as community ANC outreaches to improve the IPTp-SP coverage across the regions in Nigeria. Also, future research should explore the drivers of low uptake of optimal doses of IPTp-SP among pregnant women in South-West Nigeria.

Keywords: Pregnancy-associated malaria, Intermittent preventive treatment, Sulfadoxine-Pyrimethamine, Antenatal care, Malaria morbidity, Nigeria,

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Acronyms

ANC	Antenatal Care
FCT	Federal Capital Territory
IPTp	Intermittent Preventive Treatment in Pregnancy
IPTp-SP	Intermittent Preventive Treatment in Pregnancy with Sulfadoxine-Pyrimethamine
NMEP	National Malaria Elimination Programme
NDHS	Nigeria Demographic Health Survey
NPHC	National Population and Housing Census
NPC	Nigeria Population Commission
SP	Sulfadoxine-Pyrimethamine
SSA	sub-Saharan Africa
RBM	Roll Back Malaria Partnership
WHO	The World Health Organization

Definition of terms

IPTp-SP	This is a complete antimalarial regimen for prevention or treatment involves administering a dose or tablet of effective anti-malarial drugs called Sulfadoxine-Pyrimethamine (SP) to eligible pregnant women. The common brand name of SP is Fansidar (1).
Uptake	This means administering, taking, receiving, delivering or utilising the anti-malarial drugs or Sulfadoxine-Pyrimethamine during pregnancy.
At least one IPTp-SP dose	This means at least one dose of the anti-malarial regimens or Sulfadoxine-Pyrimethamine. One dose or tablet contains 500 mg/25 mg of SP, which provides only partial protection against pregnancy-associated malaria (1).
Optimal IPTp-SP doses	This implies three or more doses of antimalarial regimen or Sulfadoxine-Pyrimethamine. Three doses or tablets contain 1500 mg/75 mg of SP, which is the minimum required dose for complete protection against pregnancy-associated malaria (1).
Prevalence	This implies the proportion of pregnant women who received IPTp-SP out of the total population of eligible pregnant women to receive SP during pregnancy.

CHAPTER 1 – INTRODUCTION

1 Chapter Outline

This chapter provides a general summary of malaria's burden in sub-Saharan Africa and Nigeria. It consists of background to the study, literature review, problem statement, study justification, the research question, aim, objectives, and the conceptual framework. The literature review section of this chapter reviews various studies that have determined the prevalence of Intermittent Preventive Treatment with Sulfadoxine-Pyrimethamine for malaria in pregnancy (IPTp-SP) uptake in sub-Saharan Africa, including Nigeria. It also reviews studies that have established the different contributing factors related to IPTp-SP uptake of malaria preventive therapy during pregnancy.

1.1 Background

1.1.1 The estimated Malaria burden in Sub-Saharan Africa

Malaria is an infection caused by *Plasmodium species such as falciparum, malariae, vivax, ovale and knowesi* transmitted to human beings when the female Anopheles mosquitoes feed or bite them (2). It is a life-threatening disease that plagues 91 countries globally, even though it is a preventable or curable infection. In 2019, approximately 50% of the estimated world population was susceptible to malaria, especially in subtropical and tropical countries (3). In the same year, countries in Africa accounted for 93% of the 229 million malaria cases and 94% of the 405,000 mortality cases (3). Consequently, nearly 85% of malaria deaths were in 19 of these African countries. Despite the situation, the global effort towards a malaria-free world has also been evident.

Over the past decade, the estimated number of malaria deaths reduced from 585,000 in 2010 to 405,000 in 2019 (3,4). However, malaria deaths are disproportionately distributed in sub-Saharan African countries depending on the malaria burden, management, and challenges to implementing the World Health Organization (WHO) recommended guidelines across the different countries. For example, In SSA countries, Nigeria and the Democratic Republic of Congo have the highest malaria burden, at 25% and 11%, respectively, compared to 5% in Mozambique and 4 % in Uganda (3). Likewise, malaria deaths are highest at 19% in Nigeria compared to other sub-tropical and tropical countries (3).

1.1.2 The estimated Malaria burden in Nigeria

Malaria is endemic in Nigeria, and it contributes to the highest prevalence of morbidity (25%) and mortality (19%) of the global malaria burden (3). Consequently, it is associated with the substantial burden plaguing the country's health systems (5). Additionally, it contributes to an increased economic cost on individuals and the country at large, mainly due to low or no health insurance coverage among the Nigerian population (6). For instance, about 110 million diagnosed malaria cases accounts for 30% of all healthcare facilities admission and 60% of all outpatient visits each year in Nigeria (7).

1.1.3 Malaria in Pregnancy

Pregnancy-associated malaria is a leading public health threat that poses significant risks to pregnant women and their neonates (8). Studies have shown that female Anopheles mosquitoes, the malaria parasites' vector have twice more preference for pregnant women for their bloodmeal than their non-pregnant counterparts (9–11). The finding makes them three times more likely to be infected by malaria and vulnerable to malaria-related illness or deaths (12). According to the

WHO malaria report in 2018, Anopheles mosquitoes infected around 11 million pregnant women with malaria (3). As a result, about 900,000 children born with low birth weights were due to malaria in sub-Saharan African countries (3). Also, pregnancy-associated malaria can result in severe impediments such as spontaneous abortion, low birth weight, premature delivery, stillbirth, placental malaria, maternal anaemia, and maternal mortality (13–16). For instance, the case fatality rate is twice higher at 13% among pregnant women than in non-pregnant women at 6.5% (17). Malaria impediments translate to approximately 67% (274,000) of mortality cases in children five years old and below (18). In addition, it is responsible for 20% of all stillbirths per year (19) and about 10,000 maternal death globally (22). The situation is even more problematic in Nigeria.

The high endemicity of malaria in Nigeria means about 97% of the estimated population are substantially at risk of malaria infection (21). Moreover, the risk is two-fold higher among pregnant women because of their attractiveness to mosquitoes than their non-pregnant counterparts (9). In the same country, pregnancy-associated malaria is estimated at 79.5% (21) but varies across the geo-political zone. For example, 52% of pregnant women in the Southwestern region tested positive with malaria during ANC visits (22). And in the Southeastern region, 99% were infected with malaria during pregnancy (21).

1.1.4 IPTp-SP as Malaria Preventive Measure in Pregnancy

Annually, over 50 million women are at significant risk of pregnancy-associated malaria and possible malaria-related death (23). Therefore, to combat the impact of pregnancy-associated malaria, the WHO recommends a multilevel three-staged strategy. The strategy involves three tenets: administrating Intermittent Preventive Treatment with Sulphadoxine-Pyrimethamine (IPTp-SP) to pregnant women, effective distribution and use of insecticide-treated nets (ITNs), case management through prompt and effective treatment of malaria (24).

IPTp-SP utilisation among pregnant women has contributed to a nearly 42% decrease in low birth weight, 38% decrease in neonatal death, and 65% decrease in placental malaria in SSA countries (25). However, full IPTp-SP benefits are evident when pregnant women administer more IPTp-SP doses (26). Administering three or more IPTp-SP doses during pregnancy has been found to increase the mean birth weight, reduce low birth weight and fewer placental malaria than administering at most two doses (26). Regarding this evidence, the WHO revised the IPTp-SP guidelines in 2012 to increase the IPTp-SP uptake during pregnancy (1). The updated policy recommends that SP be delivered at each scheduled ANC visit except during the first trimester. It can be continuously given monthly to eligible pregnant women until delivery at a month interval between each dose of SP (1).

1.1.5 IPTp-SP as Malaria Preventive Measure in Pregnancy in Nigeria

In response to the WHO's recommendations for malaria prevention in pregnancy, the Federal Ministry of Health in Nigeria, under the coordination of the National Malaria Elimination Programme, adopted the new IPTp-SP guideline in 2014 to prevent malaria and complications due to malaria among pregnant women (27). Henceforth, all pregnant women should receive one dose of Sulphadoxine-Pyrimethamine (SP) at every scheduled ANC visit as early as the second trimester to prevent malaria or treat asymptomatic malaria infection. At a one-month interval between each dose of IPTp-SP (28). The delivery of IPTp-SP is supposed to be done under direct observation treatment (DOT) by a health care provider at every scheduled antenatal care ANC) visit (28). The decision pathway to administer IPTp-SP during scheduled ANC visits; is such that if a woman presents malaria symptoms, the symptoms examined before administering IPTp-SP. If she tests positive for malaria by either microscopy or rapid diagnostic test (RDT), she should treat it

according to the recommended national case management strategies. If she tests negative for malaria, she should receive IPTp-SP (24).

1.2 Literature Review

This section presents the prevalence of IPTp-SP uptake for pregnancy-associated malaria across sub-Saharan African countries, including Nigeria. It also outlines the various associated factors to receiving IPTp-SP by pregnant women. This review grouped the associated factors into socio-demographic, malaria-related knowledge, pregnancy-related and healthcare system factors. It considered both the pregnant women and the healthcare providers perspectives.

1.2.1 Prevalence of Intermittent Preventive Treatment with SP (IPTp-SP) uptake

According to Yaya et al., 2018, the overall prevalence of receiving three or more doses of IPTp-SP (optimal doses) was 29.5% (95% CI:28.2–30.5) by pregnant women in malaria-endemic countries. This study included data obtained from eight malaria-endemic countries: Nigeria, Uganda, Burkina Faso, Ghana, Mali, Malawi, Kenya, and Sierra Leone. This estimated prevalence of optimal IPTp-SP doses is significantly lower than the national target of 80% prevalence of uptake of IPTp-SP in SSA (29). Regarding the uptake of at least one IPTp-SP dose, the coverage has also been reported disproportionately lower across SSA countries than the 80% national target (29).

In Nigeria, a study estimated the overall prevalence of at least the first dose of IPTp-SP uptake was 63.6% as well as 16.8% of the pregnant women utilised the optimal doses of the malaria preventive therapy in 2018 (30). In contrast, uptake of optimal IPTp-SP doses was much higher at 63% in Ghana than in Nigeria at 16.8% (31). Similarly, Pons-Duran et al., 2020, estimated that the

overall prevalence of receiving optimal IPTp-SP doses for malaria in Madagascar, DR Congo, and Nigeria was significantly below 25% (32). The situations were somewhat different in Malawi and Tanzania. The estimated prevalence of optimal doses of IPTp-SP was 52% in Malawi (33), 43.6% in Tanzania (34).

1.2.2 Factors associated with IPTp-SP uptake during pregnancy

Hill et al., 2013 established the various factors associated with the access, use, and delivery of malaria preventive measures during pregnancy in sub-Saharan Africa. The study reported that factors associated with IPTp-SP uptake in sub-Saharan Africa, including Nigeria, could be in two different perspectives: the pregnant women's perspectives and the healthcare providers' perspectives (35). Thus, this study reviews previous studies based on these two perspectives.

According to the pregnant women's perspectives, their attitudes and motivation to receive IPTp-SP was related to their levels of knowledge of malaria-related factors such as malaria consequences (35). Similarly, socio-demographic factors such as education level, socio-economic status, residence, religion, age, and marital status were associated with the different IPTp-SP doses received during pregnancy (35–37).

From the healthcare providers perspective, studies established that the healthcare providers' level of knowledge and awareness about the IPTp-SP guidelines were associated with its uptake during pregnancy (35,38,39). Similarly, Okello et al., 2018 and other studies reported that poor service quality, occasional stock out of drugs and cost of antenatal care registration was related to IPTp-SP uptake for pregnancy-associated malaria in sub-Saharan African countries (40–42).

1.2.2.1 Socio-demographic factors and the uptake of IPTp-SP

This literature review revealed that the IPTp-SP doses received by pregnant women were associated with socio-demographic factors such as age, residence, marital status, religion, level of education of the pregnant women, and the level of their spouse's educational attainment (35). For instance, several studies in the review showed that pregnant women older than 34 years old had a 30% lower probability of receiving the optimal doses of IPTp-SP than their younger counterparts (37,43). In contrast, studies conducted in Tanzania and Nigeria reported that women 30 years and older had 40% increased chances to receive at least the first IPTp-SP dose than the younger women (44,45). Also, IPTp-SP doses received by pregnant women varied based on their marital status or religious affiliations.

In Tanzania, Exavery et al., 2014 demonstrated that being married facilitated increased IPTp-SP doses during pregnancy (34). Studies in Nigeria and Ghana revealed that being a Christian was significantly related to increased IPTp-SP uptake (31,46). The articles reviewed reported that women with at least secondary education had a 44% increased likelihood of receiving optimal IPTp-SP doses during pregnancy (35). In addition, the disparities in IPTp-SP doses administered during pregnancy widened by the women's household wealth index and where they lived (30,47). For instance, poor women who lived in the rural areas in SSA countries were less likely to receive the optimal doses of the malaria preventive regimen (46).

1.2.2.2 Knowledge of malaria-related factors and the uptake of IPTp-SP

The systematic and meta-analysis conducted by Hill et al., 2013 in SSA revealed that exposing the women to knowledge about the consequence of malaria and malaria-related messages contributed to influencing their demand for IPTp-SP during pregnancy (35). Similarly, the findings from

studies conducted in Ghana, Tanzania, Uganda, Nigeria and Mozambique showed that women aware and well-informed about the consequence of malaria and IPTp-SP had an increased likelihood of receiving the optimal doses of the preventive regimen during pregnancy (42,43,48).

1.2.2.3 Pregnancy-related factors and the uptake of IPTp-SP

From previous studies, IPTp-SP usage was related to the following pregnancy-related factors, such as the timing of antenatal care (ANC), frequency of ANC attendance, and parity of pregnant women living across sub-Saharan Africa (32,49). Studies in Tanzania and Malawi revealed that women who initiated ANC in the first 17 weeks of their pregnancy; and attended more than four ANC visits were more likely to receive the minimum required doses of IPTp-SP (38,50). Likewise, women with more than one child or previous childbirth experience have a high likelihood of optimal drug uptake during pregnancy (50). Though the timing of ANC initiation and frequency of ANC visit can serve as an independent factor to IPTp-SP uptake, a study in Mozambique established that delay in initiating ANC and irregular ANC attendance could simultaneously pose as a barrier to optimal use of the drug (42).

1.2.2.4 Healthcare System Factors and the uptake of IPTp-SP

A study in Kenya revealed that healthcare system constraints such as drug stock-out pose barriers to receive three or more doses of IPTp-SP by pregnant women (41). In addition, the shortage of healthcare workers reduced IPTp-SP demand during pregnancy (41). During ANC services, out-of-pocket expenses at the healthcare facilities have been revealed to lower IPTp-SP demand by pregnant women. Similarly, hidden charges by public health facilities reduced the demand for IPTp-SP among pregnant women, especially those living in rural areas (39,46).

A study reported that non-optimal to IPTp-SP uptake was associated with a lack of direct supervision of the pregnant women by designated healthcare providers (52). In addition, non-compliance to the WHO guidelines for IPTp-SP administration in Nigeria among healthcare workers reduced IPTp-SP delivery (46). Another supply-side barrier was inadequate counselling during ANC attendance across sub-Saharan Africa (42).

1.3 Conceptual Framework

Figure 1.1 shows the conceptual framework that informed the selection and extraction of variables of interest from the Nigerian Demographic Health Survey (NDHS) 2018 to answer the research question for this study. The conceptual framework outlines the possible exposure variables theoretically and empirically associated with the IPTp-SP uptake during pregnancy identified from previous studies conducted in SSA countries. The exposure variables include the socio-demographic, pregnancy-related and malaria-related knowledge factors that may influence the uptake of IPTp-SP among pregnant women in Nigeria.

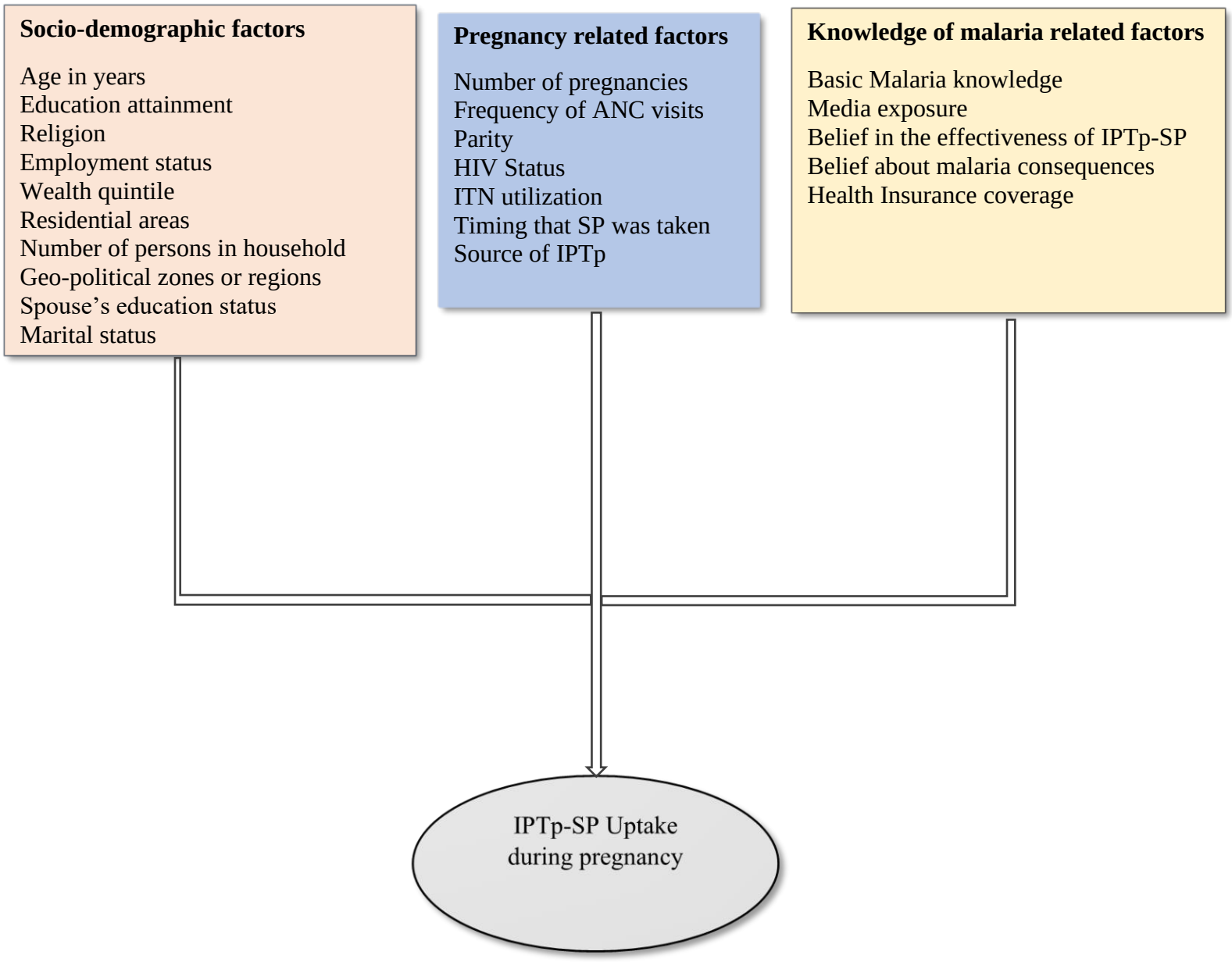

Figure 1.1: Conceptual Framework for the study (31)

1.4 Problem Statement

In Nigeria, the overall prevalence of IPTp-SP uptake among pregnant women remains lower than 25% compared to the 80% national target (32), even though this efficacious intervention is free in public healthcare facilities (53). Also, there is a substantial disparity between the receipt of at least one dose of SP and three or more doses of SP among pregnant women, regardless of the low prevalence of IPTp-SP uptake. For example, in 2018, 64% of eligible pregnant women took at least the first dose of anti-malaria drugs, whereas only 17% of them received at least three IPTp-SP doses during pregnancy (30,54).

This low uptake of IPTp-SP has consistently contributed to the reduced livelihood of the women of child-bearing age and their children (55). This problem depicts evidence of implementation failure; hence, an urgent need to establish the factors that hinder the effective delivery of the anti-malarial drugs during pregnancy in Nigeria.

1.5 Justification

Most studies in Nigeria focused on the factors associated with the uptake of optimal doses of IPTp-SP (45,55), even though the uptake of optimal doses predicated upon receiving at least the first dose of IPTp-SP among pregnant women (48). In addition, several studies have established different associated factors with IPTp-SP uptake using data obtained from healthcare facilities (53,55,56). Yet, only a few research studies have established the factors affecting IPTp-SP use (at least one dose and at three doses) separately in a study using nationally representative data (45). Therefore, using the 2018 Nigeria Demographic Health Survey, this study will establish potential factors associated with receiving at least one dose of IPTp-SP (**uptake of at least one dose of**

IPTp-SP) by pregnant women. At the same time, this study will establish the possible factors associated with the uptake of at least three IPTp-SP doses (**uptake of optimal doses of IPTp-SP**) by women during pregnancy in Nigeria.

The findings from this study will contribute to the malaria preventive programming efforts to ensure the initiation of intermittent preventive therapy (IPTp-SP); and optimal delivery of the anti-malarial drugs during pregnancy across the six regions in Nigeria. In addition, this study will also establish the influence of subscribing to health insurance packages by pregnant women aged 15 to 49 years on the level of IPTp-SP uptake. Finally, it will draw attention to the depth of the socio-cultural issues by establishing the influence of malaria-related knowledge (belief in the effectiveness of IPTp-SP and belief about malaria consequences).

1.6 Research Question

What factors are associated with the uptake of at least one dose and at least three doses of IPTp-SP for malaria by pregnant women aged 15 to 49 years old in Nigeria, 2018?

1.7 Research Aim

To establish the factors associated with the uptake of at least one dose and at least three doses of IPTp-SP for malaria by pregnant women aged 15 to 49 years old in Nigeria, 2018.

1.7.1 Research Objectives

1. To determine the prevalence of IPTp-SP uptake among pregnant women aged 15 to 49 years in Nigeria, 2018.
2. To establish the factors associated with the uptake of at least one dose of IPTp-SP among pregnant women aged 15 to 49 years in Nigeria, 2018.
3. To establish the factors associated with the uptake of optimal doses of IPTp-SP among pregnant women aged 15 to 49 years in Nigeria, 2018.

CHAPTER 2 – METHODOLOGY

2 Chapter Outline

This chapter provides an outline of the methods and design of the study. It also details the primary study description, the outcome variable's description, and the selected exposure variables. The chapter further elaborates on the study design, study population, power calculation, data extraction method, data management, consideration in analysing survey data, data analysis and ethical considerations.

2.1 Study setting

Nigeria lies in the west of Africa and South of Sahara with a surface area of 923,768 sq. kilometres. It comprises six regions and 36 States, and the Federal Capital Territory (As shown in Figure 2.1). In addition, there are 774 Local Government Areas and 9,555 wards. In 2019, Nigeria's estimated population was 200.93 million. This population comprises males and females at 101.83 million and 99.13 million, respectively (57). Although English is the lingua franca, there are over 250 languages spoken, the commonest being Hausa, Igbo and Yoruba.

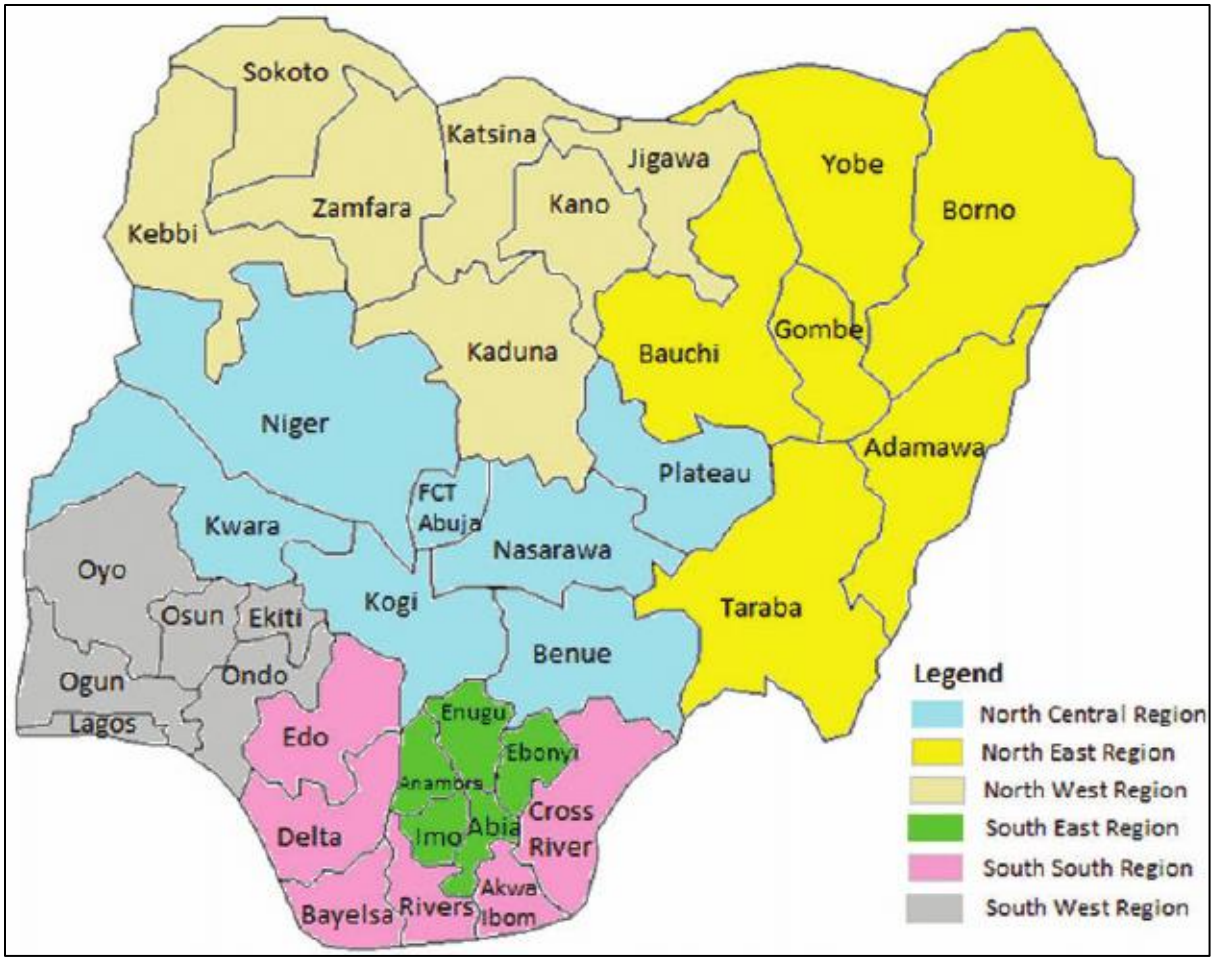

Figure 2.1: Map of Nigeria showing the Six regions and the 36 States including Federal Capital Territory (58)

2.2 Description of Primary Study

The study used a dataset obtained during the Nigeria Demographics and Health Survey (NDHS) conducted in 2018. The NDHS data was collected between 14 August to 29 December 2018. The sampling frame of the NDHS relied on the National Population and Housing Census (NPHC) carried out in 2006. Two sampling stages were carried out, and each of the 36 states and the Federal Capital Territory (FCT) were grouped into urban and rural areas to form 74 strata (54). First, 1389 census enumeration areas (EAs) were chosen from 74 strata using probability proportional to EA size as clusters independently. Secondly, 30 households were selected from each cluster to form a

sample size of 41,666 households without replacing any household that fails to respond. Weighting accurately represented the population during the NDHS dataset analysis due to the unequal distributed samples across each state and the potential disparity in the response rates. A sum of 42,121 women, 15 to 49 years old, was scheduled for an interview. 99% of the women, that is, 41,821 women, were successfully interviewed (54).

2.3 Study design and population

A cross-sectional study- the secondary data analysis of the women's recode dataset in the 2018 Nigeria DHS. The survey was conducted in the 36 States, including Federal Territory Capital (FCT), across Nigeria's six regions. The 2018 NDHS is a household survey based on a cluster study design (54). Here, all women of child-bearing age, between 15 to 49 years old, either resident in the selected household or female guests available in the households a night before the survey were eligible and interviewed, and responses coded in the women recode dataset. From the survey sampling frame, a total of 41,821 women of child-bearing age were interviewed and considered for this analysis. Among these women, 12,935 were with live births during or two years preceding the 2018 NDH survey were extracted. Of these, 12,742 women were extracted; they responded to have received and known the exact number of doses of IPTp-SP they took during pregnancy. The 12,742 women served as the sample size for this study after the survey weighting was applied. (As shown in Figure 2.2).

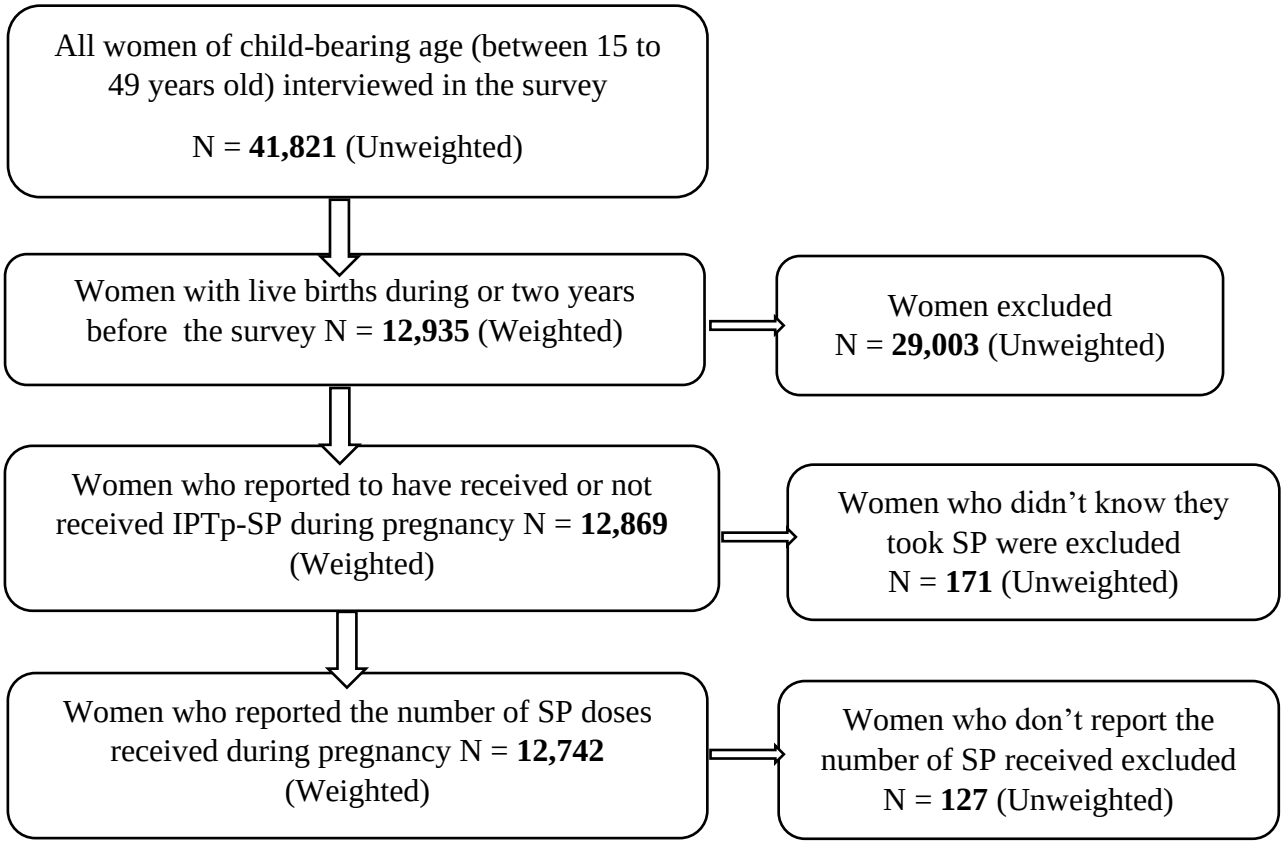

Figure 2.2: The Flow chart of the sample included from the NDHS 2018

2.4 Power calculation

Power calculation for a two samples comparison of proportions (using normal approximations) without continuity correction. The proportions of at least one dose of IPTp-SP uptake from the NDHS 2015 and 2018 at 51% and 63%, respectively. Using the "clustersampsi" STATA command and the following parameters: Prevalence of IPTp-SP in 2015 (P1) = 0.51, Prevalence of IPTp-SP in 2018 = 0.63, Average Cluster Size (m) = 9.0, Number of clusters per arm (k) = 693, Standard Deviation of cluster size (size_cv) = 9.81, Intra-cluster correlation (ICC) = 0.020 (59). Using the "clustersampsi" STATA command, the calculated power for the study was 89%%; therefore, the available data is sufficient to determine the prevalence of IPTp-SP uptake and establish various factors related to the uptake of at least one dose and optimal IPTp-SP doses.

2.5 Outcome Variables

The outcome variables are the uptake of at least one dose of IPTp-SP and optimal doses of IPTp-SP during pregnancy. The outcomes were created using responses from the following two NDHS survey questions (54): *"did you take SP/Fansidar to prevent you from getting malaria during pregnancy?* and *how many times did you receive SP/Fansidar during this pregnancy?"* The proportion of the outcomes was the ratio of pregnant women who took SP and knew the doses they took to the total number of the study participants. For statistical analysis, the uptake of at least one dose of IPTp-SP was categorised and coded into 0 = no dose of IPTp-SP and 1 = at least one dose of IPTp-SP (≥1 dose). The uptake of optimal doses of IPTp-SP was categorised and coded into 0 = two or fewer doses (≤ 2 doses) and 1 = at least three doses of IPTp-SP (≥ 3 doses) (32,60).

2.6 Exposure Variables

The exposure variables extracted from the women's dataset for the analysis were empirically or theoretically associated with IPTp-SP uptake. Literature reviews guided the extraction of the variables. Consequently, the exposure variables were sub-grouped into the following factors: socio-demographic, pregnancy-related, and knowledge of malaria-related factors. Socio-demographic factors include residential areas, age in years, household wealth index, the highest level of education, region, religion, employment and spouse's educational attainment. Pregnancy-related factors include frequency of ANC visits, the timing of first ANC initiation, and parity. In addition, knowledge of malaria-related factors includes belief in the effectiveness of IPTp-SP, belief about malaria consequences, subscription to health insurance and media exposure. The household wealth index was derived in the primary study (Nigeria DHS 2018) by scoring each number and asset owned by the selected households using principal component analysis (PCA). The assets ranged from a television to a bicycle or car and housing characteristics such as the source of drinking water, toilet facilities, and flooring materials. Then, the National wealth quintiles or index compiled by allocating the household score to each usual (de jure) household resident. Subsequently, each 20% of the household population was ranked and divided into five equal categories from poorest to richest. (54).

The score for the level of belief in the effectiveness of IPTp-SP and about malaria consequences was generated using a three-point Likert scale (61). The level of belief score about the effectiveness of IPTp-SP from two survey questions (54): *"does malaria preventive medicine keep the mother healthy?" "Does malaria preventive medicine keep the baby healthy?"* Also, the level of belief score about malaria consequences was derived from the following four survey questions (54): *"can*

malaria lead to death?" "can malaria make people dangerously sick?" "only weak children die of malaria?" "Do not worry about malaria can be cured?" The women's responses to the abovementioned questions asked in the Nigeria DHS were scored using a three-point Likert scale such that 1 = Disagree, 2 = Do not know, and 3 = Agree (61). After that, row mean scores were calculated for the women's array of responses to these questions using the "egen" command on STATA. A score of one was the least possible score, and three was the highest possible score. Finally, the terciles of the composite scores were used as a cut-off to categorise the level of belief scores into low (1.0 – 1.9), average (2.0) and high scores (2.1 – 3.0).

STATA version 16 was used for data management and analysis (62). Exposure variables reported in previous studies were extracted from the women recode dataset from the 2018 NDHS. Then, the women's data extracted was restricted to only women with live births during or two years before the survey inception. The outcome variables (uptake of at least one dose and uptake of optimal doses of IPTp-SP) generated from responses to the two variables (took SP/Fansidar and the number of times took SP/Fansidar during pregnancy) from the NDHS 2018. Afterwards, uptake of at least one dose of IPTp-SP coded as (0 = no dose vs 1 = at least one dose), and uptake of optimal doses of IPTp-SP coded as (0 = two or fewer doses vs 1 = optimal doses (≥ 3 doses). All selected exposure variables were categorical, and the missing observations across the exposure variables reported as missing responses. However, in creating the outcome variable, women who did not know if they took SP/Fansidar and the number of doses of SP/Fansidar taken was dropped, that is, 171 and 127 women, respectively. Finally, the cleaned dataset was saved independently and converted into a survey dataset by applying the weighting, stratification and clustering. Then, stored the dataset in a password-protected laptop and google-drive as backup files.

The clean dataset extracted from the women recodes dataset of the Nigeria DHS 2018 was used to answer the research questions for this study. As a survey dataset, the complex sampling design parameters, the clustering, sampling weights, and stratification were considered in estimating the standard errors, confidence intervals, or level of statistical significance reported from this analysis.

2.7 Data Analysis

The data were analysed based on the statistical approach applied in epidemiological studies. First, one-way tabulations or the frequency distributions of participants across study characteristics was carried out. All analysis adjusted for the random effect and the complex survey design by the "svy" command on STATA. The detailed analysis for each objective described below:

Analysis of Objective 1: *To determine the prevalence of IPTp-SP uptake among pregnant women, 15 – 49 years old in Nigeria, 2018.*

Pearson's Chi-square test was used to determine the prevalence of IPTp-SP uptake (at least one dose and optimal doses of IPTp-SP) across the socio-demographic, pregnancy-related and knowledge of malaria-related factors. Each selected exposure variable was cross-tabulated with the outcome variable (uptake of at least one dose and optimal doses of IPTp-SP). The output of this cross-tabulation was reported as proportions (%), 95% confidence intervals (CI) and a p-value of <0.05 was considered statistically significant.

Analysis of Objective 2: *To establish the factors associated with the uptake of at least one dose of IPTp-SP among pregnant women, 15 - 49 years old in Nigeria, 2018.*

The outcome variable used for objective 2 was the **uptake of at least one dose of IPTp-SP**; this was created and explained in section 2.5. The outcome variable was coded into 0 = no IPTp-SP dose and 1 = at least one dose of IPTp-SP.

Analysis of Objective 3*: To establish the factors associated with the uptake of optimal doses of IPTp-SP among pregnant women, 15 - 49 years old in Nigeria, 2018.*

The outcome variable used for objective 3 was the **uptake of optimal doses of IPTp-SP**; this was created and explained in section 2.5. The outcome variable was coded into 0 = ≤ 2 doses of IPTp-SP and 1 = at least three doses of IPTp-SP (≥ 3 doses).

For objectives 2 and 3, multivariable logistic regression models were fitted using a four-step approach for modelling survey data as Heeringa et al., 2017 (59) and Hosmer and Lemeshow 2000 (60) recommended. The four-step approach is detailed below:

First, fitted a bivariate logistic regression model to estimate the association between outcome variables (at least one dose and optimal uptake) and each selected exposure variable extracted from the Nigeria DHS survey 2018. Then, each outcome variable was regressed on each exposure variable separately to estimate the unadjusted or crude odds ratios (cOR), p-values and corresponding 95% confidence intervals (CI).

Second, all exposure variables with a p-value of <0.10 from the bivariate models were selected as candidates for main effects in the multivariable logistic regression model. Building the final multivariable logistic regression model involved an iterative process—the exposure variables of importance identified by previous studies arranged from highest to the least. Third, fitted different

model specifications by manually adding or dropping each exposure variable by performing the adjusted Wald test to assess each exposure variable's contribution to the model. Lastly, scientifically plausible interactions among the exposure variables were checked. The interaction term was assessed by specifying factorial interaction using binary operators (##). The selection of the variables to be interacted was based on epidemiological notions or from previous literature. However, the selected multivariable logistic regression model accounted for only interaction terms with a p-value < 5%. Then, the final model fit for the **uptake of at least one dose and optimal doses of IPTp-SP** assessed using the Hosmer-Lemeshow goodness-of-fit test. Finally, the final model's output, the adjusted odds ratios (aOR), p-values, and 95% confidence intervals were estimated and reported.

2.8 Ethical Consideration

The Nigeria DHS 2018 was conducted by the Nigerian Population Commission in collaboration with the National Malaria Elimination Programme (NMEP) of the Federal Ministry of Health, Nigeria. Before each interview during the 2018 NDHS survey, all respondents provided informed consent, and the fieldworker ensured confidentiality. The respondents' records were coded and de-identified (54). For this study, permission for NDHS 2018 dataset for secondary data analysis has been obtained from ICF International – Measure DHS website (Appendix C). Ethics approval was obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical) **– M2011103** (Appendix D).

2.9 Limitation

This section draws attention to some of the biases or limitations inherent in the 2018 NDHS. This study used data from a cross-sectional survey; hence it is unreliable for inferring causality between the outcome variables and exposures variables. The study is also liable to social desirability bias, and recall bias as the self-reported information by the women might not reflect the reality of the issues. However, some of these recall biases were minimised by restricting the sample population to only women with live births during or two years before the Nigeria Demographic Health Survey in 2018. Lastly, the data collection method used does not provide an in-depth understanding of the relationship or challenges to using IPTp-SP according to the stakeholders' perspectives. The discussion chapter (chapter four) provides details on how the limitations could affect the interpretations of the study's findings.

CHAPTER 3 – RESULTS

3 Chapter Outline

This chapter presents the results according to the following order: study objectives and the associated factors among pregnant women. The factors are socio-demographic factors, pregnancy-related factors, and knowledge of malaria-related factors. The results primarily presented in Table format showing the frequencies, proportion or percentage, odds ratios (crude odds ratios or adjusted odds ratios), 95% confidence intervals, and p-values. Figure format was used to present some of the results. The frequencies and proportions reported in this study adjusted for the complex sampling design, including weights, stratification and clustering.

3.1 Description of study characteristics

Table 3.1 shows the distributions (frequency and percentages) of the generated outcome variables and exposure variables extracted from the 2018 NDHS. The current study included 12,742 pregnant women between 15 to 49 years with live births from the survey. 92.8% were married, and their average age was 28.3 ± 6.7 years old in 2018. 8019 (62.9%) had three or more children, and more than half, 7888 (61.9%) of the women resided in rural areas. However, all of them were residents in Nigeria during or before the 2018 NDHS. In addition, the distribution varied across the outcomes variables and the selected exposure variables. In 2018, 63.8% (8098) received at least one dose of IPTp-SP, while only 2143 (16.8%) received three or more doses of the anti-malaria drug. Of the 12742 pregnant women, 5766 (45.3%) and 4568 (35.9%) husbands had no formal education. Although 8827 (69.3%) of the study participants were gainfully employed, only 2.0% subscribed to any form of health insurance coverage.

Table 3.1: Study characteristics of pregnant women aged 15 to 49 years old

Variables	Levels	Frequency (N)	Percentage (%)
Outcome Variables		**12742**	**100%**
Uptake of at least one dose of IPTp-SP	No Dose	4644	36.4
	≥ 1 Dose	8098	63.8
Uptake of optimal doses of IPTp-SP	0 - 2 Doses	10598	83.2
	≥ 3 Doses	2144	16.8
Socio-demographic variables			
Age in years Mean age: 28.3 years old Standard deviation: 6.7 years	15-24	3,842	30.2
	25-34	6,242	49.0
	35-44	2,462	19.3
	>45	196	1.5
Household wealth Index	Poorest	2,763	21.7
	Poorer	2,933	23.0
	Middle	2,636	20.7
	Richer	2,358	18.5
	Richest	2052	16.1
Region	North Central	1,770	13.9
	North East	2,339	18.4
	North West	4,638	36.4
	South East	1,263	9.9
	South-South	1,126	8.8
	South West	1,606	12.6
Place of Residence	urban	4,854	38.1
	rural	7,888	61.9
Religion	Catholic	1,083	8.5
	Protestants/Pentecostal	3,496	27.4
	Islam/Muslim	8,093	63.5
	Traditionalist	43	0.3
	Others	27	0.2
Highest Educational Levels	No Education	5,766	45.3
	Primary	1,856	14.6
	Secondary	4,050	31.8
	Higher	1,070	8.4
Marital Status	Single	278	2.2
	Married	11,822	92.8

	Co-habit	358	2.8
	Widow	88	0.7
	Divorced/Separated	196	1.5
Employment status	Not Employed	3,915	30.7
	Employed	8,827	69.3
Spouse's Education Level	No Education	4,568	35.9
	Primary	1,624	12.7
	Secondary	4,116	32.7
	Higher	1,873	14.7
	Missing	561	4.4
Pregnancy-related variables			
Number of ANC Visits	No ANC Visit	3,081	24.2
	< 4 ANC Visits	2,350	18.4
	≥4 ANC Visits	7,151	56.1
	Missing Response	160	1.3
Timing of ANC Initiation	1st Trimester	2,273	17.8
	2nd Trimester	6,003	47.1
	3rd Trimester	1,366	10.7
	Missing	3,100	24.3
Parity	1 Child	2388	18.7
	2 Children	2335	18.4
	3+ Children	8019	62.9
Knowledge of malaria-related variables			
Belief in Effectiveness of IPTp-SP	Low	200	1.6
	Average	504	4.0
	High	12,038	94.5
Belief about Malaria Consequences	Low	1,614	12.7
	Average	3,869	30.4
	High	7,259	57.0
Health Insurance Coverage	No	12,484	98.0
	Yes	258	2.0
Exposed to malaria messages via media	No	11,823	92.8
	Yes	919	7.2
Exposed media messages means listened malaria messages from radio, TV, or newspaper at least once a week.			

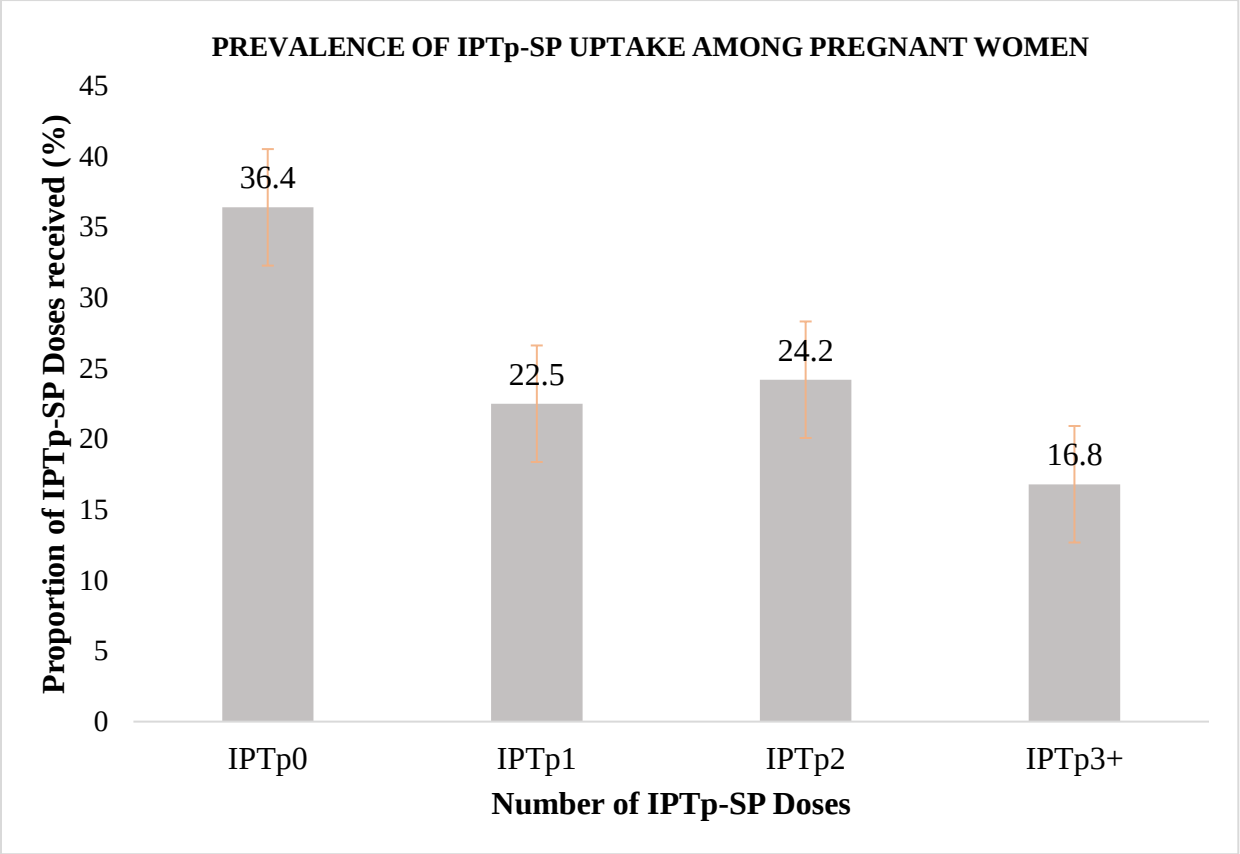

Figure 3.1: Prevalence of IPTp-SP uptake among Nigerian pregnant women

3.2 Prevalence of IPTp-SP Uptake

Figure 3.1 presents an overview of the prevalence of IPTp-SP doses received by pregnant women in 2018. The overall prevalence of IPTp-SP also varied substantially by the number of IPTp-SP doses received during pregnancy. The results showed that 22.5% (95% CI: 21.4 – 23.7), 24.2% (95% CI:23.2 – 25.2), and 16.8% (95% CI: 15.9 – 17.8) of all pregnant women received a single dose, two doses and at least three doses of IPTp-SP, respectively.

3.2.1 Prevalence of Uptake of at least one dose of IPTp-SP

In the current study, the overall prevalence of receiving at least one dose of IPTp-SP was 63.6% (95% CI: 62.0 – 65.1). However, at the level of pregnant women, the overall prevalence varied by different factors. Thus, the results were presented according to socio-demographic factors (Table 3.2), pregnancy-related factors (Table 3.3) and knowledge of malaria-related factors (Table 3.4).

3.2.2 Prevalence of at least one dose of IPTp-SP by the socio-demographic factors

Table 3.2 presents the prevalence of receiving at least one dose of IPTp-SP across the various socio-demographic factors. Though more women lived in rural areas in 2018, those who lived in urban areas had a higher prevalence of at least one dose of IPTp-SP at 72.6% (95% CI: 70.4 – 74.7). The uptake of at least one dose of IPTp-SP varied across the region. The women in the South-Eastern reported the highest prevalence at 79.5% (95% CI:76.4 – 82.2). In contrast, the prevalence of at least one dose was lowest at 56.7% (95% CI: 53.2 – 60.1) among North Central women. Pregnant women living in the North West accounted for the highest proportion of the study population at 36.4%. However, only 58.5% reported receipt of at least one dose of IPTp-SP. The older the women, the higher the prevalence expect for those older than 45 years. These women recorded the lowest prevalence of at least one dose of the malaria drug at 60.8% (95% CI:52.9 – 68.2). The prevalence of at least one dose of IPTp-SP increased from no formal education to higher education. The women with no formal education accounted for the lowest prevalence of uptake of at least one dose of IPTp-SP at 51.2% (95% CI: 48.7–53.7). At the same time, the highest prevalence of at least one dose was 82.3% (95% CI: 79.2 – 84.7) among those who had higher education.

In addition, a similar trend of prevalence was observed by spouse's educational level. The prevalence of at least one dose of IPTp-SP was lowest at 47.3% among women whose spouses had no formal education. Contrarily, pregnant women whose husbands had attained higher education recorded the highest uptake of at least one dose of IPTp-SP at 80.3% (95% CI:77.9 – 82.5) in Nigeria, 2018. Similarly, the uptake of at least one dose varied by household wealth index (p-value <0.001).

There was an increasing prevalence of at least one SP dose depending on the household wealth index of pregnant women. For example, the highest prevalence of at least one dose received was among women who belong to the wealthier and wealthiest households at 73.3% (95% CI:70.7 – 75.7) and 80.8% (95% CI:78.3 – 83.2), respectively.

Table 3.2: Prevalence of at least one dose of IPTp-SP by the socio-demographic factors

Factors	**Total N (*%*)[a]**	**≥ 1 Doses *n (%)*[a]**	**No Dose n (%)**	**Rao-Scott F-test**	**P-Value**
Uptake of at least one dose of SP	**12742 (100%)**	**8098 (63.6)**	**4644 (36.4)**		
Age in years				F (3, 3855) = 3.22	0.023*
15-24	3842 (30.2)	2352 (61.2)	1490 (38.8)		
25-34	6242 (49.0)	4049 (64.9)	2194 (35.1)		
35-44	2462 (19.3)	1578 (64.1)	884 (35.9)		
>45	195 (1.5)	119 (60.8)	77 (39.2)		
Region				F(4, 5573) = 23.70	<0.001*
North Central	1770 (13.9)	1003 (56.7)	767 (43.3)		
North East	2339 (18.4)	1520 (65.0)	819 (35.0)		
North West	4939 (36.4)	2712 (58.5)	1927 (41.5)		
South East	1263 (9.9)	1003 (79.5)	259 (20.5)		
South South	1129 (8.8)	837 (74.3)	289 (25.7)		
South West	1606 (12.6)	1023 (62.7)	583 (36.3)		
Residential areas				F(1, 1313) = 85.20	<0.001*
Urban	4853 (38.1)	3524 (72.6)	1330 (27.4)		
Rural	7888 (61.9)	4574 (58.0)	3314 (42.0)		

Highest Educational level				F(3, 3493) = 144.57	<0.001*
No Education	5766 (45.3)	2953 (51.2)	2814 (48.8)		
Primary	1856 (14.6)	1259 (67.8)	597 (32.2)		
Secondary	4050 (31.8)	3008 (74.3)	1042 (25.7)		
Higher	1070 (8.4)	878 (82.1)	191 (17.9)		
Wealth Index				F(4, 4934) = 94.68	<0.001*
Poorest	2763 (21.7)	1325 (47.9)	1438 (52.1)		
Poorer	2933 (23.0)	1593 (54.3)	1340 (45.7)		
Middle	2636 (20.7)	1793 (68.0)	842 (32.0)		
Richer	2358 (18.5)	1728 (73.3)	630 (26.7)		
Richest	2052 (16.1)	1659 (80.8)	393 (19.2)		
Marital Status				F(4, 5178) = 1.02	0.392
Single	277 (2.2)	168 (60.6)	109 (39.4)		
Married	11822 (92.8)	7497 (63.4)	4325 (36.6)		
Co-habit	358 (2.8)	244 (68.1)	114 (31.9)		
Widow	88 (0.7)	58 (65.9)	30 (34.1)		
Divorced	196 (1.5)	131 (66.8)	65 (33.2)		
Employment Status				F(1, 1313) = 50.19	<0.001*
Not Employed	3915 (30.7)	2247 (57.4)	1667 (42.6)		
Employed	8827 (69.3)	5851 (66.3)	2976 (33.7)		
Religion				F(4, 4545) = 36.11	<0.001*
Catholic	1083 (8.5)	785 (72.5)	298 (27.5)		
Protestant/Pentecostal	3496 (27.4)	2512 (71.8)	984 (28.2)		
Islam/Muslim	8093 (63.5)	4755 (58.8)	3338 (41.2)		
Traditional	43 (0.3)	30 (68.9)	13 (31.1)		
Others	27 (0.2)	17 (63.6)	10 (36.4)		
Spouse's Educational Level				F(3, 3763) = 163.83	<0.001*
No Education	4568 (35.9)	2160 (47.3)	2408 (52.7)		
Primary	1624 (12.7)	1058 (65.2)	566 (34.8)		
Secondary	4116 (32.7)	3020 (73.4)	1096 (26.6)		
Higher	1872 (14.7)	1502 (80.3)	369 (19.7)		
Missing Response	561 (4.4)				

*%[a] weighted total proportion, n(%)[a] – the weighted proportion of women who received at least one SP dose, * potential factor selected for the multivariable logistic regression because p-value <0.10. p-value = adjusted Chi Square test; Rao-Scott F-test = weights adjusted Chi Square F-statistic*

3.2.3 Prevalence of at least one dose of IPTp-SP by the pregnancy-related factors

From Table 3.3, 75.8% of the 12742 pregnant women attended ANC services during pregnancy in 2018. However, 18.4% attended fewer than four ANC visits, and 56.1% visited more than four

times. The prevalence of at least one dose of IPTp-SP was significantly different based on the frequency of ANC visits (p <0.001). The uptake of at least one dose was 80.3% (95% CI: 78.8 – 81.7) among pregnant women who attended at least four ANC visits. Early initiation of antenatal care was related to a higher prevalence of at least one dose of IPTp-SP (p <0.001). The prevalence of at least one dose was 79.2% (95% CI:77.6 – 80.7) and 73.8% (95% CI:70.9 – 76.5) among women who initiated antenatal care in the second and third trimesters. More so, women with two children reported the highest prevalence of at least one dose of IPTp-SP at 66.9% (95% CI:64.5 – 69.2). In contrast, the prevalence lowest at 62.2% (95% CI:60.4 – 64.1) among women with three or more children.

Table 3.3: Prevalence of at least one dose of IPTp-SP by the pregnancy-related factors

Factors	**Total N (%)[a]**	**≥ 1 Dose n (%)[a]**	**No Dose n (%)**	**Rao Scot F-test**	**P-Value**
Uptake of at least one dose of SP	**12742 (100)**	**8098 (63.6)**	**4644 (36.4)**		
Frequency of ANC Visits				F(1, 1277) = 33.56	<0.001*
No ANC Visit	3081 (24.1)	508 (16.5)	2573 (83.5)		
<4 ANC Visits	2350 (18.4)	1717 (73.1)	633 (26.9)		
≥ 4 ANC Visits	7151 (56.1)	5739 (80.3)	1411 (19.7)		
Missing Response	160 (1.3)				
Timing of first ANC initiation				F(2, 2543) = 7.23	<0.001*
1st Trimester	2273 (17.8)	1813 (79.8)	460 (20.2)		
2nd Trimester	6003 (47.1)	4752 (79.2)	1251 (20.8)		
3rd Trimester	1365 (10.7)	1007 (73.8)	358 (26.2)		
Missing Response	3100 (24.3)				
Parity				F(2, 2563) = 6.42	0.002*
1 Child	2388 (18.7)	1546 (64.7)	842 (35.3)		
2 Children	2335 (18.4)	1561 (66.9)	774 (33.1)		
≥ 3 Children	8019 (62.9)	4991 (62.2)	3028 (37.8)		

*%[a] weighted total proportion, n(%)[a] – the weighted proportion of women who received at least one SP dose, * potential factor selected for the multivariable logistic regression because p-value<0.10.*
p-value = adjusted Chi Square test; Rao-Scott F-test = weights adjusted Chi Square F-statistic

3.2.4 Prevalence of at least one dose of SP the knowledge of malaria-related factors

Table 3.4 presents the prevalence of at least one dose of IPTp-SP by the knowledge of malaria-related factors. The prevalence of at least one dose of IPTp-SP varied depending on exposure to media messages or not ($p < 0.001$). Although 92.8% of the 12,742 pregnant women had no exposure to any form of media, those exposed to media messages had the highest uptake of at least one dose at 81.5% (95% CI: 78.1 – 84.6). The results indicated that only 2% of the 12,742 pregnant women subscribed to health insurance. However, the prevalence of at least one dose of IPTp-SP was 81.2% (95% CI: 71.6 – 88.0) among women subscribed to insurance. The prevalence of those without insurance coverage was 63.2% (95% CI: 61.6 – 64.8).

94.5% of the 12742 pregnant women reported a high level of belief in the effectiveness of IPTp-SP. Higher uptake of at least one dose was significantly dependent on the level of belief in the drugs' effectiveness ($p < 0.001$). As observed, 65.1% of them received at least the first dose of IPTp-SP during pregnancy. At the same time, those with low belief in the drug's effectiveness recorded a lower uptake at 43.1% (95% CI: 35.7 – 50.7). The level of belief about malaria consequences was related to uptake of at least one dose of IPTp-SP ($p < 0.001$). The prevalence of at least one dose of IPTp-SP was 65.5% (95% CI:63.4 – 67.2) among pregnant women with a high level of belief about malaria consequences.

Table 3.4: Prevalence of at least one dose of IPTp-SP by the knowledge of malaria-related factors

Factors	Total N (%)[a]	≥ 1 Dose n (%)[a]	No Dose n (%)	Rao Scot F-test	P-Value
Uptake of at least one dose of SP	**12742 (100)**	**8098 (63.6)**	**4644 (36.4)**		
Media Exposure				F(1, 1313) = 78.32	<0.001*
No	11822 (92.8)	7349 (62.2)	4474 (37.8)		
Yes	919 (7.2)	749 (81.5)	170 (18.5)		
Health Insurance Subscription				F(1, 1313) = 12.29	0.001*
No	12484 (98.0)	7889 (63.2)	4595 (36.8)		
Yes	257 (2.0)	209 (81.2)	48 (18.8)		
Belief in Effectiveness of SP				F(2, 2452) = 71.00	<0.001*
Low level of belief	200 (1.6)	86 (43.0)	114 (57.0)		
Average level of belief	504 (4.0)	174 (34.4)	331 (65.6)		
High level of belief	12038 (94.5)	7838 (65.1)	4199 (34.9)		
Belief about Malaria Consequences				F(2, 2610) = 13.91	<0.001*
Low level of belief	1614 (12.7)	912 (56.5)	702 (43.5)		
Average level of belief	3869 (30.4)	5400 (62.8)	1441 (37.2)		
High level of belief	7258 (57.0)	134 (65.5)	2501 (34.5)		

%[a] weighted total proportion, n(%)[a] – the weighted proportion of women who received at least one SP dose.
** potential factor selected for the multivariable logistic regression because p-value <0.10,*
p-value = adjusted Chi Square test; Rao-Scott F-test = weights adjusted Chi Square F-statistic

3.2.5 Prevalence of the uptake of optimal doses of IPTp-SP

The overall prevalence of optimal IPTp-SP doses was 16.8% (95% CI:15.9 -17.8) among pregnant women. The prevalence varied depending on socio-demographic factors (Table 3.5), pregnancy-related (Table 3.6) and knowledge of malaria-related factors (Table 3.7).

3.2.6 Prevalence of optimal doses of IPTp-SP by the socio-demographic factors

Table 3.5 presents the varying prevalence of receiving IPTp-SP among pregnant women by socio-demographic factors. The results revealed that the prevalence of optimal doses varied by age group. Women 45 years and above had the lowest prevalence of optimal doses of IPTp-SP at 10.8% (95%

CI:7.0 – 16.3) than the younger women. At the same time, the highest prevalence at 17.9% (95% CI: 16.1–19.9) among women between 35 to 44 years old. Also, prevalence varied from the North to the South of Nigeria.

The uptake of optimal doses was higher in Southern than Northern Nigeria. In particular, uptake was highest at 39.1% (95% CI:35.9–42.3) among women in the South-East than in other regions. On the other hand, receipt of optimal doses was lowest at 10.8% (95% CI:9.4–12.4) in the North-West, even though the region had 36.4% of all pregnant women-the highest. Also, pregnant women in the urban areas of Nigeria had a higher 21.3% (95% CI: 19.6 – 23.0) uptake of optimal doses than in the rural areas. Education attainment predicted increasing receipt of optimal IPTp-SP doses.

Compared to no educational attainment, the prevalence of optimal doses of anti-malaria drugs was higher at 23.2% (95% CI:21.6 - 24.9) and 25.0% (95% CI:21.7 –28.8) for women with secondary and tertiary education, respectively. A similar increasing trend with the spouse's educational level was observed. The prevalence of optimal IPTp-SP doses was highest at 23.7% (95% CI:22.0 – 25.4) among women whose husbands had secondary education than no education at 8.6%. In contrast, the prevalence dropped to 23.0% (95% CI:20.5 – 25.8) for women whose husbands had tertiary education. There was a varying degree of receiving optimal anti-malarial drugs based on the household wealth index. A higher prevalence of optimal IPTp-SP doses was found among the richest at 24.9% (95% CI: 22.3 – 27.8) and richer at 23.3% (95% CI: 21.0 – 25.9) households to the most impoverished households. At the same time, women gainfully employed during the NDHS survey had a higher prevalence of receiving optimal anti-malarial drugs at 18.2% (95% CI:17.1 – 19.3) than unemployed women at 13.8%.

Table 3.5: Prevalence of optimal doses of IPTp-SP by the socio-demographic factors

Factors	Total N (%)[a]	≥ 3 Doses n (%)[a]	0 - 2 Doses n (%)	Rao Scot F-test	p-value
Uptake of Optimal dose of SP	**12742 (100)**	**2143 (16.8)**	**10598 (83.2)**		
Age in years				F(3, 3862.8) = 4.99	0.002
15-24	3842 (30.2)	578 (15.0)	3264 (85.0)		
25-34	6242 (49.0)	1103 (17.7)	5139 (82.3)		
35-44	2462 (19.3)	441 (17.9)	2021 (82.1)		
>45	195 (1.5)	21 (10.8)	174 (89.2)		
Region				F(5, 6140) = 64.67	<0.001
North Central	1770 (13.9)	264 (14.9)	1506 (85.1)		
North East	2339 (18.4)	329 (14.1)	2010 (85.9)		
North West	4639 (36.4)	503 (10.8)	4136 (89.2)		
South East	1263 (9.9)	493 (39.1)	769 (60.9)		
South South	1126 (8.8)	275 (24.4)	851 (75.6)		
South West	1606 (12.6)	279 (17.4)	1327 (82.6)		
Residential areas				F(1, 1313) = 49.89	<0.001
Urban	4853 (38.1)	1032 (21.3)	3822 (78.7)		
Rural	7888 (61.9)	1112 (14.1)	6776 (85.9)		
Highest Educational Level				F(3, 3759) = 71.43	<0.001
No Education	5766 (45.3)	597 (10.4)	5169 (89.6)		
Primary	1856 (14.6)	340 (18.3)	1516 (81.7)		
Secondary	4050 (31.8)	938 (23.2)	3111 (76.8)		
Higher	1070 (8.4)	268 (25.0)	802 (75.0)		
Wealth Index				F(4, 5137) = 37.56	<0.001
Poorest	2763 (21.7)	335 (12.1)	2428 (87.9)		
Poorer	2933 (23.0)	323 (11.0)	2610 (89.0)		
Middle	2636 (20.7)	423 (16.1)	2212 (83.9)		
Richer	2358 (18.5)	550 (23.3)	1808 (76.7)		
Richest	2052 (16.1)	512 (24.9)	1540 (75.1)		
Marital Status				F(4, 5163) = 2.10	0.078
Single	277 (2.2)	48 (17.2)	230 (82.8)		
Married	11822 (92.8)	1964 (16.6)	9858 (83.4)		
Co-habit	358 (2.8)	82 (22.8)	276 (77.2)		
Widow	88 (0.7)	17 (19.6)	71 (80.4)		
Divorced	196 (1.5)	33 (16.6)	163 (83.4)		
Employment Status				F(1, 1313) = 21.20	<0.001
Not Employed	3915 (30.7)	539 (13.8)	3376 (86.2)		
Employed	8827 (69.3)	1604 (18.2)	7222 (81.8)		
Religion				F(3, 4376) = 54.55	<0.001
Catholic	1083 (8.5)	330 (30.5)	753 (69.5)		
Protestant/Pentecostal	3496 (27.4)	798 (22.8)	2698 (77.2)		
Islam/Muslim	8093 (63.7)	1009 (12.5)	7083 (87.5)		
Traditional	43 (0.3)	5 (12.1)	38 (87.9)		

Others	27 (0.2)	1 (4.5)	26 (95.5)		
Spouse's Educational Level				F(3, 3799) = 78.92	<0.001
No Education	4568 (35.9)	392 (8.6)	4176 (91.4)		
Primary	1624 (12.7)	248 (15.3)	1376 (84.7)		
Secondary	4116 (32.7)	974 (23.7)	3142 (76.3)		
Higher	1872 (14.7)	431 (23.0)	1440 (77.0)		
Missing Response	561 (4.4)				
*%[a] weighted total proportion, n(%)[a] – the weighted proportion of women who received optimal IPTp-SP doses, * potential factor selected for the multivariable logistic regression because p-value <0.10. p-value = adjusted Chi Square test; Rao-Scott F-test = weights adjusted Chi Square F-statistic*					

3.2.7 Prevalence of optimal doses of IPTp-SP by the pregnancy-related factors

Table 3.6 shows the varying degree of IPTp-SP prevalence by the pregnancy-related factors among pregnant women. The prevalence of receiving optimal anti-malarial drugs increased as the number of ANC visits increased (p <0.001). From the results, the prevalence was 23.3% (95% CI:22.0–24.6) among pregnant women who visited ANC more than four times. At the same time, the prevalence was 12.6% (95% CI: 1.0–14.4) among pregnant women with fewer than four ANC attendance.

Early initiation of antenatal care was related to a higher prevalence of at least three doses of IPTp-SP (p <0.001). The prevalence of receiving optimal anti-malarial drugs was 19.6% (95% CI: 18.3–21.0) for women who initiated ANC services after the first trimester. And 13.6% (95% CI: 1.5–16.1) for those who initiated ANC in the third trimester. Likewise, the prevalence of optimal IPTp-SP doses of IPTp-SP differed by parity. The prevalence of at least three doses of the anti-malarial drugs was highest at 19.2% (95% CI:17.3–21.3) among women with only two children.

Table 3.6: Prevalence of optimal doses of IPTp-SP by the pregnancy-related factors

Factors	Total N (%)	≥ 3 Doses n (%)	0 - 2 Doses n (%)	Rao Scot F-test	P-Value
Uptake of optimal dose of SP	**12742 (100)**	**2143 (16.8)**	**10598 (83.2)**		
Frequency of ANC visits				F(1, 1277) = 85.96	<0.001*
No ANC Visit	3081 (24.2)	134 (4.4)	2947 (95.6)		
<4 ANC Visits	2350 (18.4)	297 (12.6)	2053 (87.4)		
≥ 4 ANC Visits	7151 (56.1)	1667 (23.3)	5484 (76.7)		
Missing Response	160 (1.3)				
Timing of first ANC visit				F(2, 2552) = 41.13	<0.001*
1st Trimester	2273 (17.8)	640 (28.2)	1633 (71.8)		
2nd Trimester	6003 (47.1)	1177 (19.6)	4826 (80.4)		
3rd Trimester	1365 (10.7)	186 (13.6)	1179 (86.4)		
Missing Response	3100 (24.3)				
Parity				F(2, 2610) = 8.22	0.001*
1 Child	2388 (18.7)	442 (18.5)	1946 (81.5)		
2 Children	2335 (18.4)	448 (19.2)	1887 (80.8)		
≥ 3 Children	8019 (62.9)	1254 (15.6)	6765 (84.4)		

*%[a] weighted total proportion, n(%)[a] – the weighted proportion of women who received optimal IPTp-SP doses, * potential factor selected for the multivariable logistic regression because p-value <0.10.*
ANC – Antenatal Care, p-value = adjusted Chi Square test; Rao-Scott F-test = weights adjusted Chi Square F-statistic

3.2.8 Prevalence of optimal doses of IPTp-SP by the knowledge of malaria-related factors

Table 3.7 displays the prevalence of receiving optimal anti-malarial regimens differed based on the level of belief in the effectiveness of IPTp-SP. From the results, the prevalence improved from 7.2% (95% CI:4.5 – 11.4) to 17.3% (95% CI:16.3 – 18.3) as the women's belief in IPTp-SP effectiveness increased from low to high. Similarly, the prevalence of taking optimal anti-malarial drugs varied by the level of belief about malaria consequences. The prevalence was 17.3% (95% CI:15.8 – 18.2) among women with a high belief in malaria consequences. And 14.9% (95% CI: 12.7 – 16.7) for those with a low level of belief about malaria consequences. Furthermore, exposure to malaria messages was related to a higher prevalence of optimal doses of the

antimalarial regimen at 31.3% (95% CI:26.9 – 36.2). Similarly, the prevalence of receiving at least three doses of IPTp-SP was SP at 27.8% (95% CI:21.9 – 34.6) among women who subscribed to health insurance.

Table 3.7: Prevalence of optimal doses of IPTp-SP by the knowledge of malaria-related factors

Factors	Total N (%)[a]	≥ 3 Doses n (%)[a]	0 - 2 Doses n(%)	Rao-Scott F-test	P-Value
Uptake of Optimal dose of SP	**12742 (100)**	**2143 (16.8)**	**10598 (83.2)**		
Media Exposure				F(1, 1313) = 64.28	<0.001*
No	11822 (92.8)	1855 (15.7)	9967 (84.3)		
Yes	919 (7.2)	288 (31.3)	631 (68.7)		
Health Insurance Subscription				F(1, 1313) = 17.32	<0.001*
No	12484 (98.0)	2072 (16.6)	10412 (83.4)		
Yes	257 (2.0)	72 (27.8)	186 (72.2)		
Belief in the Effectiveness of IPTp-SP				F(2, 2342) = 11.18	<0.001*
Low Belief	200 (1.6)	14 (7.2)	185 (92.8)		
Average	504 (4.0)	52 (10.4)	452 (89.6)		
High	12038 (94.5)	2077 (17.3)	9961 (82.7)		
Belief about Malaria consequences				F(2, 2441) = 2.03	0.242
Low	1614 (12.7)	240 (14.9)	1374 (85.1)		
Average	3869 (30.4)	648 (16.8)	6976 (83.2)		
High	7258 (57.0)	1255 (17.3)	220 (82.7)		

*%[a] weighted total proportion, n(%)[a] – the weighted proportion of women who received optimal IPTp-SP doses, * potential factor selected for the multivariable logistic regression because p-value <0.10.*
p-value = adjusted Chi Square test; Rao-Scott F-test = weights adjusted Chi Square F-statistic

3.3 Factors associated with uptake of at least one dose of IPTp-SP by pregnant women

This section presents the final model of the uptake of at least one dose of IPTp-SP compared to no IPTp-SP dose by pregnant women 15 to 49 years old. The results indicated several factors associated with receiving at least one dose of IPTp-SP; and written in sub-sections by the factors. The factors include the socio-demographic factors, pregnancy-related and knowledge of malaria-related factors. The final model was presented in Table 3.8, with extended details of the first-order interaction of household wealth index and spouse's educational level in Table 3.9. Moreso, the details of the initial model without interaction term are presented in Appendix A.

3.3.1 Socio-demographic factors and the uptake of at least one dose of IPTp-SP

Table 3.8 displays the socio-demographic factors associated with receiving at least one dose of IPTp-SP. The results revealed the uptake of at least one dose of the anti-malarial drugs was positively associated with the age group (p =0.014). Pregnant women aged 35 to 44 years had a 31% higher likelihood to receive at least one SP dose than those 15 to 25 years old (aOR:1.31; 95% CI: 1.08–1.58). Also, women above 45 years were 65% more likely to take at least the first dose of the anti-malaria drug than the younger women (aOR:1.65; 95% CI: 0.97–2.70). However, this relationship was not significant (p = 0.064). Administration of at least one IPTp-SP dose among pregnant was dependent on the region (p <0.001).

In South-Western Nigeria, women were 50% less likely to administer at least one preventive regimen dose than those in North-Central (aOR: 0.50; 95% CI:0.39–0.65). Conversely, the probability of receiving at least a single dose of IPTp-SP among women in the North-West was 1.51 times greater than the probability of those in North-Central (aOR: 2.51; 95% CI: 2.02–3.27).

The results revealed that uptake of at least one dose was 15% higher among women in the rural areas (aOR:1.15; 95% CI: 0.98–1.36) than in the urban areas in Nigeria. However, the relationship was not statistically significant (p = 0.082). The women's educational attainment was inversely related to being administered with at least one dose of IPTp-SP. After controlling for other factors in the model, there was no significant relationship (p=0.911). The household wealth index and spouse's educational level predicted a higher odds of receiving IPTp-SP doses (p = 0.048).

From Table 3.9, the interaction term revealed that odds of receiving at least one dose of IPTp-SP differs by the household wealth index and their spouse's educational level (p=0.048). From the results, pregnant women in the middle class whose spouses had secondary education had a two-fold greater likelihood to receive at least one dose of IPTp-SP; than those in the poorest households whose spouses had no formal education (aOR: 3.05; 95% CI: 1.23–3.29). Similarly, women in the richest household whose husbands had secondary education had a three-fold higher odds to administer at least one dose of IPTp-SP; than those in the most impoverished households whose spouses had no formal education (aOR:4.17; 95% CI:1.11–8.85).

3.3.2 Pregnancy-related factors and the uptake of at least one dose of IPTp-SP

Table 3.8 presents the pregnancy-related factors predicting the receipt of at least one dose of IPTp-SP among pregnant women aged 15 – 49 years. The frequency of ANC attendance was significantly related to administering at least one dose of the anti-malaria drug (p <0.001). The results indicate that those with four or more ANC visits have 61% greater odds to administer at least one dose of the anti-malarial regimen than those with fewer ANC attendance (aOR: 1.61; 95% CI: 1.36 – 1.91). The timing of ANC initiation showed no significant association with using at least one IPTp-SP dose (p =0.127). However, the results across strata indicate that pregnant

women who started ANC services in their third trimester had a 19% lower odds to utilize at least one dose of IPTp-SP than in their first trimester (aOR: 0.81; 95% CI: 0.64–1.02).

3.3.3 Knowledge of malaria-related factors and the uptake of at least one dose of IPTp-SP

From Table 3.8, the odds of receiving at least one dose of prophylaxis among women exposed to media messages were 1.69 times greater than the odds of those not exposed to media messages (aOR:2.69; 95% CI:2.14 - 3.37). After controlling for other factors, those exposed to media messages were 21% more likely to receive at least one IPTp-SP dose than those not exposed to media messages (aOR: 1.21; 95% CI: 0.93–1.57). However, the relationship was not statistically significant (p =0.163).

The uptake of at least one dose of IPTp-SP significantly differed by the women's level of belief in the drug's effectiveness (p<0.001). From the results, those with an average belief in the drug's effectiveness were 51% less likely to receive at least a single dose of the anti-malaria drug than those with a low level of belief in the drug's effectiveness (aOR:0.51; 95% CI: 0.26–1.00). Conversely, pregnant women very aware of malaria consequences were 33% more likely to receive a single dose of the anti-malarial drug than those with weak belief about malaria consequences (aOR: 1.33; 95% CI: 1.10–1.62). Thus, the association between any uptake and belief about the consequences of malaria was significant (p =0.004).

Table 3.8: Factors associated with uptake of at least one dose of IPTp-SP among pregnant women

Factors	Total N (%)	Crude OR (95% CI) Uptake of at least one dose	P-value	Adjusted OR (95%CI) Uptake of at least one dose	P-value
Socio-demographic Factors					
Age in years			***0.021**		***0.014**
15-24	3,842 (30.2)	1		1	
25-34	6,242 (49.0)	1.19 (1.06 - 1.29)	0.003	1.06 (0.91 - 1.21)	0.479
35-44	2,462 (19.3)	1.13 (0.99 - 1.30	0.080	1.31 (1.08 - 1.58)	0.006
>45	196 (1.5)	0.98 (0.71 - 1.37)	0.919	1.65 (0.97 - 2.70)	0.064
Region			***<0.001**		***<0.001**
North Central	1,770 (13.9)	1		1	
North East	2,339 (18.4)	1.42 (1.17 - 1.73)	<0.001	2.04 (1.62 - 2.60)	<0.001
North West	4,639 (36.4)	1.08 (0.88 - 1.31)	0.465	2.51 (1.97 - 3.20)	<0.001
South East	1,263 (9.9)	2. 96 (2.36 - 3.71)	<0.001	1.33 (1.02 - 1.74)	0.037
South South	1,126 (8.8)	2.22 (1.817 - 2.700)	<0.001	1.62 (1.27 - 21.17)	0.001
South West	1,606 (12.6)	1.34 (1.08 - 1.66)	0.007	0.50 (0.39 - 0.65)	<0.001
Residential areas			***<0.001**		***0.082**
Urban	4,854 (38.1)	1		1	
Rural	7,888 (61.9)	0.52 (0.45 - 0.60)	<0.001	1.15 (0.98 - 1.36)	0.082
Highest Educational Level			***<0.001**		***0.911**
No Education	5,766 (45.3)	1		1	
Primary	1,856 (14.6)	2.01 (1.74 - 2.33)	<0.001	1.01 (0.84 - 1.22)	0.918
Secondary	4,050 (31.8)	2.75 (2.41 - 3.14)	<0.001	0.95 (0.78 - 1.16)	0.593
Higher	1,070 (8.4)	4.371 (3.53 - 5.42)	<0.001	0.94 (0.69 - 1.28)	0.700
Household wealth Index			***<0.001**		***0.851**
Poorest	2,763 (21.7)	1		1	
Poorer	2,933 (23.0)	1.29 (1.10 - 1.51)	0.001	0.93 (0.72 – 1.22)	0.609
Middle	2,636 (20.7)	2.31 (1.97 - 2.72)	<0.001	1.07 (0.77 – 1.49)	0.671
Richer	2,358 (18.5)	2.98 (2.49 - 3.57)	<0.001	1.20 (0.69 – 2.08)	0.511
Richest	2,052 (16.1)	4.58 (3.75 - 5.61)	<0.001	0.96 (0.38 – 2.38)	0.929
Employment Status			***<0.001**		***0.755**
Not Employed	3,915 (30.7)	1		1	
Employed	8,827 (69.3)	1.46 (1.31 - 1.62)	<0.001	1.21 (0.88 - 1.18)	0.755
Spouse's Education Level			***<0.001**		***0.704**
No Education	4,568 (35.6)	1		1	
Primary	1,624 (12.7)	2.09 (1.77 - 2.46)	<0.001	1.10 (0.66 - 1.83)	0.707
Secondary	4,116 (32.7)	3.07 (2.69 - 3.51)	<0.001	1.04 (0.71 – 1.52)	0.854
Higher	1,872 (14.7)	4.54 (3.80 - 5.42)	<0.001	1.95 (0.60 – 6.36)	0.268
Pregnancy-related factors					
Frequency of ANC visits			***<0.001**		***<0.001**
<4 ANC Visits	2,351 (24.7)	1		1	
≥ 4 ANC Visits	7,151 (75.3)	1.50 (1.31 - 1.72)	<0.001	1.61 (1.36 - 1.91)	<0.001

Timing of First ANC Initiation			***0.001**		***0.127**
1st Trimester	2,273 (23.6)	1		1	
2nd Trimester	6,003 (62.3)	0.96 (0.83 - 1.12)	0.631	0.97 (0.83 - 1.15)	0.746
3rd Trimester	1,365 (14.2)	0.71 (0.59 - 0.86)	<0.001	0.81 (0.64 - 1.02)	0.072
Knowledge of malaria-related factors					
Media Exposure			***<0.001**		***0.163**
No	11,823 (92.8)	1		1	
Yes	919 (7.2)	2.69 (2.14 - 3.37)	<0.001	1.21 (0.93 - 1.57)	0.163
Health Insurance Subscription			***0.001**		***0.078**
No	12,484 (98.0)	1		1	
Yes	258 (2.0)	2.51 (1.47 - 4.28)	0.001	1.57 (0.95 - 2.58)	0.078
Belief in Effectiveness of IPTp-SP			***<0.001**		***<0.001**
Low belief	200 (1.6)	1		1	
Average belief	504 (4.0)	0.69 (0.47 - 1.03)	0.072	0.51 (0.26 - 1.00)	0.051
High belief	12,038 (94.5)	2.47 (1.81 - 3.38)	<0.001	1.50 (0.90 - 2.50)	0.123
Belief about Malaria Consequences			***<0.001**		***0.014**
Low belief	1,615 (12.7)	1		1	
Average belief	3,869 (30.4)	1.38 (1.17 - 1.62)	<0.001	1.32 (1.05 - 1.66)	0.018
High belief	7,258 (57.0)	1.49 (1.29 - 1.72)	<0.001	1.33 (1.10 - 1.62)	0.004

ANC – Antenatal care
**p-values – overall p-values for each exposure variable in the model, CI – Confidence Intervals*
OR – Odds ratios, crude OR (from Bivariate analysis) Adjusted OR (from Multivariable analysis)
Goodness-of-fit of the model = F(9, 1262) = 1.38; p = 0.194
1 => Reference category

Table 3.9: Interaction Term between spouse's Educational levels Household wealth index from the final model (uptake of at least one dose).

Household Wealth Index	Spouse's Educational levels – aOR[1] (95% CI)			Interaction p-value
	Primary	**Secondary**	**Higher**	
Poorest	1	1	1	
Poorer	1.00 (0.56–1.79)	1.15 (0.72 – 1.82)	0.90 (0.25 – 3.19)	
Middle	1.05 (0.53–2.08)	**2.01 (1.23 – 3.29) ****	0.87 (0.24 – 3.13)	**0.048[a]**
Richer	1.21 (0.55–2.67)	1.61 (0.83 – 3.10)	0.74 (0.20 – 2.72)	
Richest	1.28 (0.41–3.96)	**3.13 (1.11 – 8.85) ***	1.33 (0.29 – 6.04)	

[a]p-value – overall p-value of the interaction term
95% CI – 95% Confidence Intervals, aOR[1] – Adjusted Odds ratio
aOR[1] was adjusted for all factors presented in Table 3.8 (uptake of at least one dose of IPTp-SP)
**p<0.05, **p<0.01 (Actual p-value *p= 0.032; **p =0.005)*
Note: Table 3.9 is an extension of Table 3.8, the selected model with interaction term.

3.4 Factors associated with the uptake of optimal doses of IPTp-SP

The final model (Table 3.10) revealed various factors associated with administering at least three doses of anti-malarial drugs to pregnant women aged 15 to 49 years old. The factors include socio-demographic factors, pregnancy-related factors, and knowledge of malaria-related factors. Even though there was an interaction term (one stratum) between household wealth index and spouse's education, the final model selected was the model without the interaction (Table 3.10).

The choice was based on the results of the adjusted goodness-fit-test (GOF) and the Wald test. First, the interaction terms showed no improvement to the initial model (p =0.215). Next, the adjusted GOF of the model without the interaction term was much closer to 1 (p=0.974) than the model with the interaction term (p =0.477). More so, details of the model with the interaction term can be found in Appendix B.

3.4.1 Socio-demographic factors and uptake of optimal doses of IPTp-SP

Table 3.10 presents socio-demographic factors associated with receiving at least three doses of IPTp-SP by pregnant women aged 15 to 49 years. There was a negative association between receipt of optimal doses of IPTp-SP and educational attainment. Compared to women with no formal education, the odds of admnistering at least three prophylaxis doses reduced by 16% among those with secondary education (aOR: 0.84; 95% CI:0.68 -1.03); and reduced by 30% among women with tertiary education (aOR: 0.70 95% CI:0.51–0.97). In contrast, their spouse's educational level related directly to the receipt of optimal doses of anti-malarial regimen during pregnancy. The odds to administer at least three doses of IPTp-SP among women whose spouses had a higher education was 86% greater than the odds in those whose spouses had no formal education (aOR: 1.86; 95% CI: 1.40–2.49).

Receiving optimal doses of the anti-malarial regimen was inversely associated with the household wealth index. Compared to women in most impoverished households, the chances to administer at least three doses of the anti-malarial regimen reduced by 35% among poorer households (aOR: 0.65; 95% CI:0.52–0.81), and reduced by 29% among wealthiest households (aOR: 0.71; 95% CI: 0.52 – 0.96). Also, the result revealed age group before adjusting for other factors was directly related to taking optimal doses of the antimalarial regimen.

Women, 25 to 34 years old, were 21% more likely to utilize at least three doses of IPTp-SP than those aged 15 – 24 years during pregnancy (cOR: 1.21; 95% CI: 1.06 – 1.38). However, after controlling for other factors, there was no relationship between women's age group and taking optimal doses ($p = 0.121$). Also, the probability of completing at least three doses varied based on the regions where the women lived ($p < 0.001$). The results revealed that the odds to take at least three doses were generally higher among pregnant women in Southern than in Northern Nigeria. In the South-East, the odds of utilising optimal doses of the antimalarial regimen among pregnant women was 196% higher than the odds in the North-Central (aOR: 2.96; 95% CI: 2.31 – 3.80).

3.4.2 Pregnancy-related factors and uptake of optimal doses of IPTp-SP

The final model (Table 3.10) also shows the various pregnancy-related factors significantly associated with taking optimal doses of IPTp-SP by pregnant women. The results established a positive association between the frequency of ANC attendance and taking optimal doses of the anti-malarial ($p < 0.001$). The probability of completing at least three doses among pregnant women who attended four or more ANC visits was 58% higher; than the probability of completing at least three doses of IPTp-SP among those with fewer ANC visits (aOR: 1.58; 95% CI:1.31 – 1.88). More so, the timing of initiating ANC services was inversely related to taking optimal doses of the anti-malarial regimen during pregnancy ($p < 0.001$). Compared to pregnant women who started

care in their first trimester, the likelihood of taking three or more prophylaxis doses reduced by 40% among pregnant women who started ANC in their third trimester (aOR: 0.60; 95% CI:0.47–0.78). In addition, the odds reduced by 29% among those who started ANC after the first trimester during pregnancy (aOR: 0.71; 95% CI: 0.61 – 0.82).

3.4.3 Knowledge of malaria-related factors and uptake of optimal doses of IPTp-SP

Table 3.10 revealed the possible malaria-related factors related to taking optimal doses of IPTp-SP during pregnancy. Pregnant women exposed to media messages were 1.39 times as likely as completing optimal doses of IPTp-SP than those not exposed to media messages (aOR: 1.39; 95% CI: 1.10 – 1.75). Equally, the odds of taking optimal anti-malarial regimens among pregnant women who subscribed to health insurance packages were 94% greater than those without any health insurance package (cOR:1.94; 95% CI: 1.41-2.66). However, after controlling for other factors, the relationship was not directly associated with administering at least three IPTp-SP doses (p =0.083). The results also indicated women who believe highly in the drug's effectiveness prevent malaria in pregnancy had a 64% higher odds of completing optimal IPTp-SP doses than those with a low level of belief in the drug's effectiveness (aOR: 1.64; 95% CI: 0.93 – 2.91). In addition, odds of taking optimal antimalarial regimens by pregnant women differed based on their level of belief about malaria consequences (p = 0.021).

Table 3.10: Factors associated with uptake of optimal doses of IPTp-SP among pregnant women

Factors	Total N (%)	Crude OR (95% CI) Uptake of optimal doses	p-value	Adjusted OR (95% CI) Uptake of optimal doses	p-value
Socio-demographic factors					
Age in years			**0.003**		**0.121**
15-24	3,842 (30.2)	1		1	
25-34	6,242 (49.0)	1.21 (1.06 - 1.38)	0.004	1.06 (0.91 - 1.22)	0.478
35-44	2,462 (19.3)	1.23 (1.05 - 1.45)	0.012	1.15 (0.95 - 1.39)	0.159
>45	196 (1.5)	0.68 (0.42 - 1.12)	0.130	0.62 (0.35 - 1.10)	0.103
Region			**<0.001**		**<0.001**
North Central	1,770 (13.9)	1		1	
North East	2,339 (18.4)	0.93 (0.74 - 1.18)	0.558	0.90 (0.70 - 1.15)	0.400
North West	4,639 (36.4)	0.69 (0.56 - 0.86)	0.001	0.97 (0.76 - 1.24)	0.816
South East	1,263 (9.9)	3.65 (2.98 - 4.48)	<0.001	2.96 (2.31 - 3.80)	<0.001
South South	1,126 (8.8)	1.84 (1.48 - 2.30)	<0.001	1.58 (1.20 - 2.06)	0.001
South West	1,606 (12.6)	1.20 (0.28 - 1.55)	0.166	0.82 (0.63 - 1.06)	0.130
Residential areas			**<0.001**		**0.247**
Urban	4,854 (38.1)	1		1	
Rural	7,888 (61.9)	0.61 (0.53 - 0.70)	<0.001	1.11 (0.93 - 1.31)	0.247
Highest Educational Level			**<0.001**		**0.151**
No Education	5,766 (45.3)	1		1	
Primary	1,856 (14.6)	1.94 (1.63 - 2.31)	<0.001	0.97 (0.80 - 1.17)	0.712
Secondary	4,050 (31.8)	2.61 (2.25 - 3.04)	<0.001	0.84 (0.68 - 1.03)	0.099
Higher	1,070 (8.4)	2.89 (2.31 - 3.62)	<0.001	0.70 (0.51 - 0.97	0.032
Wealth Index			**<0.001**		**0.003**
Poorest	2,763 (21.7)	1		1	
Poorer	2,933 (23.0)	0.90 (0.72 - 1.11)	0.326	0.65 (0.520 - 0.812	<0.001
Middle	2,636 (20.7)	1.38 (1.12 - 1.71)	0.003	0.64 (0.510 - 0.811	<0.001
Richer	2,358 (18.5)	2.20 (1.78 - 2.73)	<0.001	0.81 (0.64 - 1.03)	0.088
Richest	2,052 (16.1)	2.41 (1.93 - 2.30)	<0.001	0.71 (0.52 - 0.96)	0.027
Employment Status			**<0.001**		**0.662**
Not Employed	3,915 (30.7)	1		1	
Employed	8,827 (69.3)	1.39 (1.21 - 1.60)	<0.001	0.97 (0.82 - 1.13)	0.662
Husband's Educational Level			**<0.001**		**<0.001**
No Education	4,568 (35.6)	1		1	
Primary	1,624 (12.7)	1.92 (1.55 - 2.39)	<0.001	1.07 (0.85 - 1.34)	0.586
Secondary	4,116 (32.7)	3.30 (2.76 - 3.93)	<0.001	1.71 (1.40 - 2.10)	<0.001
Higher	1,872 (14.7)	3.19 (2.568 - 3.961)	<0.001	1.86 (1.40 - 2.49)	<0.001
Pregnancy-related factors					
Frequency of ANC Visits			**<0.001***		**<0.001***

<4 ANC Visits	2,351 (24.7)	1		1	
≥4 ANC Visits	7,151 (75.3)	2.10 (1.79 - 2.47)	<0.001	1.58 (1.31 - 1.88)	<0.001
Timing of First ANC Initiation			**<0.001***		**<0.001***
1st Trimester	2,273 (23.6)	1		1	
2nd Trimester	6,003 (62.3)	0.62 (0.54 - 0.71)	<0.001	0.71 (0.61 - 0.82)	<0.001
3rd Trimester	1,365 (14.2)	0.40 (0.32 - 0.50)	<0.001	0.60 (0.47 - 0.78)	<0.001
Knowledge of malaria-related factors					
Media Exposure			**<0.001***		**0.006***
No	11,823 (92.8)	1		1	
Yes	919 (7.2)	2.45 (1.96 - 3.07)	<0.001	1.39 (1.10 - 1.75)	0.006
Health Insurance Subscription			**<0.001***		**0.083***
No	12,484 (98.0)	1		1	
Yes	258 (2.0)	1.94 (1.41 - 2.66)	<0.001	1.36 (0.96 - 1.93)	0.083
Belief in Effectiveness of IPTp-SP			**<0.001***		**0.095***
Low	200 (1.6)	1		1	
Average	504 (4.0)	1.49 (0.78 - 2.85)	0.223	1.17 (0.54 - 2.57)	0.689
High	12,038 (94.5)	2.68 (1.62 - 4.44)	<0.001	1.64 (0.93 - 2.91)	0.088
Belief about Malaria Consequences			**0.074***		**0.021***
Low	1,615 (12.7)	1		1	
Average	3,869 (30.4)	1.25 (1.01 - 1.54)	0.037	1.14 (0.91 - 1.42)	0.254
High	7,258 (57.0)	1.20 (1.01 - 1.43)	0.041	0.90 (0.73 - 1.10)	0.296

uptake of optimal doses of IPTp-SP implies uptake of at least three doses of IPTp-SP;
ANC – Antenatal care
**p-values – overall p-values for each exposure variable in the model, CI – Confidence Intervals*
OR – Odds ratios, crude OR (from Bivariate analysis) Adjusted OR (from Multivariable analysis)
Goodness-of-fit of the model = F(9, 1262) = 0.30; p = 0.974
1 => Reference category

CHAPTER 4 – DISCUSSION

This study sought to establish the factors associated with the uptake of at least one dose and at least three doses of IPTp-SP among pregnant women in Nigeria. The main findings of this study are that prevalence of at least one dose of IPTp-SP among pregnant women in Nigeria is low. And the prevalence of optimal doses of IPTp-SP is much lower than the national target at 80%. Furthermore, pregnant women's regions, household wealth index, spouse's educational level, frequency and timing of ANC attendance, women's level of beliefs, insurance coverage, and exposure to media messages among pregnant women were significantly associated with the uptake of at least one dose and optimal doses of IPTp-SP.

4 Prevalence of the uptake of IPTp-SP

The current study determined the prevalence of IPTp-SP uptake among pregnant women aged 15 to 49 years old. The receipt of fewer than three IPTp-SP doses provides less effective for treating asymptomatic malaria parasitaemia and preventing maternal malaria (63). In contrast, pregnant women who take optimal IPTp-SP doses get fully protected against asymptomatic parasitaemia and malaria infection (63). From the current study, the prevalence of taking at least a single IPTp-SP dose is 63.6% among pregnant women. The receipt of optimal IPTp-SP doses is 16.8% as well among pregnant women in Nigeria. The findings were significantly lower than the stipulated 80% target by the Roll-Back-Malaria partnership, a global platform whose main objective is towards a world free from malaria (64). The findings highlight a significant number of missed opportunities, given that 63.6% received at least the first dose of IPTp-SP among pregnant women in Nigeria. The current study's low prevalence of IPTp-SP is supported by the WHO malaria report for sub-Saharan Africa in 2019 (25). The WHO malaria report estimated that 62% of eligible pregnant women receive at least one SP dose while only 34% took at least three SP doses during pregnancy

in SSA countries.Also, Pons-Duran et al., 2020 reported that the prevalence of taking optimal IPTp-SP doses are significantly below 25% in Nigeria, DR Congo, and Madagascar (32). Conversely, the literature shows the situation is somewhat different in Uganda, Ghana, and Malawi.

The receipt of at least one SP dose is slightly lower in Uganda at an estimated 46.0% (43). In contrast, the prevalence of optimal anti-malarial regimens is much higher in Ghana and Malawi at an estimated 63.0% and 42.0%, respectively (31,33). In 2013, Hill and colleagues found that regional variations of IPTp-SP uptake are due to different levels of malaria knowledge among pregnant women in sub-Saharan Africa (35). The current study confirmed the finding. The receipt of IPTp-SP doses in ANC services varied.

From the current study, nearly 76% of all pregnant women attend ANC services in Nigeria. And about 57% attended at least four ANC visits during pregnancy. Of those who attended four or more ANC visits, 80.3% took at least one dose, and 23.3% took optimal IPTp-SP doses. The results mean that about 57% of pregnant women lost their opportunity to be protected against malaria infection, even after attending more than four ANC visits (50). The situation calls for urgent attention to maximise ANC clinic to deliver optimal anti-malarial regimens. The WHO malaria report in 2019 also found regional variations in IPTp-SP uptake via ANC services in SSA countries (65). The finding is consistent with the current findings among Nigerian pregnant women. The variation in IPTp-SP uptake via ANC services further varies in other countries compared to Nigeria.

The proportion of at least four ANC visits was higher at 57% in this study compared to less than 50% in Malawi (33). However, Azizi reported a higher utilisation of optimal IPTp-SP doses at 52% in 2020 (33) than the 16.8% optimal uptake found in this study. Olukoya and Adebiyi, 2017

in Nigeria attributed the low receipt of optimal anti-malarial regimens by pregnant women to non-compliance to IPTp-SP guidelines among healthcare workers (46). The findings suggest a lost opportunity to deliver optimal doses to Nigerian pregnant women via ANC services. Even though the WHO recommends that eligible pregnant women be given IPTp-SP doses at every scheduled ANC visit, the findings suggest otherwise in Nigeria.

4.1 Factors associated with IPTp-SP Uptake

The associated factors with taking IPTp-SP among pregnant women in this study are discussed based on the established socio-demographic, pregnancy-related, and malaria knowledge factors. First, each sub-section discusses the factors associated with taking at least one dose and optimal IPTp-SP doses separately. Then discusses possible overlaps and differences in the associated factors with either the uptake of at least one dose or optimal IPTp-SP doses among Nigerian pregnant women.

4.1.1 Socio-demographic factors and IPTp-SP Uptake

The socio-demographic factors related to taking at least one IPTp-SP dose include age group, region, residential areas, household wealth index, and spouse's educational level. The study found that women 35 years old and above have 31% higher odds to receive at least one IPTp-SP dose during pregnancy than the younger ones. The finding was consistent with Olugbade et al., 2019 in Nigeria (45) and Kibusi et al., 2015 in Tanzania (44), who observed that the receipt of at least one SP dose was positively associated with being 35 years and above. From the current study, 62.9% of pregnant women had at least three children before 2018. Hence, the higher uptake of at least one dose among older women may be attributed to earlier exposure to the benefit of IPTp-SP during pregnancy (66). Generally, the evidence may also suggest older women have more positive

attitudes towards IPTp-SP uptake during pregnancy. The receipt of at least one IPTp-SP dose varied by residential areas and regions in Nigeria.

In 2018, pregnant women living in rural North-West Nigeria were the most likely to take at least one IPTp-SP dose than other regions. The finding might be ascribed to the increased healthcare interventions programmes and implementation in Northern Nigeria by Non-governmental Organisations (NGOs). The increased NGOs' activities in the North may have contributed to the higher chances of taking at least one IPTp-SP dose by women residing in rural areas. The current finding is supported by Masaniga et al., 2016that found Zambian women living in the rural areas were more likely to receive the first dose of IPTp-SP compared to those in urban areas in 2016(67). In Nigeria, the finding is also supported by Olukoya and Adebiyi 2017 that found a higher inequality in accessing care in urban areas than rural areas (46). The higher inequality may contribute to lower chances of initiating anti-malarial regimens in urban areas during pregnancy. The utilisation of optimal anti-malarial regimens is dependent on similar socio-demographic factors but not age groups.

The receipt of optimal IPTp-SP doses are associated with pregnant women's region, household wealth index, education level, and spouse's educational level. In Nigeria, pregnant women living in the southern region have higher odds to receive at least three IPTp-SP doses than those living in the northern region. The regional variation in taking optimal IPTp-SP doses are supported by Ndu et al., 2020 in Nigeria (47). The finding implies that pregnant women's location can contribute to unequal access to healthcare in Nigeria (47). The women's age group does not play a significant role in taking optimal anti-malarial regimens. The finding is supported by Hill et al., 2013 (35).

The utilisation of at least three IPTp-SP doses is inversely related to women's educational attainment. The finding agrees with Yaya et al., 2018, who found that pregnant women's

educational status in malaria-endemic countries negatively predicted the receipt of optimal IPTp-SP doses (29). The evidence suggests that level of education can contribute to poor adherence to receiving optimal anti-malarial regimens during pregnancy. The opposite is accurate in terms of the association with IPTp-SP and spouse's educational level. Pregnant women whose spouses have attained at least secondary education have higher odds of receiving at least one IPTp-SP dose. In addition, adherence to completing optimal doses is related to the spouse's educational level. The current findings agree with the findings of studies conducted in Northern and Eastern Nigeria (45,54). The findings infer that male involvement in ANC services during pregnancy might predict a higher IPTp-SP uptake (68). The utilisation of at least one dose and optimal IPTp-SP doses is associated with the household wealth index in different directions.

The household wealth index positively influences the receipt of at least one IPTp-SP dose during pregnancy. Women from wealthier households whose spouses had secondary education increased the chance of initiating IPTp-SP uptake during pregnancy. The positive association of wealth index with receiving at least one IPTp-SP dose is consistent with the findings by Pons-Duran et al., 2020 (29), and Rassi et al., 2016 (40).

Previous studies established a positive association between the receipt of optimal IPTp-SP doses and the household's wealth index (30,32). However, this current study found that pregnant women have reduced odds to receive the optimal doses of IPTp-SP regardless of their wealth index. Conversely, Mohammed et al., 2020 found that pregnant women from the richest households have increased IPTp-SP uptake than those from the poorest households in Nigeria (30). The disparity in the results may be attributed to the different methodologies adopted in assessing the association between wealth index and uptake of IPTp-SP. The current study reported that 84.3% of pregnant women who did not receive the optimal doses of IPTp-SP were also not exposed to media

messages. The results may be a plausible reason for the wealth index indirectly influencing the uptake of optimal doses of IPTp-SP in this study. Also, studies support the evidence that knowledge of malaria-related interventions may affect adherence to taking optimal doses of IPTp-SP regardless of the wealth index. (35,38).

4.1.2 Pregnancy-related factors and IPTp-SP Uptake

The study found that the timing of the first ANC initiation is inversely related to the receipt of at least one dose and optimal IPTp-SP doses. This finding means that early commencement of ANC services increases the likelihood of receiving at least one and at least three doses of anti-malarial regimens during pregnancy. Women who commenced ANC service in their third trimester have reduced odds to receive at least one dose and optimal IPTp-SP doses than those who commenced ANC service in the first trimester. This finding is widely supported by various studies across sub-Saharan Africa, such as studies conducted in Tanzania (34), Uganda (43), Malawi (37), and Nigeria (30). This finding also supports the WHO recommendations as stated in the updated IPTp-SP policy in 2012. The policy stated that every pregnant woman should receive their first dose of IPTp-SP after the first trimester. And the successive IPTp-SP doses received in each scheduled ANC visit at a one-month interval (24).

The results indicated that the odds of taking at least one dose and optimal IPTp-SP doses among women with at least four ANC attendance are greater odds than those with less than four ANC visits during pregnancy. These findings are consistent with Hill et al., 2013, a study conducted in SSA countries, including Nigeria (35). Moreover, this study estimates that approximately 84% of pregnant women who visited ANC clinics at least four times initiated ANC services in the second trimester of their pregnancy. Yet, only 23.3% of these women received optimal doses of IPTp-SP, though 80.3% of them received at least the first dose of IPTp-SP during pregnancy. This evidence

implies lost opportunities to deliver the optimal anti-malarial regimens to pregnant women who visited ANC clinics at least four times. Even though the WHO recommends delivering IPTp-SP via scheduled ANC services to pregnant women living in malaria-endemic countries such as Nigeria, the number of IPTp-SP doses received differs substantially.

This difference in the proportions of anti-malarial regimens among pregnant women may be attributed to identified healthcare system constraints such as non-compliance to IPTp-SP guidelines and a shortage of trained healthcare workers (39,41). This difference in proportions of the uptake may also be attributed to inadequate knowledge or awareness about IPTp-SP guidelines, poor service delivery among healthcare workers (38,39,52). Similarly, occasional stock-out of IPTp-SP in public hospitals has also been identified to hinder the supply and demand of IPTp-SP during pregnancy (38,41).

4.1.3 Knowledge of malaria-related factors and IPTp-SP Uptake

Exposure to media messages has a direct effect on the uptake of anti-malarial drugs during pregnancy. This study shows that pregnant women exposed to media messages at least once a week have an increased odds of taking optimal IPTp-SP doses. This finding is consistent with other countries such as Ghana (31), Uganda (43) and Tanzania (34). The finding suggests that exposure to any form of media message at least once a week may increase the odds of being aware of the benefits of taking IPTp-SP doses among pregnant women. In addition, insurance coverage directly relates to the receipt of IPTp-SP during pregnancy. Insurance coverage contributed to initiating the first dose and completing at least three anti-malarial regimens among pregnant women. In Ghana, a similar finding was supported by Darteh et al., 2020 (31).

Furthermore, the belief in the effectiveness of IPTp-SP is positively associated with the receipt of IPTp-SP. The women's belief level in the effectiveness of IPTp-SP may translate to their level of trust in the efficacy and safety of malaria preventive medicine. As opposed to more trust, the findings mean that women who have less trust in the effectiveness of IPTp-SP are less likely to initiate IPTp-SP use. Whereas more trust in the effectiveness of IPTp-SP translates to a higher probability of receiving optimal anti-malarial drugs during pregnancy. The finding aligns with Balami et al., 2020, that knowledge about the efficacy of SP predicts the receipt of the first dose of the anti-malaria drug. And ultimately, the subsequent IPTp-SP doses during pregnancy (48).

Pregnant women's belief about malaria consequences predicts the proportion of IPTp-SP doses received. The level of belief about malaria consequences can also mean the level of awareness about malaria consequences. Pregnant women with more awareness about malaria consequences received more doses of IPTp-SP. That is the uptake of at least one dose and optimal doses of IPTp-SP during pregnancy compared to those with low awareness. In Mozambique, the findings are supported by Arnaldo et al., 2019 that lack of awareness of malaria consequences in pregnancy had a reduced likelihood of taking IPTp-SP during pregnancy (42).

4.2 Strengths and Limitations of this study

The major strength of this study was using a nationally representative sample to establish the factors related to IPTp-SP uptake. Next, the sample used was considerably large (n=12,742), and the calculated statistical power for this study is 100%. (As shown in section 2.3). Therefore, the findings may be generalizable to Nigerian women with live births on the factors that may influence the effective delivery of anti-malarial regimens during pregnancy. Even though the uptake of optimal doses predicated upon receiving at least the first dose of IPTp-SP among pregnant women

(48), most studies focus on the factors related to the uptake of optimal doses of IPTp-SP (33,43). Hence, this study established the factors that separately influence the uptake of at least the first and optimal IPTp-SP doses. To the best of my knowledge, this is the first study that has used a national representative sample to establish the influence of women's belief in the effectiveness of IPTp-SP to keep themselves and their foetus healthy on IPTp-SP uptake in Nigeria. It is essential to note the following limitations in considering the findings of this study on the factors associated with IPTp-SP use among women with live births in Nigeria.

First, the established factors associated with IPTp-SP use do not imply causality because of the cross-sectional nature of the study design. Secondly, this study could not assess the challenges or attitudes of pregnant women concerning IPTp-SP use because the analysis was limited to the variables available in the 2018 NDHS questionnaire. In addition, the study did not address healthcare-related constraints such as stock-outs of SP, shortage of healthcare workers, little or no awareness and non-compliance to the IPTp-SP guidelines. Therefore, there is a likelihood that women who attended at least four ANC visits during pregnancy did not receive IPTp-SP because of stock-out of the drug. Third, the exclusion of women who had stillbirths may have resulted in selection bias. The exclusion might have reduced the estimated effect of each possible factor on the uptake of IPTp-SP (13). Therefore, these findings are only generalisable to women with live births. Fourth, as a self-reported survey, the study is liable to social desirability bias as the women's self-reported responses might not reflect the reality of the issues. Lastly, recall bias is an inherent limitation of survey designs resulting in varying degrees of accuracy in their previous experiences. However, some of these recall biases were minimised by including only women with live births during or two years before the Nigeria Demographic Health Survey in 2018.

4.3 Conclusion and Recommendation

In conclusion, this study has shown that there is non-optimal uptake of IPTp-SP during pregnancy in Nigeria. In addition, the prevalence of uptake of at least one dose of IPTp-SP during pregnancy is low. A range of socio-demographic, pregnancy-related, and malaria knowledge factors are associated with varying uptake levels of IPTp-SP during pregnancy. Therefore, there is a need for context-specific strategies such as targeted mass sensitization and community awareness to increase the coverage of IPTp-SP uptake among vulnerable women. In addition, future research should explore the drivers of region-specific low uptake of optimal doses among pregnant women, especially in South-West Nigeria.

This current study indicated that antenatal care attendance is high among Nigerian women. However, the uptake of three or more doses of anti-malaria drugs during pregnancy remains low, even though most pregnant women reported receiving at least the first dose of IPTp-SP via ANC clinic. Thus, the evidence suggests there are existing implementation gaps in utilizing ANC clinics as a platform to deliver IPTp-SP to pregnant women in Nigeria. This situation calls for urgent action to deploy region-specific strategies to mitigate the bottlenecks (such as drug stock-out, non-compliance to the guidelines) at the healthcare facilities that hinder the delivery of IPTp-SP via ANC clinics in Nigeria.

Finally, this study ascertained that pregnant women's belief in the effectiveness of IPTp-SP predicts the uptake of the first dose but not optimal doses of IPTp-SP in Nigeria. Hence, there is a need for future research to understand the social-behavioural issues that drive poor adherence to complete the optimal doses among pregnant women in Nigeria.

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6 APPENDICES

6.1 Appendix A: The model without the interaction term for the uptake of at least one dose

Factors	Total N (%)	Crude ORs (95% CI) Uptake of at least one dose	P-value	Adjusted ORs (95%CI) Uptake of at least one dose	P-value
Socio-demographic Factors					
Age in years			***0.021**		***0.014**
15-24	3,842 (30.2)	1		1	
25-34	6,242 (49.0)	1.19 (1.06 - 1.29)	0.003	1.06 (0.92 - 1.23)	0.391
35-44	2,462 (19.3)	1.13 (0.99 - 1.30	0.080	1.31 (1.08 - 1.59)	0.006
>45	195 (1.5)	0.98 (0.71 - 1.37)	0.919	1.65 (1.00 - 2.73)	0.051
Region			***<0.001**		***<0.001**
North Central	1,770 (13.9)	1		1	
North East	2,339 (18.4)	1.42 (1.17 - 1.73)	<0.001	2.06 (1.64 - 2.60)	<0.001
North West	4,639 (36.4)	1.08 (0.88 - 1.31)	0.465	2.57 (2.02 - 3.27)	<0.001
South East	1,263 (9.9)	2. 96 (2.36 - 3.71)	<0.001	1.39 (1.07 - 1.82)	0.015
South South	1,126 (8.8)	2.22 (1.817 - 2.700)	<0.001	1.66 (1.27 - 21.17)	<0.001
South West	1,606 (12.6)	1.34 (1.08 - 1.66)	0.007	0.52 (0.40 - 0.67)	<0.001
Residential areas			***<0.001**		***0.062**
Urban	4,853 (38.1)	1		1	
Rural	7,888 (61.9)	0.52 (0.45 - 0.60)	<0.001	1.17 (0.99 - 1.37)	0.062
Highest Educational Level			***<0.001**		***0.954**
No Education	5,766 (45.3)	1		1	
Primary	1,856 (14.6)	2.01 (1.74 - 2.33)	<0.001	0.98 (0.80 - 1.19)	0.814
Secondary	4,050 (31.8)	2.75 (2.41 - 3.14)	<0.001	0.94 (0.77 - 1.16)	0.578
Higher	1,070 (8.4)	4.371 (3.53 - 5.42)	<0.001	0.93 (0.68 - 1.27)	0.660
Household wealth Index			***<0.001**		***<0.001**
Poorest	2,763 (21.7)	1		1	
Poorer	2,933 (23.0)	1.29 (1.10 - 1.51)	0.001	0.93 (0.76 - 1.14)	0.490
Middle	2,636 (20.7)	2.31 (1.97 - 2.72)	<0.001	1.32 (1.06 - 1.64)	0.013
Richer	2,358 (18.5)	2.98 (2.49 - 3.57)	<0.001	1.35 (1.04 - 1.75)	0.024
Richest	2,052 (16.1)	4.58 (3.75 - 5.61)	<0.001	1.83 (1.36 - 2.47)	<0.001
Employment Status			***<0.001**		***0.839**
Not Employed	3,915 (30.7)	1		1	
Employed	8,827 (69.3)	1.46 (1.31 - 1.62)	<0.001	1.02 (0.88 - 1.17)	0.839

Spouse's Education Level			***<0.001**		***<0.001**
No Education	4,568 (35.6)	1		1	
Primary	1,624 (12.7)	2.09 (1.77 - 2.46)	<0.001	1.12 (0.87 - 1.44)	0.367
Secondary	4,116 (32.7)	3.07 (2.69 - 3.51)	<0.001	1.58 (1.29 - 1.95)	<0.001
Higher	1,872 (14.7)	4.54 (3.80 - 5.42)	<0.001	1.47 (1.12 - 1.94)	0.006
Pregnancy-related factors					
Frequency of ANC visits			***<0.001**		***<0.001**
<4 ANC Visits	2,350 (24.7)	1		1	
≥ 4 ANC Visits	7,151 (75.3)	1.50 (1.31 - 1.72)	<0.001	1.60 (1.36 - 1.90)	<0.001
Timing of First ANC Initiation			***0.001**		***0.133**
1st Trimester	2,273 (23.6)	1		1	
2nd Trimester	6,003 (62.3)	0.96 (0.83 - 1.12)	0.631	0.98 (0.83 - 1.16)	0.822
3rd Trimester	1,365 (14.2)	0.71 (0.59 - 0.86)	<0.001	0.82 (0.65 - 1.03)	0.086
Knowledge of malaria-related factors					
Media Exposure			***<0.001**		***0.132**
No	11,822 (92.8)	1		1	
Yes	919 (7.2)	2.69 (2.14 - 3.37)	<0.001	1.22 (0.94 - 1.59)	0.133
Health Insurance Subscription			***0.001**		***0.073**
No	12,484 (98.0)	1		1	
Yes	257 (2.0)	2.51 (1.47 - 4.28)	0.001	1.58 (0.96 - 2.60)	0.073
Belief in Effectiveness of IPTp-SP			***<0.001**		***<0.001**
Low belief	200 (1.6)	1		1	
Average belief	504 (4.0)	0.69 (0.47 - 1.03)	0.072	0.51 (0.26 - 1.00)	0.053
High belief	12,038 (94.5)	2.47 (1.81 - 3.38)	<0.001	1.50 (0.90 - 2.50)	0.118
Belief about Malaria Consequences			***<0.001**		***<0.009**
Low belief	1,614 (12.7)	1		1	
Average belief	3,869 (30.4)	1.38 (1.17 - 1.62)	<0.001	1.34 (1.06 - 1.70)	0.015
High belief	7,258 (57.0)	1.49 (1.29 - 1.72)	<0.001	1.35 (1.11 - 1.64)	0.002

uptake of at least one dose of IPTp-SP implies uptake of at least one dose of IPTp-SP; ANC – Antenatal care

**p-values – overall p-values for each exposure variable in the model, CI – Confidence Intervals*
OR – Odds ratios, crude OR (from Bivariate analysis) Adjusted OR (from Multivariable analysis)
Goodness-of-fit of the model = F(9, 1262) = 1.006; p = 0.433

6.2 Appendix B: The Model with the interaction term for optimal doses of IPTp-SP

Factors	Total N (%)	Crude ORs (95% CI) Uptake of optimal doses	p-value	Adjusted ORs (95% CI) Uptake of optimal doses	p-value
Socio-demographic factors					
Age in years			***0.003**		**0.142***
15-24	3,842 (30.2)	1		1	
25-34	6,242 (49.0)	1.21 (1.06 - 1.38)	0.004	1.05 (0.91 - 1.22)	0.522
35-44	2,462 (19.3)	1.23 (1.05 - 1.45)	0.012	1.14 (0.94 - 1.38)	0.173
>45	195 (1.5)	0.68 (0.42 - 1.12)	0.130	0.62 (0.35 - 1.12)	0.112
Region			*** <0.001**		**<0.001***
North Central	1,770 (13.9)	1		1	
North East	2,339 (18.4)	0.93 (0.74 - 1.18)	0.558	0.90 (0.70 - 1.15)	0.402
North West	4,639 (36.4)	0.69 (0.56 - 0.86)	0.001	0.97 (0.76 - 1.24)	0.810
South East	1,263 (9.9)	3.65 (2.98 - 4.48)	<0.001	2.98 (2.32 - 3.81)	<0.001
South South	1,126 (8.8)	1.84 (1.48 - 2.30)	<0.001	1.58 (1.21 - 2.06)	0.001
South West	1,606 (12.6)	1.20 (0.28 - 1.55)	0.166	0.82 (0.63 - 1.06)	0.151
Residential areas			**<0.001**		**0.259***
Urban	4,853 (38.1)	1		1	
Rural	7,888 (61.9)	0.61 (0.53 - 0.70)	<0.001	1.10 (0.93 - 1.30)	0.247
Highest Educational Level			**<0.001**		**0.139***
No Education	5,766 (45.3)	1		1	
Primary	1,856 (14.6)	1.94 (1.63 - 2.31)	<0.001	0.97 (0.80 - 1.18)	0.754
Secondary	4,050 (31.8)	2.61 (2.25 - 3.04)	<0.001	0.83 (0.68 - 1.03)	0.068
Higher	1,070 (8.4)	2.89 (2.31 - 3.62)	<0.001	0.71 (0.51 - 0.97)	0.042
Wealth Index			**<0.001**		**0.004***
Poorest	2,763 (21.7)	1		1	
Poorer	2,933 (23.0)	0.90 (0.72 - 1.11)	0.326	0.51 (0.36 - 0.73)	<0.001
Middle	2,636 (20.7)	1.38 (1.12 - 1.71)	0.003	0.65 (0.43 - 0.98)	0.037
Richer	2,358 (18.5)	2.20 (1.78 - 2.73)	<0.001	0.59 (0.33 - 1.06)	0.077
Richest	2,052 (16.1)	2.41 (1.93 - 2.30)	<0.001	0.50 (0.16 – 1.54)	0.226
Employment Status			**<0.001**		**0.603***
Not Employed	3,915 (30.7)	1		1	
Employed	8,827 (69.3)	1.39 (1.21 - 1.60)	<0.001	0.95 (0.82 - 1.13)	0.603
Husband's Educational Level			**<0.001**		**0.322***
No Education	4,568 (35.6)	1		1	
Primary	1,624 (12.7)	1.92 (1.55 - 2.39)	<0.001	0.89 (0.57 – 1.38)	0.597
Secondary	4,116 (32.7)	3.30 (2.76 - 3.93)	<0.001	1.24 (0.82 – 1.89)	0.308
Higher	1,872 (14.7)	3.19 (2.568 - 3.961)	<0.001	2.00 (0.74 – 5.43)	0.173
Pregnancy-related factors					
Frequency of ANC Visits			**<0.001***		**<0.001***
<4 ANC Visits	2,350 (24.7)	1		1	
≥ 4 ANC Visits	7,151 (75.3)	2.10 (1.79 - 2.47)	<0.001	1.58 (1.31 - 1.88)	<0.001
Timing of First ANC Initiation			**<0.001***		**<0.001***
1st Trimester	2,273 (23.6)	1		1	
2nd Trimester	6,003 (62.3)	0.62 (0.54 - 0.71)	<0.001	0.71 (0.62 - 0.82)	<0.001

3rd Trimester	1,365 (14.2)	0.40 (0.32 - 0.50)	<0.001	0.60 (0.47 - 0.78)	<0.001
Knowledge of malaria-related factors					
Media Exposure			**<0.001***		**0.005***
No	11,822 (92.8)	1		1	
Yes	919 (7.2)	2.45 (1.96 - 3.07)	<0.001	1.39 (1.11 - 1.76)	0.005
Health Insurance Subscription			**<0.001***		**0.067***
No	12,484 (98.0)	1		1	
Yes	257 (2.0)	1.94 (1.41 - 2.66)	<0.001	1.38 (0.98 - 1.96)	0.067
Belief in Effectiveness of IPTp-SP			**<0.001***		**0.107***
Low	200 (1.6)	1		1	
Average	504 (4.0)	1.49 (0.78 - 2.85)	0.223	1.17 (0.54 - 2.56)	0.693
High	12,038 (94.5)	2.68 (1.62 - 4.44)	<0.001	1.63 (0.92 - 2.88)	0.095
Belief about Malaria Consequences			**0.074***		**0.023***
Low	1,614 (12.7)	1		1	
Average	3,869 (30.4)	1.25 (1.01 - 1.54)	0.037	1.13 (0.90 - 1.41)	0.254
High	7,258 (57.0)	1.20 (1.01 - 1.43)	0.041	0.89 (0.73 - 1.10)	0.296

uptake of optimal dose of IPTp-SP implies uptake of at least three doses of IPTp-SP;
ANC – Antenatal care
**p-values – overall p-values for each exposure variable in the model, CI – Confidence Intervals*
OR – Odds ratios, crude OR (from Bivariate analysis) Adjusted OR (from Multivariable analysis)
Goodness-of-fit of the model = F(9, 1262) = 0.95; p = 0.477

6.2.1 Appendix BI: The Interaction of Wealth index and Spouse's Educational level

Household Wealth Index	**Spouse's Educational levels – aOR[1] (95% CI)**			**Interaction p-value**
	Primary	**Secondary**	**Higher**	
Poorest	1	1	1	**0.215[a]**
Poorer	1.33 (0.73–2.45)	**1.74 (1.03 – 2.96) ***	1.36 (0.41 – 4.52)	
Middle	1.01 (0.53 – 1.93)	1.29 (0.73 – 2.27)	0.70 (0.23 – 2.09)	
Richer	1.42 (0.67 – 3.00)	1.69 (0.86 – 3.36)	1.28 (0.40 – 4.06)	
Richest	2.92 (0.80 –10.64)	1.77 (0.55 – 5.73)	1.13 (0.25 – 4.99)	

[a]p-value – overall p-value of the interaction term
95% CI – 95% Confidence Intervals, aOR[1] – Adjusted Odds ratio
aOR[1] was adjusted for all factors presented in Appendix B (uptake of optimal IPTp-SP doses)
**p<0.05, (Actual p-value *p= 0.039)*

6.3 Appendix C: The Permission letter to use the 2018 NDHS from Measure DHS

Jan 26, 2021

Godwin Kalu
University of the Witwatersrand
South Africa
Phone: +27647041856
Email: 2219460@students.wits.ac.za
Request Date: 01/26/2021

Dear Godwin Kalu:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Factors Associated with the Uptake of Intermittent Preventive treatment (IPTp-SP) for malaria among pregnant women aged 15 – 45 years in Nigeria 2018":

Nigeria

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

6.4 Appendix D: Ethics Clearance Certificate for the study

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R49 Mr G Kalu

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M2011103

NAME: (Principal Investigator)	Mr G Kalu
DEPARTMENT:	School of Public Health Division of Epidemiology and Biostatistics Medical School University
PROJECT TITLE:	*Factors associated with the uptake of intermittent preventive treatment for Malaria among pregnant women aged 15-49 years old in Nigeria, 2018*
DATE CONSIDERED:	2020/11/27
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Drs J Kagura and J Francis
APPROVED BY:	CB Penny Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2021/02/16

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

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 submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **«Missing mail merge field»** and therefore reports and re-certification will be due in the month of **«Missing mail merge field»** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

May 28, 2021
Date

6.5 Appendix E: 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 Godwin Okeke Kalu (Student number: 2219460) am a student registered for the degree of Implementation Science in the academic year 2021.

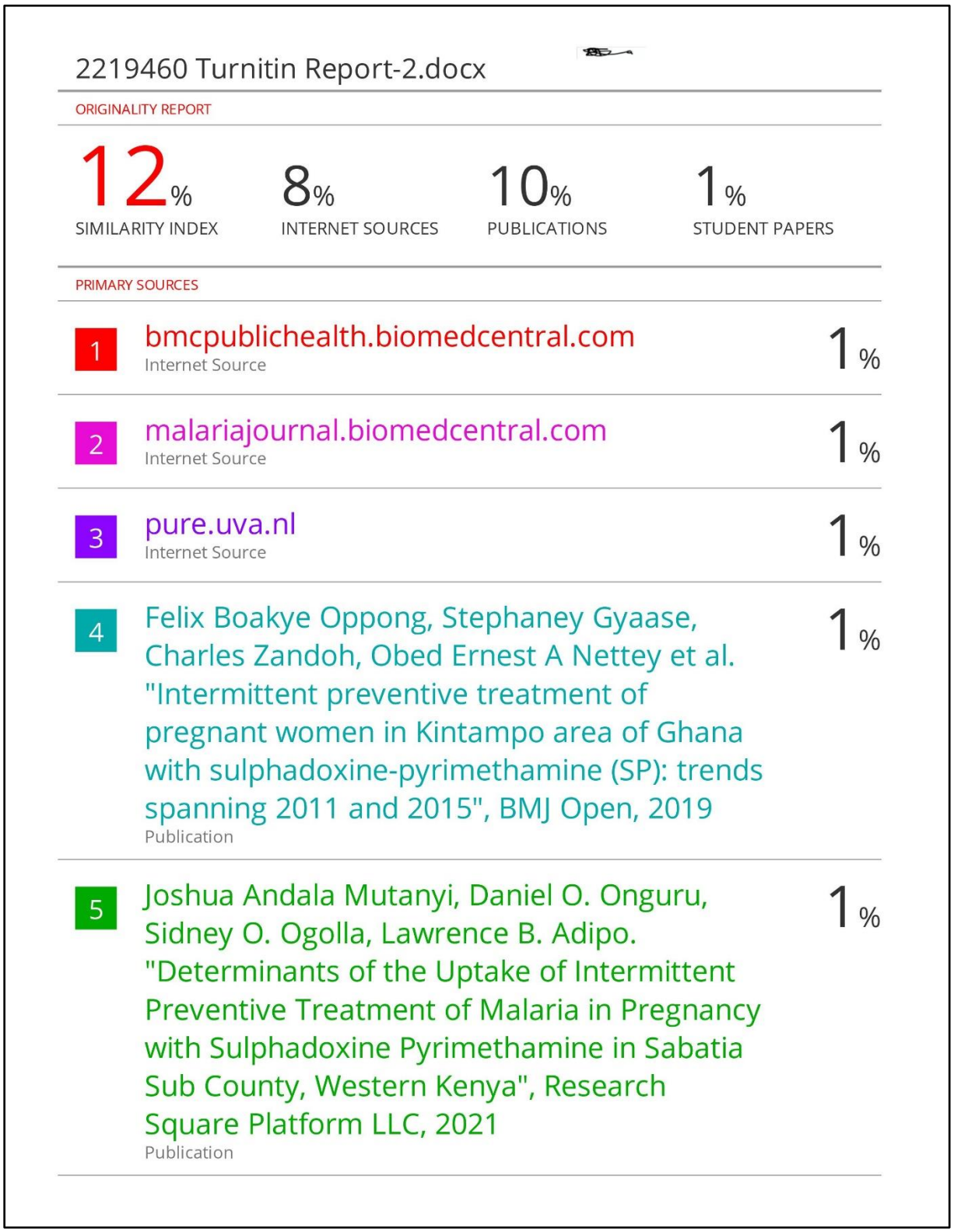
I hereby declare the following:

- 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: June 20, 2021

1

6.6 Appendix F: Turnitin Report



2219460 Turnitin Report-2.docx

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