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ADHERENCE TO THE ADMINISTRATION GUIDELINES OF SEASONAL MALARIA CHEMOPREVENTION BY CAREGIVERS IN THE TAMALE CENTRAL DISTRICT

MOHAMMED SHAMSUDEEN FUSEINI

(10937085)

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DECLARATION

I Mohammed Shamsudeen Fuseini declare that this dissertation is my own research work conducted under supervision. Other people's work used in this study has been acknowledged duly. I equally state that this dissertation has neither been submitted in whole nor in part for any other degree.

31/01/2023

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Mohammed Shamsudeen Fuseini Date

(Student)

31/01/2023

…….. ……

Dr. Priscillia Nortey Date

(Supervisor)

DEDICATION

I dedicate this work to Almighty Allah, my family, my friends, and those who have a hand in my upbringing.

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LIST OF ACRONYMS

AIDS	----------	Acquired Immune Deficiency Syndrome
CHPS	----------	Community-Based Health Planning and Services
CHWs	----------	Community Health Workers
CHVs	----------	Community Health Volunteers
CWC	----------	Child Welfare Clinic
DHMT	----------	District Health Management Team
DOTS	----------	Directly Observed Treatment Short-Course
IPTi	----------	Intermittent Preventative Treatment in Infant
IPTp	----------	Intermittent Preventative Treatment in Pregnant woman
IPTc	----------	Intermittent Preventative Treatment in Children
IRS	----------	Indoor Residual Spray
ITNs	----------	Insecticide Treated Nets
NMCP	----------	National Malaria Control Program
PMI	----------	President Malaria Initiative
PMC	----------	Perennial Malaria Chemoprevention
RA	----------	Research Assistants
SMC	----------	Seasonal Malaria Chemoprevention
SP+AQ	----------	Sulphadoxine-Pyrimethamine + Amodiaquine
TBA	----------	Traditional Birth Attendant
UNICEF	----------	United Nations Children's Fund
WHO	----------	World Health Organization

ABSTRACT

Background: In developing countries including Ghana, malaria continues to be a major cause of morbidity and mortality, especially in children below five years. The World Health Organization (WHO) introduced Seasonal Malaria Chemoprevention (SMC) as an additional strategy to strengthen malaria control. The intervention is very effective in the prevention of clinical episodes of malaria in children but not without adherence to the administration protocols. This study examines the factors that are associated with adherence to SMC among caregivers in the Tamale Central District.

Objective: To assess the factors influencing adherence to Seasonal Malaria Chemoprevention (SMC) administration guidelines by caregivers in the Tamale Central District.

Methods: The study approach used was cross-sectional, conducted in four (4) subdistricts in the Tamale Central District. Eight (8) communities were selected through simple random sampling. A total of 471 caregivers from households were randomly sampled by balloting to participate in the study. Knowledge of malaria and awareness of the benefits of SMC was assessed by scoring correct answer questions from multiple choice questions related to malaria and SMC. We used close-ended questions to assess community health volunteer factors. Pearson Chi-square test was used to test the association between adherence to SMC and the predictor variables. Multiple logistic regression analysis was performed to examine the strength of the associations between adherence to SMC and the predictor variables and the results were interpreted at a 95% confidence level.

Results: The study obtained an SMC adherence rate of 90.9%. Forgetfulness (62.5%) was the main reason for missing SMC doses. Overall knowledge of caregivers on malaria was low at 71.1%, moderate at 26.5%, and high at.3%. About 85% of respondents were aware of the benefits of SMC. The factors that were significantly related to adherence in the multiple logistic regression model were educational background, knowledge of malaria, source of information on SMC, and satisfaction level of caregivers.

Conclusion: The adherence rate of SMC in the Tamale Central District is 90.9%. The result from the study reveals that having secondary and tertiary education, those who reported the child refused to play as the effects of malaria, those who use mosquito coil as a way of preventing a child from malaria, those whose source of information on SMC is from friends, and those who are happy with SMC, were significantly associated with adherence to SMC.

Keywords: Adherence, seasonal malaria chemoprevention, malaria, Children under five Sulfadoxine Pyrimethamine Amodiaquine,

CHAPTER ONE

1.1. Background

Malaria is a life-threatening disease and a public health priority to the global community. It is mostly endemic in the tropical and sub-tropical countries of the world with about 90% of the global burden recorded in sub-Saharan Africa (Attu et.al., 2018). Malaria is transmitted to humans by five plasmodial species. *Plasmodium falciparum* is the most significant in terms of fatalities. *P. vivax* causes most of the illnesses across the world. *P. knowlesi*, *P. ovale*, and *P. malariae*, cause less significant disease (Cowman et al., 2016)

Intervention programs and measures of effective malaria control have been put in place, but the poor implementation in the affected areas makes the disease a ubiquitous killer in the subregion (Cowman et al., 2016) including Ghana. Indoor Residual Spraying (IRS), insecticide-treated bed nets (ITNs), early detection and treatment of malaria cases with artemisinin combination therapies (ACTs), intermittent preventive treatment of malaria in pregnant women (IPTp) and infants (IPTi), vaccination are currently the prevention and control programs in Ghana, (Stelmach et al., 2018).

In 2012 the World Health Organization (WHO) recommended seasonal malaria chemoprevention (SMC) for the control of malaria infections in children under five years in regions with seasonal malaria transmission. SMC involves the intermittent administration of full treatment courses of antimalaria medicine (Amodiaquine plus Sulfadoxine-Pyrimethamine), to children below 5 years during the malaria season to avert malaria infections and maintain therapeutic antimalarial drug concentration levels in the blood throughout the period of greatest malaria risk. In sub–Saharan Africa, countries like Niger, Nigeria, Mali, Chad, Gambia, Guinea, and Burkina Faso adopted SMC in 2014 as a new tool for malaria control, and by 2015 and 2016, 3.6 million and 7.6 million

children (aged 3-59 months) respectively in areas of the Sahelian Sub-region were targeted and received SMC (Orok et al., 2021). The WHO also reported that in 2017 15.7 million children in countries implementing SMC were protected against malaria. Sylla et al., 2017, and Baba et al., 2020 in their studies showed that SMC is effective, cost-effective, and safe for the prevention of malaria.

In Ghana, SMC was incorporated as an additional malaria control intervention in the vision 2014-2020 Strategic Plan for Malaria Control. Malaria is endemic in Ghana and varies from season to season. There are two major transmission patterns, dependent on geographical location and duration of the dry season - December to March, at which time transmission is less. A larger part of the north has about a 6–7-month transmission season and a shorter 3–4-month transmission in the upper part of the North, with the highest number of cases of malaria occurring between July and November. In the South, transmission season can exceed 9 months, it peaks a little from May to June and a larger peak from October to November. The Northern Region is the major hotspot for malaria cases in the country, recording about 40% of malaria cases in children below 5 years. Piloted in the Upper West Region in 2015, SMC implementation extended to Upper East Region in 2016, Northern Region in 2019, and Bono East and Oti regions in 2021 (Severe Malaria Observatory, 2021).

In 2020, nearly 700,000 children under 5 years received the SMC drug in three Northern Regions from the community health workers (USAID, 2021). Meanwhile, malaria cases reported in the region persist among these age groups. This study will assess the factors influencing adherence to the administration guidelines of SMC by caregivers in the Tamale Central District.

1.2. Problem Statement

In sub-Saharan Africa, the majority of malaria morbidities and mortalities occur during and after the short rainy season (Baba et al., 2020). As recommended by the WHO, SMC has been included in the strategic plan for malaria control by many countries. Transmission of the disease is highly seasonal in the Sahelian regions including Ghana. SMC involves administering a full malaria treatment course of sulfadoxine-pyrimethamine + amodiaquine to children aged 3-59 months during the malaria season to prevent infections and to maintain a therapeutic concentration of anti-malaria drug levels in the blood (Ansah et al., 2021a)

The Ghana national malaria control program implemented the SMC tool as an additional measure for the prevention and control of malaria in children under 5 years in 2015. But there exists limited information with regard to whether caregivers strictly adhere to the administration guidelines. SMC involves a three-day consecutive administration of full treatment doses of sulfadoxine-pyrimethamine (SP) and amodiaquine (AQ) to these children at monthly intervals, beginning at the start of the malaria transmission season (rainy season). This is supposed to be done for a maximum of four months. Community Health Volunteers visit every household to administer the drug to eligible children under Directly Observed Treatment Short-course (DOTS) and the remaining two days doses of the drug are given to the caregivers to be administered the next consecutive days.

Evidence suggests that some caregivers do not adhere to the administration guidelines of SMC (Antwi et al., 2016; Doumbia, C. O., 2021). Earlier studies have identified seasonal factors that may influence adherence, Chatio et al., 2019 identified farm demands and forgetfulness as causing non-adherence to SMC. Other studies have also shown that sociodemographic characteristics, household past experiences, drug distributors-related factors, individual factors, community

leaders, awareness of the benefits of SMC, knowledge about malaria, the media, and drug-related factors influence adherence to SMC (Ansah et al., 2021a; Chatio et al., 2019; Druetz et al., 2018)

Studies on SMC have analyzed the impact, coverage, effectiveness, and accessibility of seasonal malaria chemoprevention but few studies have examined the pertinent individual, sociodemographic, seasonal, and operational factors within households that can promote or prevent adherence to SMC (Doumbia O. C., 2021). Children who miss SMC doses show lower protection against malaria attacks. Therefore, caregivers are expected to adhere strictly to the administration guidelines to maximize the level of protection of the drug and minimize the capacity of the malaria parasites' to become resistant to SP+AQ. Ding et al., 2020 revealed in their study that a randomized placebo-controlled trial of SMC elsewhere in Ghana showed close to 100% adherence to the 3-day administration protocol when self-reported. Some caregivers, however were found to have the remaining medicines of SMC in the blister packs not administered, albeit not in the SMC setting.

The issue of non-adherence by caregivers calls for attention, to identify the factors associated. This will propel and encourage the design and implementation of measures to avert the prevalence, morbidity, and mortality of malaria in children below 5 years. It is imperative to understand why children under 5 still get malaria while there have been many interventions put in place vis-a-vis the high coverage of the SMC implementation. This study will assess adherence to the administration guidelines of SMC by caregivers in the Tamale Central District

1.3. Conceptual Framework

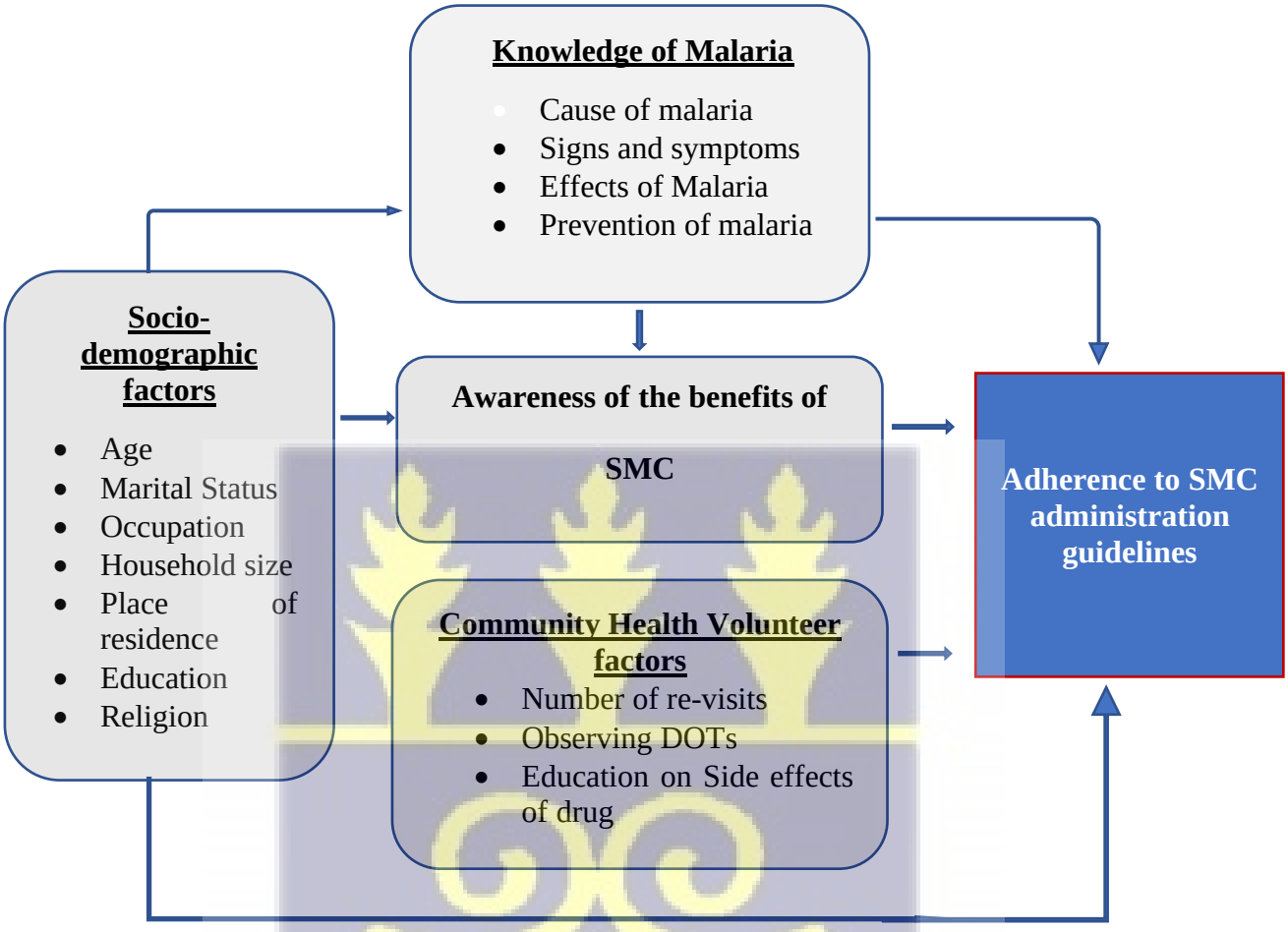


Figure 1: Conceptual Framework illustrating factors influencing adherence to SMC.

1.4. Narration of Conceptual Framework

Adherence to Seasonal Malaria Chemoprevention guidelines can be affected by several factors. These independent variables include sociodemographic factors like age, marital status, number of children, household size, place of residence, level of education, ethnicity, and religion. Low

educational background is said to be related to an individual's understanding and reactions towards health intervention programs, like SMC. Those with little or no education might not adhere to SMC. In a large household with a higher number of caregivers and a small household with only the principal caregiver in charge of decision-making on the child's wellbeing and medication, adherence will surely differ in these two households. We assume that caregivers who have knowledge of malaria are more likely to adhere to the SMC program. An individual's understanding of malaria, its causes, and effects on children will embrace an intervention like SMC compared to someone with little or no Knowledge of the condition. We also assume that awareness of the benefits of SMC will affect the level of caregiver's adherence. Individual's perceptions will influence the adherence to SMC, the perceptions caregivers hold about SMC - whether they see the need for SMC will directly influence adherence. In addition, those who report satisfied with the program are more likely to adhere and cause others to adhere, on the other hand, side effects following drug administration might nurture negative perceptions, believes, and attitude towards SMC.

Community Health Volunteers or the drug distributors are very instrumental in the success of the SMC program. They move door-to-door to administer these medicines under DOT and are to revisit household to ensure the subsequent days medicines are administered. It's reported that some of the CHVs do not perform these duties well and this can have influence on caregiver's adherence.

1.5. Justification of the Study

The study is focused on caregiver's adherence to the administration guidelines of SMC in the Tamale Central District and the factors associated with same. Identifying these factors that influence adherence will be a useful information for the District Health Authorities in planning

towards addressing these factors. The results of the study will also be a useful information to consider in the execution of future SMC programs and other malaria campaigns in these age groups. The findings will provide a reference source of information for future research in Malaria in the Tamale Metropolis and beyond.

1.6. Research Questions

1. Are caregivers adhering to the administration protocols of SMC?
2. What is the association between knowledge of malaria on adherence to SMC?
3. Does awareness of the benefits of SMC affect adherence?
4. What sociodemographic factors influence adherence to SMC?
5. What are the community health volunteer factors that influence adherence?

1.7 Research Objectives

1.7.1 General Objective

To assess the factors influencing adherence to Seasonal Malaria Chemoprevention administration guidelines by caregivers in the Tamale Central District.

1.7.2 Specific Objectives

1. To assess caregivers' adherence to the administration protocols of SMC.
2. To examine the association between knowledge of malaria and adherence to SMC.
3. To determine whether awareness of the benefits of SMC affect adherence.
4. To determine the sociodemographic factors influencing adherence to SMC.
5. To examine community health volunteer factors that influence adherence.

CHAPTER TWO

LITTERATURE REVIEW

2.1. Epidemiology of Malaria

Malaria is a protozoan infectious disease caused by the plasmodium parasites and transmitted in humans through the bite of the *Anopheles* female mosquito (Varo et al., 2020). Malaria has been with man for decades, causing substantial economic, social and health consequences. Each year thousands of lives are lost to this curable and preventable disease. The disease still has a considerable impact on public health in Sub-Saharan African and is responsible for about 10% of all fatalities despite a significant decline in the disease's burden over the past two decades (Ansah et al., 2021b).

Although the worldwide burden of malaria has significantly decreased since 2000 (WHO, 2016), morbidity and mortality caused by malaria are still unacceptable, with 200 million new cases reported each year (WHO, 2018). In 2016, 91 countries worldwide reported 216 million malaria cases - 5 million more cases than in 2015, and an estimated 445,000 deaths, which is roughly in line with the 446,000 deaths reported in 2015 (WHO, 2017). In 2017, cases again rose above the 2016 figures. The years saw and increased of about 3 million more cases, and 10, 000 decrease in the death rate relative to 2016. The WHO has indicated that the decrease in deaths in the past ten years is rather happening at a very slow rate (WHO, 2018). Similarly, there were 241million malaria cases recorded in 85 countries with high endemicity of malaria in the year 2020, more than the 2019 figure of 227 million cases (World Health Organization, 2021). The World Health Organization (WHO) African region alone had 228 million cases in 2020, representing 95% of the Global figure (WHO, 2021).

Malaria deaths in the WHO African Region also saw an increase from 534 000 in 2019 to 602 000 in 2020. The mortality rate also increased, rising from 56 per 100 000 at-risk population in 2019, to 62 per 100 000 in 2020, and children under 5 years old made up about 80% of all the malaria mortalities in the region. (WHO, 2021). About 720 deaths occurs in children under five years everyday due to malaria (WHO,2018). This age group is vulnerable because of the incomplete development of their immune system. Though it is known that breastmilk provides some form of immunity to infants, they eventually become vulnerable after three months.

Malaria appears to be the main contributing factor to mortality and morbidity in Ghana (NMCP, 2013). About 10.4 million persons were reported to have malaria in various health care facilities in 2016, representing 39% of OPD cases in the country. This represents a 2.5% increase in cases when compared to the same time in 2015. (GHS, 2017) with 1,264 malaria-related deaths, of which 590 were children under five. Over 4.9 million cases and 11,000 deaths were reported in 2019 (PMI Fact Sheet, 2020). The northern region is the major hotspot for malaria cases in the country, recording about 40% of malaria cases in children under 5.

2.2. Malaria Control Strategies

Malaria prevalence and transmission is an interactive process involving the environment, the vector and man. Control and elimination programs will only be successful if it targets the forces that exists in these interactions, (Orok et al., 2021).

Vector control

Vector control is one of the strategies in place for malaria control. It includes environmental hygiene and sanitation, insecticide-treated mosquito bed nets and drying irrigation channels. This will reduce the vector human contact and break the transmission path ("WHO | Core Vector

Control Methods," 2020). The 2 core interventions are insecticide-treated nets (ITNs) and indoor residual spraying (IRS). Chemicals are also used in indoor and outdoor spraying. Mineral oil mixed with 1% DDT or Dihedron is spread on the surface of stagnant or standing water to destroy mosquito larvae ("WHO | Environmental Management for Vector Control," 2016). At the individual level, the use of mosquito repellants, insecticide tablets and sprays, wearing of protective clothing, and the use of ITNs are encouraged. In the period between 2010 and 2019, 78 countries reported mosquito resistance to at least 1 of the 4 widely used pesticides classes, according to the most recent World Malaria Report. Mosquito resistance to all pesticides classes was observed in 29 different countries. Churcher et al., (2016) opines that the adoption, distribution, and use of vector control products save lives.

Preventive Chemotherapy

This is the practice of using medications to stop malaria infections and its effects. Perennial malaria chemoprevention (PMC), seasonal malaria chemoprevention (SMC), intermittent preventive treatment of malaria in pregnancy (IPTp) and school-aged children (IPTsc), post-discharge malaria chemoprevention (PDMC), and mass drug administration (MDA), according to WHO (2022), are all effective methods of preventing malaria. Sulphadoxine-pyramethamine (SP) is the drug recommended for use in Africa as prophylaxis for pregnant women (IPTp). The NMCP of Ghana currently recommends the administration of SP to every pregnant woman starting from 16 weeks of gestation and one month apart until delivery.

The WHO also recommends chemoprevention therapies for children under five years in both endemic and non-endemic countries. It is known as SMC, previously called intermittent preventive treatment in children (IPTc). It is very effective in regions where the transmission period for malaria is short (Cairns et al., 2012). It involves the administration of antimalaria medicines to

children under five years when the transmission period is usually high (rainy season) (WHO, 2020).

Vaccine

Since October 2021, WHO has recommended widespread vaccination against malaria with the RTS, S/AS01 malaria vaccine in children residing in areas with moderate to high P. falciparum malaria transmission. The vaccine has been shown to significantly reduce malaria, including severe malaria among young children.

Other interventions include Diagnostic testing and treatment. The WHO recommends that all suspected cases of malaria be confirmed through testing using microscopy or the RDT before treating. Integrated Community Case Management (iCCM) has been adopted by 26 countries that have established policies to train and equip health facilities and community health workers (CHWs) on the integrated management of the top three life-threatening conditions in children-malaria, diarrhea, and pneumonia.

2.3. The Concept of the Seasonal Malaria Chemoprevention

According to the World Health Organization (WHO), the epidemiology of malaria is changing, and this requires progressive attention which is a shift from the "one size fits all" approach to malaria control (WHO, 2012). In effect, the WHO recommended Seasonal Malaria Chemoprevention (SMC), as a new preventive measure against the *Plasmodium falciparum*, in 2012. SMC is defined as "the intermittent administration of full treatment courses of an antimalarial medicine during the malaria season to prevent malarial illness and to maintain therapeutic antimalarial drug concentrations in the blood throughout the period of greatest malarial risk" (WHO, 2012). Particularly, preventive chemotherapy is connected with the use of medicines

in combination or alone, for the prevention of malaria infections and its consequences. The SMC was previously known to be the Intermittent Preventive Treatment in children (IPTc).

The SMC is identified to be among the three (3) malaria prevention strategies recommended by the WHO. The others are perennial malaria chemoprevention (PMC – previously known as intermittent preventive treatment in infants, or IPTi) and intermittent preventive treatment of malaria in pregnancy (IPTp) (WHO, 2022). The chemoprevention therapy is administered to pregnant women and young children identified as being prone to and vulnerable to malaria. Furthermore, the SMC is administered on a community basis, typically delivered door-to-door either by volunteer community distributors or community health workers. In 2020 the SMC was implemented in 13 countries in the Sahel, which targeted about 22 million children (WHO, 2020). The target children are between the ages of 3 to 59 months of age to receive the dose, especially during the intense malaria season (Coldiron et al., 2017).

Before the scaling up of the SMC, several other chemoprevention strategies (IPTp, IPTi, IPTc, etc.) had been adopted and used in health care centers for antenatal visits and routine childhood vaccination, (WHO, 2012). Afterward, from 2012 when the SMC was scaled up and introduced, there has seen a tremendous impact as about 12 million children received the intervention in 2016 (Coldiron et al., 2017). York (2017) adds that the impact was greatly driven by the UNITAID funding and the Access-SMC by provided SMCs to 4 million children in 2016. Also, the World Bank and UNICEF funded the implementation. These supports and commitments have prevented 10 million malaria cases and 60,000 deaths over the period from 2013 to 2017 since the commencement of the program in countries like Cameroon, Ghana, Senegal, Togo, and Guinea-Bissau.

2.3.1. Administration of the SMC

WHO has recommended two antimalarial medicines for use. The drugs used in the sub-Sahara are amodiaquine plus sulfadoxine-pyrimethamine (AQ+SP). In comparison to the other drug combinations, the SP+AQ provides better protection ("WHO | World Malaria Report 2012," 2014). The combination also lowers the risk of developing resistance to SP+AQ in comparison to using these drugs as monotherapy. The combination SPAQ does not contain artemisinin-based derivatives, which are reserved for the treatment of malaria. The protocol of the NMCP for SPAQ administration in Ghana is provided below.

The drug is presented in two forms:

1. Sulfadoxine 500mg-Pyrimethamine 25mg (SP), and Amodiaquine 150mg (AQ)
2. Sulfadoxine 250mg-Pyrimethamine 12.5mg (SP), and Amodiaquine 75mg (AQ)

The dose and dosage are dependent on age. Infants 3 to 11 months of age are given one tablet of SP 250/12.5mg in a single dose and 75mg tablets of AQ daily for 3 days. For children aged 12 to 59 months, one tablet of SP 500/25mg tablet in a single dose and 150mg tablet of AQ once daily for 3 days.

It is important to note that a total of four (4) or five (5) doses are given at monthly intervals over the season WHO (2012).

2.3.2. Delivery of the SMC drug

Different methods for the delivery of the SMC drug have been proposed. Giving the SMC drug at the child welfare clinic (CWC), combining SMC with community case management, organizing community gatherings to deliver SMC drug, community kiosks permanently stationed in the community to give SMC medicine to passing caregivers, household delivery where CHWs makes

announcements for caregivers to assemble and collect SMC and delivered SMC to children in homes where carers are not present. However, field tests conducted have showed such methods are less effective (Antwi et al., 2016; Doumbia, C. O. 2021). In Ghana SMC is delivered door-to-door. Flexible point distribution has been suggested to improve uptake (Antwi et al., 2016).

2.3.3. Contraindications

There are some contraindications to the administration of the SMC drug which includes the following:

1. Children who have a severe acute illness are unable to take their medication orally.
2. Children who have been diagnosed to be allergic to the drugs (both AQ and SP).
3. Children who have received the drug in the previous month.
4. Any child that is HIV positive and is receiving co-trimoxazole (WHO, 2012),

Aside from these outlined restrictions on giving the drug, in the earlier recommendation from the WHO (2012), the AQ and SP were not to be given to countries within Southern and Eastern Africa, according to the WHO. This follows that the eligibility of the SMC may only apply to certain endemic areas in those countries. However, in the most recent WHO recommendations for malaria chemoprevention among children and pregnant women, the drug is no more geographically restricted. This recommendation was against the backdrop that in 2021, 13 African countries in the Sahel sub-region, having implemented the SMC acknowledged its worth and so believed that it could be implemented elsewhere in Africa. In concordance, those countries that are associated with highly seasonal variation in their malaria burden also have the chance to be a beneficiary of the SMC program (WHO, 2022). This hereby calls for new drugs that are more viable for malaria prevention.

Also, the dosage has been reviewed, and SMC should be given advisably during the peak times of the transmission season without any binding specific monthly cycle. Regarding age-based risks in children, more flexibility has been introduced. Children who are older than the stipulate age bracket and are at high-risk levels of severe malaria can be administered the drug other than only those below 6 years. This introduction of flexibility will enable countries like Cameroon to tailor their strategies, according to Dr. Dorothy Achu, manager of the Cameroonian Ministry of Health for the National Malaria Control Programme. She added that *"this will enhance the impact of SMC, especially when used with other interventions such as bed nets and the new malaria vaccine".*

2.4. Seasonal Malaria Chemoprevention in Ghana

Following the WHO recommendation of the SMC program, Ghana implemented it in the Upper West Region in 2015 (Chatio et al., 2019). The piloting in the Upper West Region was a result of the prevalence of under 5 malaria mortality and morbidity in all the regions in the country. Considering the significant variation of malaria transmission in Ghana, especially between the northern savannah and southern coastal regions, authorities pushed for the implementation in the north. The program was then extended to the Ashanti Region as a trial for over five months (Antwi et al., 2016), in a predominantly rural area, Ejisu-Juabeng Municipality. Under the programme in the region, the incidence of malaria was reduced by about 40 percent, indicating its significant public health impact. Tagbor et al. (2016) identified that several studies confirm the effectiveness of the seasonal malaria chemoprevention among Ghanaian children.

2.5. Factors Associated with the Effectiveness of the SMC in Ghana

Higher impacts could be badged, however, due to factors of maternal literacy, some perceived influence of the SMC, inadequate understanding of the chemoprevention, trust in caregivers, and lack of access to medication, method of distribution, coverage, and adherence (Antwi et al., 2016; Doumbia, 2021).

2.5.1. Adherence

A significant factor, probably the most important factor to the effectiveness of the SMC program is adherence (Koko et al., 2022). That is, compliance with the mode of administering the drug and the guidelines associated with it ought to be strictly followed. Compliance and adherence are major terms commonly used synonymously in public health (Doumbia, 2021). Ding et al., (2020a) explain that non-adherence to the SMC medication guidelines may fail the disease from being prevented, this will also result in the spread of drug-resistant parasites and in effect, make the drug ineffective in the future against the parasites. Under this factor, several types of research have been done to ascertain the compliance level of the drug (Pell et al., 2017; Roschnik et al., 2019; Somé et al., 2020). Okuboyejo & Eyesan (2014) opine that the adherence of patients to malaria medicines can be related to their awareness, access to information on the medicines, benefits of the drugs, and the perceived treatment obstacle. This confirms the challenges of the inadequate information associated with the SMC. The adherence level and participation are lower in the rural areas as compared to the urban and peri-urban centers (Doumbia, C. O. 2021).

In the Northern Region of Ghana, most mothers reported giving the drug and completing the dosages. Others reported their inability to complete the entire dosage for their children (Chatio et

al., 2019). Some did twice, others thrice out of the four required. Excuses such as forgetfulness due to farming in such season, and children resisting the bitter taste of the medicine among others.

2.6.2. Maternal Literacy

Poor maternal literacy has a substantial impact on how well their wards receive medication. A significant number of the mothers did not appreciate the purpose of the drug in the study by Chatio et al., (2019), although some stakeholders, mothers, parents, guardians, or caretakers acknowledge that the drug was given to protect their children from contracting malaria. Some reported that they perceive the drug to enable their lads to eat well and become healthy whiles others said the drug was for diarrhea and polio. Antwi, et al., (2016) explains that there is even a varied understanding of the malaria disease in itself. Some believe when the child walks under the sun, they could get sick with malaria. Furthermore, the knowledge of malaria was then seen not to be an important determinant in taking the SMC. In Rwanda, Asingizwe et al., (2015) reported that, the level of education, knowledge, and attitudes exhibited a statistically significant association with adherence. They noted that respondents with low educational background were more likely to have poor practices towards the disease and adherence to the use of medication for healing it, same for negative attitudes compared to those with high education. Education is hereby an important factor that positively influences the level of adherence in the administration of the SMC and even for general health decisions, especially female education according to Amu et al., (2018).

2.6.3. Community Health Volunteer Factors

The WHO (2021) identifies community health workers (CHWs) to be healthcare providers who are known to reside in the communities they serve and get less formal education and training than professional workers. They are recognized for the provision of healthcare assistance services to vulnerable group in the communities or among the population. The target group for the CHWs is the population in remote areas, the marginalized in society, deprived, to give them the necessary health care aid in their scope acceptable. Following the SMC administration, these play a significant role, with support from what we call the "community health volunteers (CHV)." They are essential to the delivery of primary healthcare (Kuule, 2017). As such several countries are known to rely on the services of these CHVs for primary health care and first aid, especially in low- and middle-income countries (Kok, 2015). In some instances, the two are used interchangeably. Community members like the traditional birth attendants (TBA) have historically filled some gaps. However, the healthcare system is formally integrating laypeople with varied levels of training (Lehman and Sanders, 2007). These laypeople, who typically go by the name community health volunteers (CHVs) participate in small-scale community-based projects to national programmes. These are non-specialist healthcare providers and village gents among the common terms (Van Ginneken et al, 2013). Their range of activities includes anything from immunization to the distribution of bed nets to the administration of medication, prenatal care, and care for chronic illnesses like AIDS and Tuberculosis (Koon et al., 2013). Several studies have reported that community health volunteers (CHV), including lay health workers, offer a number of advantages in comparison to their professional colleagues. (Gilmore and McAuliffe, 2013). Gaining the trust of their patients and interacting with the community might be simpler for them. In this regard, CHV's are often seen as a bridge connecting communities and the formal health

system. They are considered as a way to 'reach the last mile' when implementing programmes, reducing obstacles to healthcare in the community (Berthold, 2016).

For the SMC, these personnel are integral in the administering and adherence of the medicines to children and caregivers. They receive training prior to the start of the SMC program on how to administer the drug- under DOT, and to educate mothers on possible adverse drug reactions and how to manage same. They are also required as part of their mandate to revisit the household on the second and third day to ensure the caregiver administers the rest of the medication. According to Antwi et al., (2016), the CHWs make announcements for the caregivers to commute to a place, gather and receive the drug or have it delivered to them if they are unable to report for collection. In some cases, caregivers were constantly not available to take the drugs when delivered to them, they added. The reasons that afforded the frequent absence were associated with farm workers and traders. Owing to the intense work done by these, they lauded themselves for being more suitable administrators than the Child Welfare Clinics (CWC). Some challenges are also associated with the CHWs where some mothers, though few complain of having adverse events with the CHWs (Tagbor, 2016).

6.3.5. Reasons for non-adherence to SMC

Patients' perceptions, awareness, access to information on medications, the benefits of the drugs, and the perceived treatment obstacle, are found to influence adherence (Okuboyejo & Eyesan 2014). In Ghana, Doumbia, C. O. (2021), found that forgetfulness by caregivers, child refusal to take medication, vomiting, and child falling ill were the reasons for non-adherence to the SMC medicine. In Niger Ding et al., (2020) found that some children spit out the medication even after it had been dissolved, some caregivers saved the medication for future use by another member of

the family who will suffer malaria, some fathers refusing the medication for their children, sub-optimal instructions from health workers, were the reasons for non-adherence. Elsewhere in Africa, caregivers responded their children would not accept the medicine if they are to administer it themselves and preferred that the volunteers administer it (Ward et al., 2022). Somé et al., 2022 also reported low proportions of non-adherence in Burkina Faso, Mali, and Niger. The factors associated with non-adherence include travel of parents, illness of child, vomiting, child refusing to swallow medicine, and forgetfulness.

CHAPTER THREE

METHODS

3.1. Study Design

The study employed a cross-sectional design and collected data from caregivers within households in the Tamale central district. Face-to-face interviews were conducted using a standardized questionnaire to collect relevant data with regard to the study subject.

3.2. Study Area

The study was conducted in the Tamale Central District in the Northern Region of Ghana. Tamale Central is the biggest Sub-District in the Tamale Metropolis, with almost half of the entire District's population, according to the District Health Management Team (DHMT) profile.

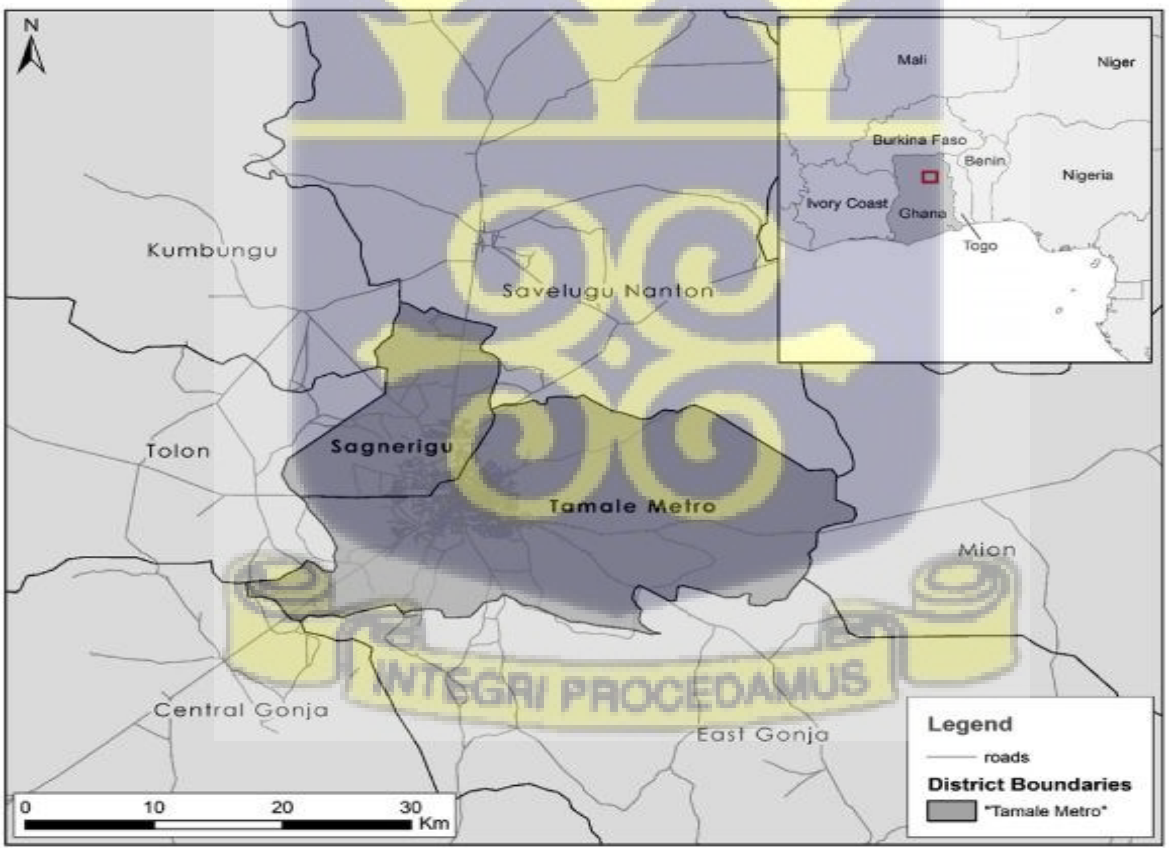


Figure 2: Map of the Tamale Metropolitan Area and surrounding districts.
Source: Fuseini & Kemp, (2016).

3.3. Description of Study Site

Tamale Central District is an urban community made up of 23 communities. The district is majorly occupied by Dagombas. The language commonly spoken is Dagbani and Islam is the predominant religion. The people are mainly traders and farmers, the majority of the population are also employed in the public sector while others are entrepreneurs owing their own shops and businesses. The district shares boundaries with Vitting at the East, Bilpeila at the South, Nyohini Sub-Metro at the West, and the Sagnerigu Municipal at the North.

Tamale is located 600km north of Accra and covers a total land area of 750 square kilometers. The Tamale Teaching Hospital, which is the third largest in the country, is located 2 km south to the Tamale Central District. Other hospitals within the district include the Tamale Central Hospital, Tamale West Hospital, and the SDA Hospital. The Tamale Central Health Center, Moshie Zongo Health Center, One Heart Medical Center, Changli clinic, Prisons clinic, Police clinic, Rabito clinic, and Tamale NMTC Prestige Hospital are all health facilities within the Tamale metropolitan area. There are also seven (7) Community-Based Health Planning and services (CHPS) zones and 20 outreach points.

3.3.2. Study Population

The study included all caregivers of children under five years in the Tamale Central District where SMC has been taking place since 2019. The projected population from the 2021 population and housing census was 138,821 people, according to the DHMT profile.

3.4. Inclusion Criteria

Caregivers were selected to take part in the study based on the following:

1. Has at least one or more children under 5 years under his or her care at the time of the study.
2. Has been a resident in the district for at least six months.
3. Has been in the community during the first round of SMC in 2022.

3.5. Exclusion Criteria

Caregivers who were absent at the time of the study.

Caregivers who do not want to participate.

3.6. Study Variables

Table 1: Study Variables

VARIABLE	OPERATIONAL DEFINITION	SCALE OF MEASUREMENT	LABEL	SOURCE OF INFORMATION
DEPENDENT VARIABLE				
Adherence to SMC	Child under 5 years who has received and completed the 3 days medication during the last round of SMC in October 2022.	Dichotomous	Yes No	Interview
INDEPENDENT VARIABLES				
Age	Age of Caregiver at last birthday	Continuous	Age in years	Interview
Highest Level of Education	Level of education	Ordinal	1. No education 2. Primary 3. JHS 4. Secondary 5. Tertiary	Interview

VARIABLE	OPERATIONAL DEFINITION	SCALE OF MEASUREMENT	LABEL	SOURCE OF INFORMATION
Marital status	Being married or otherwise	Nominal	Single Married Divorced Widowed	Interview
Religion	A system of worship or faith	Nominal	No Religion Islam Christianity Traditional religion Other	Interview
Occupation	Current employment status	Categorical	Housewife Unemployed Trader Formal Work Others	Interview
Residence location	Name of sub-district	Nominal	Tishegu zone Gumbihini zone Lamashegu zone Changli zone	Interview
Household size	Number of people currently living in the household at the time of the survey	Discrete	Raw number	Interview
Number of children below 5 years in the household	The total number of children below 5 years living in the household at the time of the survey	Discrete Categorical	Raw number 3-11 months 12-59 months	Interview
Knowledge on the cause of malaria	Does respondent know these cause of malaria	Binary 1. Infected mosquito bites 2. Dirty environment 3. Ancestors 4. Other	Yes No	Interview

VARIABLE	OPERATIONAL DEFINITION	SCALE OF MEASUREMENT	LABEL	SOURCE OF INFORMATION
Knowledge on the signs and symptoms of malaria	Do respondents know these signs and symptoms of malaria	Binary 1. The body feels warm 2. Headache 3. Poor appetite 4. Vomiting 5. Diarrhoea 6. Other	Yes No	Interview
Knowledge on the effects of malaria	Do respondent know these are effects of malaria	Binary 1. Child refuse to eat 2. Child cannot go to school 3. Child refuse to play 4. Convulsion 5. Anemia 6. Death 7. Other	Yes No	interview
Knowledge on prevention of malaria	Do respondents know these are methods of malaria preventing themselves and their children from malaria	Binary 1. Use of ITNs 2. Through SMC 3. Use of mosquito sprays and coils 4. Wearing protective clothing 5. Don't know 6. Other	Yes No	interview
Overall Knowledge on malaria	Percentage score of participants knowledge on causes, signs and symptoms, effects, and prevention of malaria.	Ordinal	Low (<50%) Moderate (50-69%) High (≥70%)	Interview
Awareness of the benefits of SMC	Respondents' awareness of the benefits of SMC	Binary	Yes No	Interview
Caregivers' satisfaction and perception of Community	Whether Respondents are happy with the work of the volunteers.	Binary	Yes No	Interview

VARIABLE	OPERATIONAL DEFINITION	SCALE OF MEASUREMENT	LABEL	SOURCE OF INFORMATION
Health Volunteers				
Community health volunteers administering SMC drug under DOT	Whether Volunteers administer day one medication under observation	Binary	Yes No	Interview
Number of revisits by Volunteers	Numbers of times volunteer revisits the house after administering the initial dose of SMC	Discrete	Raw number	Interview
Education on how to manage side effects of drug	Whether caregivers are educated by Volunteers on the possible side effects of the drug and how to manage them	Binary	Yes No	Interview

3.7. Sampling

3.7.1. Sample size determination

The Cochran formula was used to calculate the sample size given the large size of the sample population.

$$N_o = \frac{z^2 pq}{e^2}$$

N_o = The estimated sample size

Z = Standard deviation of 1.96 at 95% confidence level

p = Since the proportion of caregivers who adhere to SMC in the Tamale Central District is unknown, we assume p=50% by default.

q = 1 – *p* (1 – 0.5)

e = Margin of error at 5% or 0.05

Imputing the figures into the Cochran formula, the estimated sample size was: 384.

$$n_0 = \frac{1.96^2 \text{ X } 0.5(1-0.5)}{0.05^2}$$

A non-response rate of 5% was used and the final sample size was 400.

3.7.2 Sampling Method

Multi-stage sampling was used to sample multiple units at various stages, from the community level to the household level and the study participants.

Sub-district level sampling

The Tamale Central District has four Sub-Districts (Tishegu, Changli, Gumbihini, and Lamashegu Sub-Districts) and all were included in the study to ensure that the population is fairly represented. A simple random sampling by non-replacement balloting was used to select eight (8) communities, two each from the four (4) Sub-Districts. Names of the communities were folded in pieces of paper and placed in a bowl for balloting. The researcher with his eyes closed dipped his hand in the bowl and whichever communities he picked represented the study sites where caregivers were recruited to participate in the study. The eight communities selected included Changli, Dagbandabi fong, Gumbihini North, Warizehi, Lamashegu North, Zogbeli, Tishegu, and Salamba. A proportionate

sampling technique was utilized in determining how many participants are included in each community.

Community Level

Each of the communities selected was stratified into four- north, south, east, and west. Starting from a notable landmark in the community, the researcher randomly selected the direction to move, and went house to house until he exhausted all four directions in that community. This was repeated in all the selected communities where the study took place.

Household Level

At the household level, a caregiver who was 18 years and older and residing in the house, met the criteria and was willing to participate in the study was interviewed. In houses with more than one household, balloting was done to randomly select one of them to complete the questionnaire. The researcher continued the interview process from house to house until the targeted sample size of that community is met before moving to the next community. In a case where the required sample size for a community was not met, the data collection continued in the next candidate community until the final sample size was achieved. We used the World Bank demographic distribution of age by sex groups (World Development Indicators, 2022), (Table 2) to compute for the proportion of women of reproductive age for each sub-district (Table 3). This estimated proportion of women was then used to determine the number of interviews to be conducted in each sub-district (Table 4). In this study, we target women between the ages of 18-49 as the primary caregivers for programs like SMC and selected our sample population to be the 15-54 years group.

Table 2: Ghana's estimated population, 2021

Age Group	Proportion of Total population	Male Population	Female population	Population of females age 15-54
0-14	36.90%	5,976,570	5,728,786	
15-24	19.22%	3,117,818	2,982,639	8,504,351
25-54	35.35%	5,697,556	5,521,712	
55-64	5.32%	825,178	863,267	
65+	3.21%	468,726	549,874	

The total population (Male + Female) = 31,732,128.

It implies, therefore that the proportion of female population aged 15-54 = $\frac{8,504,351}{31,732,128} X\ 100$ = 26.8%

Table 3: Estimated sub-district population of women aged 15-54

Sub-district	Estimated population	Estimated population of women aged 15-54 in sub-district
Changli	36,500	36,500 (26.8%) = 9,782
Gumbihini	28,700	28,700 (26.8%) = 7,691.6
Lamashegu	40,710	40,710 (26.8%) = 10,910.28
Tishegu	32,911	32,911 (26.8%) = 8,820.148
Total	138,821	138,821 (26.8%) = 37,204.028

Table 4: The required sample size for each Sub-District

Sub-districts	Estimated population of women aged 15-54	Sample size calculation	Required sample size
Changli	9,782	400 (9,782÷37,204.028) = 105.17	105
Gumbihini	7,691.6	400 (7,691.6÷37,204.028) = 82.69	83
Lamashegu	10,910.28	400 (10,910.28÷37,204.028) = 117.3	117
Tishegu	8,820.148	400 (8,820.148÷37,204.028) = 94.8	95
Total	37,204.028		400

The required sample size for each sub-district was divided by two to determine the number of interviews to be conducted in each of the two communities randomly selected from the sub-district.

3.8. Data Collection Methods, Tools, and Techniques.

This study used Interviewer administered questionnaire, semi-structured, to collect data from the 400 participants in the Eight (8) selected communities. The questionnaire was written in simple English which reflected the study variables. For participants who could not speak English, data collectors asked questions in local dialects Dagbani, Hausa, Twi, Zabarima, Mossi languages for them to understand and respond appropriately. The questionnaire is in different sections with questions focused on specific demographic characteristics of respondents, their knowledge on malaria, their awareness of the benefits of SMC, adherence to SMC, and community health volunteer factors.

The questionnaire was pre-tested in Bulpela Sub-district with 25 respondents in 15 households. The feedback gathered helped finetune the tool before administering it to participants in the study area.

3.9. Data Collection Procedure

Upon entry into a household, a self-introduction was done, and the purpose of the visit explained to the household head and other members of the house present. A brief presentation on the risks and benefits of participation were clearly explained and caregivers were invited to voluntarily participate. There were consent forms for those who agree to participate. Each participant filled two forms one for the research assistant and the other for the respondent in addition to one copy of the participant information sheet. The questions covered the demographic characteristics of respondents, knowledge of malaria, awareness of the benefits of SMC, community health volunteer factors, and adherence to SMC. In total participants answered 40 questions which took an average time of 20 minutes to complete.

3.10. Quality Assurance

Research assistants (RA) were used in the data collection process. They were trained for two (2) days on basic communication skills and how to interpret and administer questionnaires, as well as how to translate questions in the local language. The RAs were also trained on ethical issues and the need to seek for informed consent before conduction any interview. Pretesting of the tool was done with the RAs before final deployment for the actual data collection. There was constant supervision by the Principal Investigator during the process to ensure data collected passed through quality control checks to scrutinize and validate data. All questionnaires had unique codes to avoid repetition.

3.11. Data Processing and Analysis

After the end of the data collection process, the questionnaire which was entered in Kobo collect toolbox, was exported into Microsoft excel and downloaded before it was imported to STATA version 16 for the statistical analysis. All subsequent analysis were performed using STATA IC version 17 (Stata Corp., College Station, TX, US). The frequencies of all variables were run to ensure completeness and correct coding of variables. Descriptive statistics was performed on the sociodemographic characteristics of respondents. The results were presented in tables, charts, and graphs using frequencies and percentages for categorical variables. Median and quartiles for continuous and discrete variables.

Overall knowledge of study participants was assessed using a composite score of participants knowledge of causes, symptoms, prevention, and effects of malaria. Scores were rescaled to a percentage scale and categorized such that those scoring below 50% were considered to have low knowledge, those scoring 50% to 70% were considered to have moderate knowledge and those scoring above 70% were considered to have high knowledge on malaria.

Bivariate analysis was performed using the Pearson chi-square test to compare proportions and test associations between the dependent variable (adherence to SMC) and the independent variable (sociodemographic factors, knowledge of malaria, awareness of the benefits of SMC, Community volunteer factors). The binary logistic regression model was used to estimate the crude and adjusted odds ratio of adherence to SMC drug administration. The 95% confidence interval and the corresponding *p*-values of the factors associated adherence to SMC drug administration. For the multivariable binary logistic regression model, variables with *p*-values less than 0.20 were considered to determine the effects of covariates on adherence to SMC and the strength of the

associations between the independent and dependent variables. All statistical analysis were considered significant at an alpha of 0.05.

3.12. Ethical Consideration

3.12.1. Ethical Clearance

Ethical clearance was sought from the Ghana Health Service Ethical Review Board. The approval letter was presented to the Metropolitan assembly to seek their Permission before the data collection. Due processes were equally followed at the community and household levels to seek approval from Chiefs and other gate keepers before data collection started.

3.12.2. Voluntary Participation

Caregivers' decision to participate in this study were entirely voluntary, those who refuse to participate were not in any way coerced as to why they did not participate. Their decision did not affect other members in the house who wish to take part in the study.

3.12.3. Risk / Benefits

There is minimal risk to study participants in this study. COVID 19 safety protocols were observed by research assistants and participants, hand washing, use of face mask, and the use of alcohol-based hand sanitizer. Participants were offered facemask before interviews and were educated on the need to maintain the COVID 19 protocols. At the end of the study, participants were appreciated for their time and energy but there are no direct benefits for participation.

3.12.4. Right to Refuse or withdraw from study.

It is within the rights of participants to withdraw at any point in time of the study or refuse to participate at all without any consequences. There was informed consent form for all participants written in simple English for respondents to understand and agree to participate by signing. Participants who could not read nor write had a witness present who read the consent form to them in a language they understand before signing, or thumb printing the form to accept participation. A copy of the form was given to them to keep.

3.12.5. Conflict of Interest

No known conflict of interest by the Principal Investigator, his supervisor and research assistants to declare.

3.12.6. Funding

There is no known external source of funding for the research project other than from the personal savings of the Principal Investigator.

3.12.7. Confidentiality

To ensure confidentiality, names and household details of participants will not be disclosed to a third party. Information collected is solely to be used for research and academic purposes and participants are identified through code numbers assigned to them. This information is encrypted and stored safely in a laptop.

3.13. Data storage and Usage

Questionnaire from this study is kept safe under lock and key, with limited access by only the principal investigator and his supervisor to that information. A secured laptop with restricted access is used to store data collected from the study.

3.14. Dissemination of Results

Duplicates of the findings of the research will be presented to the School of Public Health and the University of Ghana, Legon, in partial fulfillment for the award of a Master of Public Health degree. It will also be made available to the Regional and Metropolitan Health Directorates and will be published in peer-review journals.

CHAPTER FOUR

RESULTS

In October 2022, 471 caregivers of children under five years were randomly sampled from eight (8) communities in the Tamale Central District. The last round of SMC had just finished a month that proceeded the survey. Research assistants visited households and conducted interviews using a structured questionnaire to assess adherence to the three-day dose of the SMC drug.

4.1 Distribution of study participants.

The proportion of caregivers according to communities and subdistricts of residence is shown in Figure 4 below. We exceeded the required sample size of 400 for this study. Gumbihini sub-district had the highest representation of 31.9% (150/471) whilst Tishegu had the lowest representation with 16.7% (79/471). The response rate in Tishegu fell short of the required sample size (95) for the sub-district because eligible respondents were usually not at home during the visits, and some caregivers were reluctant to participate. However, the overall response rate was 100%.

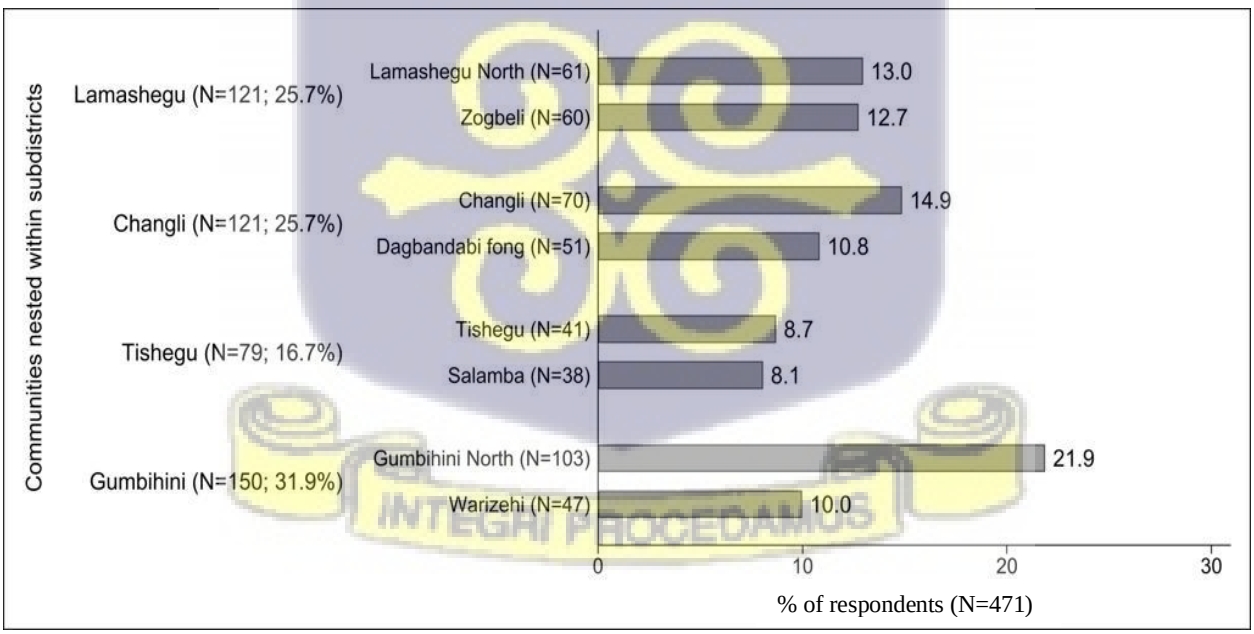


Figure 3: Distribution of study participants by communities and Subdistrict of residence

4.2 Sociodemographic characteristics

The median age of the caregivers was 36 years (13) IQR. About 7% (34/471) of participants were cohabiting, 9.1% (43/471) were widowed, 9.8% (46/471) were divorced, 15 % (73/471) were single parents and the majority 58.4% (275/471) were married. Among the 275 respondents who were married, 71.3% (196/275) were in monogamous marriages, 25.5% (70/275) in polygamous marriages, and 3.3% (9/275) were in open relationships. Close to 18% (84/471) did not have any form of formal education. Most participants were either housewives (25.3%) or unemployed (17.6%), whilst 16.1 % were employed in the formal sector and the rest had some other forms of occupation. Dagombas formed 53.9% of the study participants and 66.5% were practicing Islam religion. As shown Table 1 below, 181 out of 471 caregivers had one child under 5 and the rest of the 290 caregivers had two or more.

Table 5 below shows the distribution of the characteristics of the study participants in each of the 4 districts.

Table 5: Characteristics of study participants by Subdistrict

	Subdistricts				
Characteristics	**Lamashegu** N=121	**Changli** N=121	**Tishegu** N=79	**Gumbihini** N=150	**Total** N=471
Age of respondent; median (IQR)	32 (28-39)	38 (31-43)	33 (27-36)	41 (29-51)	36 (29-42)
Age of respondent					
<20 years	0 (0.0)	0 (0.0)	3 (3.8)	4 (2.7)	7 (1.5)
20-29 years	39 (32.2)	23 (19.0)	22 (27.8)	34 (22.7)	118 (25.1)
30-39 years	56 (46.3)	57 (47.1)	43 (54.4)	32 (21.3)	188 (39.9)
40-49 years	22 (18.2)	22 (18.2)	7 (8.9)	38 (25.3)	89 (18.9)
50-59 years	3 (2.5)	9 (7.4)	4 (5.1)	35 (23.3)	51 (10.8)
60+ years	1 (0.8)	10 (8.3)	0 (0.0)	7 (4.7)	18 (3.8)
Marital status					
Single	9 (7.4)	28 (23.1)	16 (20.3)	20 (13.3)	73 (15.5)
Married	99 (81.8)	74 (61.2)	57 (72.2)	45 (30.0)	275 (58.4)
Cohabiting	0 (0.0)	0 (0.0)	0 (0.0)	34 (22.7)	34 (7.2)
Divorced	8 (6.6)	9 (7.4)	2 (2.5)	27 (18.0)	46 (9.8)
Widowed	5 (4.1)	10 (8.3)	4 (5.1)	24 (16.0)	43 (9.1)
Type of marriage					
Monogamous	59 (59.6)	74 (100.0)	41 (71.9)	22 (48.9)	196 (71.3)
Polygamous	40 (40.4)	0 (0.0)	13 (22.8)	17 (37.8)	70 (25.5)
Open relationship	0 (0.0)	0 (0.0)	3 (5.3)	6 (13.3)	9 (3.3)

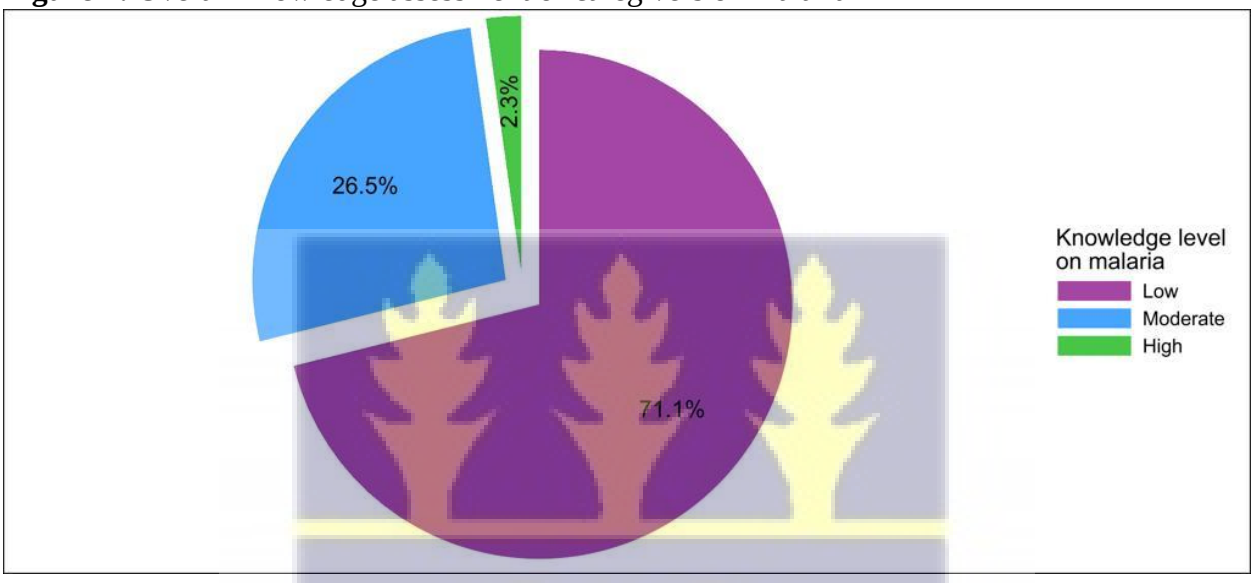
Characteristics	Subdistricts				Total
	Lamashegu N=121	**Changli** N=121	**Tishegu** N=79	**Gumbihini** N=150	**Total** N=471
Educational status					
No formal education	11 (9.1)	12 (9.9)	14 (17.7)	47 (31.3)	84 (17.8)
Primary	8 (6.6)	15 (12.4)	15 (19.0)	34 (22.7)	72 (15.3)
JHS	19 (15.7)	28 (23.1)	18 (22.8)	23 (15.3)	88 (18.7)
Secondary	30 (24.8)	54 (44.6)	26 (32.9)	29 (19.3)	139 (29.5)
Tertiary	53 (43.8)	12 (9.9)	6 (7.6)	17 (11.3)	88 (18.7)
Occupation					
Housewife	17 (14.0)	50 (41.3)	17 (21.5)	35 (23.3)	119 (25.3)
Unemployed	20 (16.5)	10 (8.3)	13 (16.5)	40 (26.7)	83 (17.6)
Farmer	4 (3.3)	1 (0.8)	3 (3.8)	34 (22.7)	42 (8.9)
Formal work	33 (27.3)	9 (7.4)	5 (6.3)	29 (19.3)	76 (16.1)
Trader	32 (26.4)	50 (41.3)	40 (50.6)	8 (5.3)	130 (27.6)
Other	15 (12.4)	1 (0.8)	1 (1.3)	4 (2.7)	21 (4.5)
Religion					
Islam	104 (86.0)	102 (84.3)	55 (69.6)	52 (34.7)	313 (66.5)
Christian	17 (14.0)	19 (15.7)	24 (30.4)	35 (23.3)	95 (20.2)
African Traditional religion	0 (0.0)	0 (0.0)	0 (0.0)	38 (25.3)	38 (8.1)
No Religion	0 (0.0)	0 (0.0)	0 (0.0)	25 (16.7)	25 (5.3)
Ethnicity					
Dagbani	79 (65.3)	67 (55.4)	45 (57.0)	63 (42.0)	254 (53.9)
Hawsa	7 (5.8)	37 (30.6)	10 (12.7)	46 (30.7)	100 (21.2)
Twi	6 (5.0)	16 (13.2)	19 (24.1)	41 (27.3)	82 (17.4)
Other	29 (24.0)	1 (0.8)	5 (6.3)	0 (0.0)	35 (7.4)
Household size: median (IQR)	5 (4-6)	5 (3-6)	4 (3-5)	5 (4-6)	5 (3-6)
Household size					
<4 members	29 (24.0)	33 (27.3)	38 (48.1)	36 (24.8)	136 (29.2)
4-6 members	63 (52.1)	74 (61.2)	34 (43.0)	80 (55.2)	251 (53.9)
7+ members	29 (24.0)	14 (11.6)	7 (8.9)	29 (20.0)	79 (17.0)
Children <5 years; median (IQR)	1 (1-2)	1 (1-2)	2 (1-2)	3 (3-5)	2 (1-3)
Children <5 years					
One child	73 (60.3)	65 (53.7)	30 (38.0)	13 (8.9)	181 (38.8)
Two children	37 (30.6)	53 (43.8)	33 (41.8)	20 (13.7)	143 (30.6)
Three children	10 (8.3)	3 (2.5)	15 (19.0)	48 (32.9)	76 (16.3)
>Three children	1 (0.8)	0 (0.0)	1 (1.3)	65 (44.5)	67 (14.3)
Relationship to the child(ren)					
Parent	111 (91.7)	106 (87.6)	62 (78.5)	74 (49.3)	353 (74.9)
Uncle/Aunt	6 (5.0)	0 (0.0)	10 (12.7)	29 (19.3)	45 (9.6)
Grandparent	3 (2.5)	14 (11.6)	7 (8.9)	11 (7.3)	35 (7.4)
Sibling	1 (0.8)	1 (0.8)	0 (0.0)	23 (15.3)	25 (5.3)
Others	0 (0.0)	0 (0.0)	0 (0.0)	13 (8.7)	13 (2.8)

4.3 Knowledge of malaria

Knowledge of study participants were assessed using a composite score of participants knowledge of causes, symptoms, prevention, and effects of malaria. Scores were rescaled to a percentage scale

and categorized such that those scoring below 50% were considered to have low knowledge, those scoring 50% to 70% had moderate knowledge and those scoring above 70% had high knowledge on malaria. As shown in Figure 4 below, overall, the knowledge level of caregivers was low for 71.1% (335/471), moderate for 26.5% (125/471) and high for 2.3% (11/471).

Figure 4: Overall knowledge assessment of caregivers on malaria



More than 80% (383/471) of respondents correctly reported malaria is caused by the bite of an infected mosquito (Fig. 5).

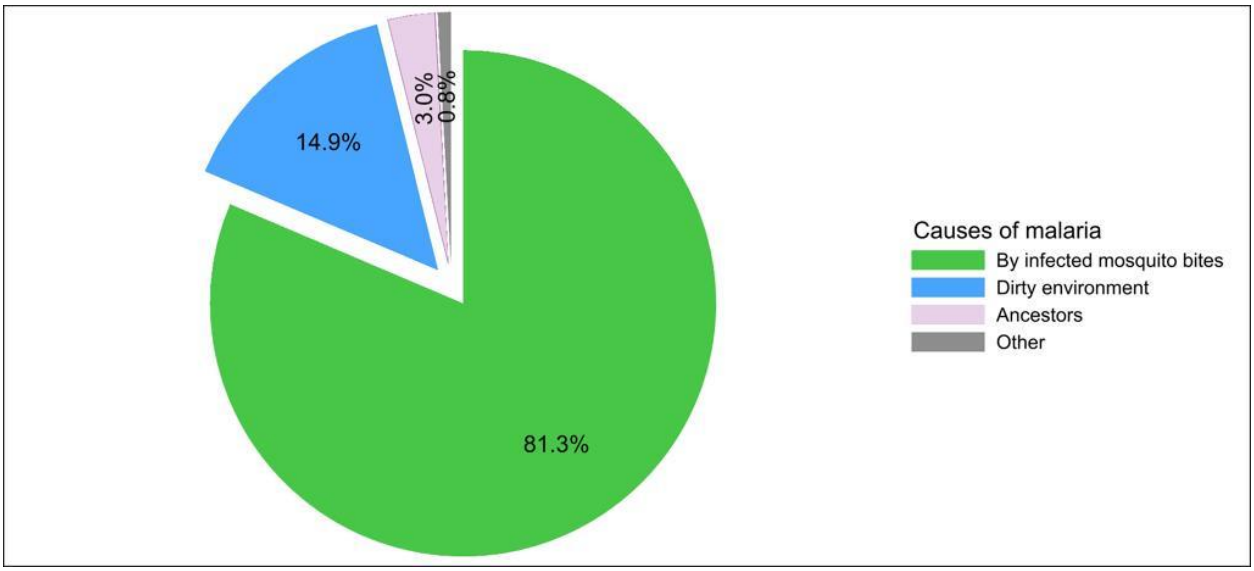


Figure 5: knowledge of caregivers on causes of malaria

On the signs and symptoms of malaria, 85.6% (403/471) mentioned the body feels warm, over 40% mentioned vomiting (204/471), headache (198/471), poor appetite (194/471) respectively (Fig. 6A). When asked about the effects of malaria, 87.7% (413/471) reported their children refused to eat, 15.9% (75/471) mentioned convulsion, 12.3% (58/471) mentioned death and 6.8% (32/471) mentioned malaria can cause anaemia (Fig. 6B).

Only 1.7% said they do not know what ways to prevent themselves from getting malaria. Of the 471 respondents 401 (85.1%) mentioned the use of insecticide-treated nets as a malaria preventive method for themselves (Fig. 6C).

Only 2 respondents said they do not know what ways to prevent their children from getting malaria. Most (81.7%) of respondents mentioned the use of insecticide treated-nets as a malaria preventive method for their children and 62% (292/471) of them mentioned SMC (Fig. 6D).

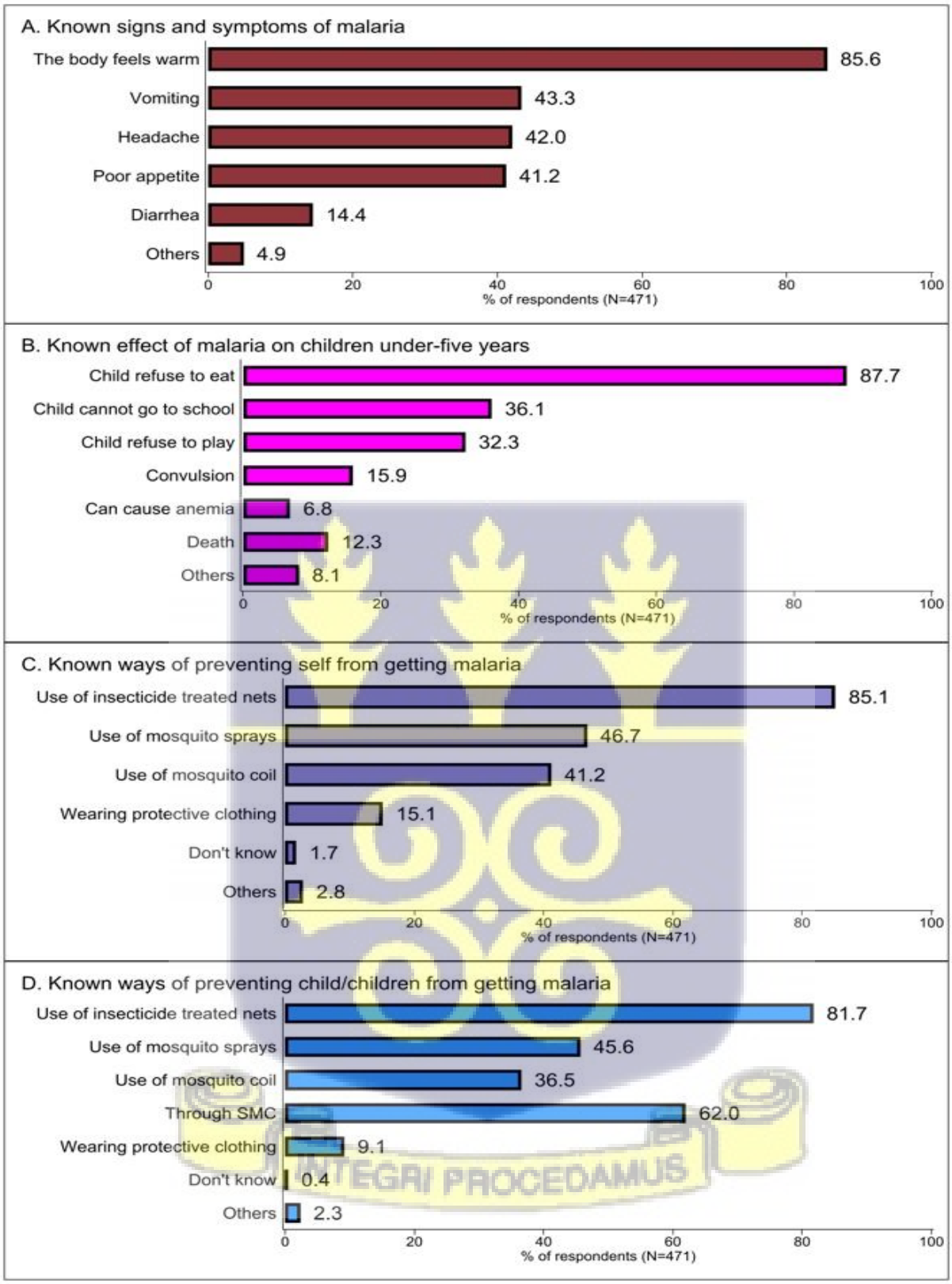


Figure 6: Knowledge of caregivers on signs and symptoms, effects, and prevention of malaria

Table 6: Caregivers' knowledge on causes, signs and symptoms, effects, and prevention of malaria by Subdistrict.

Variables	Subdistricts Lamashegu N=121	Changli N=121	Tishegu N=79	Gumbihini N=150	Total N=471
Knowledge level on malaria					
Low	62 (51.2)	114 (94.2)	11 (13.9)	148 (98.7)	335 (71.1)
Moderate	59 (48.8)	7 (5.8)	57 (72.2)	2 (1.3)	125 (26.5)
High	0 (0.0)	0 (0.0)	11 (13.9)	0 (0.0)	11 (2.3)
Cause of malaria					
By infected mosquito bites	115 (95.0)	119 (98.3)	58 (73.4)	91 (60.7)	383 (81.3)
Dirty environment	2 (1.7)	2 (1.7)	21 (26.6)	45 (30.0)	70 (14.9)
Ancestors	0 (0.0)	0 (0.0)	0 (0.0)	14 (9.3)	14 (3.0)
Other	4 (3.3)	0 (0.0)	0 (0.0)	0 (0.0)	4 (0.8)
Signs and symptoms of malaria known (M)					
The body feels warm	114 (94.2)	112 (92.6)	69 (87.3)	108 (72.0)	403 (85.6)
Vomiting	80 (66.1)	19 (15.7)	53 (67.1)	52 (34.7)	204 (43.3)
Headache	53 (43.8)	57 (47.1)	68 (86.1)	20 (13.3)	198 (42.0)
Poor appetite	93 (76.9)	75 (62.0)	18 (22.8)	8 (5.3)	194 (41.2)
Diarrhoea	10 (8.3)	13 (10.7)	40 (50.6)	5 (3.3)	68 (14.4)
Other	23 (19.0)	0 (0.0)	0 (0.0)	0 (0.0)	23 (4.9)
Effects of malaria on children (M)					
Child refuse to eat	113 (93.4)	121 (100.0)	79 (100.0)	100 (66.7)	413 (87.7)
Child cannot go to school	45 (37.2)	19 (15.7)	53 (67.1)	53 (35.3)	170 (36.1)
Child refuse to play	34 (28.1)	23 (19.0)	66 (83.5)	29 (19.3)	152 (32.3)
Convulsion	25 (20.7)	5 (4.1)	22 (27.8)	23 (15.3)	75 (15.9)
Can cause anaemia	3 (2.5)	4 (3.3)	12 (15.2)	13 (8.7)	32 (6.8)
Death	28 (23.1)	9 (7.4)	17 (21.5)	4 (2.7)	58 (12.3)
Other	38 (31.4)	0 (0.0)	0 (0.0)	0 (0.0)	38 (8.1)
Ways one can prevents themselves from getting malaria (M)					
Use of Insecticide Treated Nets	113 (93.4)	121 (100.0)	77 (97.5)	90 (60.0)	401 (85.1)
Use of mosquito sprays	87 (71.9)	27 (22.3)	63 (79.7)	43 (28.7)	220 (46.7)
Use of mosquito coil	89 (73.6)	11 (9.1)	57 (72.2)	37 (24.7)	194 (41.2)
Wearing Protective clothing	3 (2.5)	0 (0.0)	40 (50.6)	28 (18.7)	71 (15.1)
Don't know	0 (0.0)	0 (0.0)	0 (0.0)	8 (5.3)	8 (1.7)
Other	11 (9.1)	0 (0.0)	2 (2.5)	0 (0.0)	13 (2.8)
Ways one can prevents child(ren) from getting malaria (M)					
Use of Insecticide Treated Nets	118 (97.5)	117 (96.7)	76 (96.2)	74 (49.3)	385 (81.7)
Use of mosquito sprays	70 (57.9)	37 (30.6)	53 (67.1)	55 (36.7)	215 (45.6)
Use of mosquito coil	72 (59.5)	17 (14.0)	48 (60.8)	35 (23.3)	172 (36.5)
Through SMC	109 (90.1)	91 (75.2)	54 (68.4)	38 (25.3)	292 (62.0)
Wearing Protective clothing	6 (5.0)	1 (0.8)	28 (35.4)	8 (5.3)	43 (9.1)
Don't know	0 (0.0)	1 (0.8)	0 (0.0)	1 (0.7)	2 (0.4)
Other	11 (9.1)	0 (0.0)	0 (0.0)	0 (0.0)	11 (2.3)

(M): Multiple choice responses

4.4 Awareness of the benefits of SMC.

In Table 7 below, 80% (377/471) respondents reported their source of information on SMC was from the community volunteer, followed by TV (45.2%), radio (40.1%), and health worker (27.2%). Others mentioned friends (21.4%) and place of worship (10.4%) as their source of information on SMC. Almost all 94.5% (445/471) respondents know SMC is given in the rainy season, but only 38% (177/471) correctly stated the minimum age requirement for the SMC drug. About 85% (400/471) of the respondents were aware of the benefits of SMC and mentioned it prevents malaria, whiles 13.4 % (63/471) said it treats malaria. Only 2 respondents said they did not know the benefits of SMC. About 26% (124/471) of respondents answered yes when we asked if there are any problems with the SMC drug. They cited adverse drug reactions like fever, vomiting, diarrhoea, and weakness. But overall, about 97.7% (460/471) of respondents were happy with SMC (Table 7).

Table 7: Awareness of caregivers on the benefits of SMC medication

	Subdistricts				
Characteristics	**Lamashegu N=121**	**Changli N=121**	**Tishegu N=79**	**Gumbihini N=150**	**Total N=471**
Source of information on SMC (M)	1 (0.8)	100 (82.6)	10 (12.7)	102 (68.0)	213 (45.2)
TV	1 (0.8)	100 (82.6)	10 (12.7)	102 (68.0)	213 (45.2)
Radio	15 (12.4)	77 (63.6)	63 (79.7)	34 (22.7)	189 (40.1)
Community volunteer	115 (95.0)	99 (81.8)	73 (92.4)	90 (60.0)	377 (80.0)
Health worker	25 (20.7)	33 (27.3)	26 (32.9)	44 (29.3)	128 (27.2)
Friends	29 (24.0)	29 (24.0)	25 (31.6)	18 (12.0)	101 (21.4)
Worship place	0 (0.0)	37 (30.6)	2 (2.5)	10 (6.7)	49 (10.4)
Other	4 (3.3)	0 (0.0)	0 (0.0)	0 (0.0)	4 (0.8)
What season of the year is SMC given					
Rainy season	111 (91.7)	120 (99.2)	72 (91.1)	142 (94.7)	445 (94.5)
Dry season	0 (0.0)	0 (0.0)	0 (0.0)	5 (3.3)	5 (1.1)
All year round	2 (1.7)	0 (0.0)	4 (5.1)	1 (0.7)	7 (1.5)
Don't know	8 (6.6)	1 (0.8)	3 (3.8)	2 (1.3)	14 (3.0)
What are the benefits of SMC					
Prevent malaria in children under 5 years	115 (95.0)	120 (99.2)	42 (53.2)	123 (82.0)	400 (84.9)
Treat malaria in children under 5 years	2 (1.7)	0 (0.0)	37 (46.8)	24 (16.0)	63 (13.4)
Don't know	0 (0.0)	1 (0.8)	0 (0.0)	3 (2.0)	4 (0.8)
Other	4 (3.3)	0 (0.0)	0 (0.0)	0 (0.0)	4 (0.8)
Minimum age required for SMC medication (in months)					
1	0 (0.0)	114 (94.2)	1 (1.3)	7 (4.8)	122 (26.2)
2	0 (0.0)	0 (0.0)	0 (0.0)	25 (17.0)	25 (5.4)
3	109 (90.1)	5 (4.1)	39 (50.6)	24 (16.3)	177 (38.0)

Characteristics	Subdistricts				
	Lamashegu N=121	Changli N=121	Tishegu N=79	Gumbihini N=150	Total N=471
4	2 (1.7)	0 (0.0)	2 (2.6)	23 (15.6)	27 (5.8)
5	2 (1.7)	0 (0.0)	2 (2.6)	29 (19.7)	33 (7.1)
6	6 (5.0)	0 (0.0)	3 (3.9)	5 (3.4)	14 (3.0)
7	0 (0.0)	0 (0.0)	0 (0.0)	6 (4.1)	6 (1.3)
8	0 (0.0)	0 (0.0)	0 (0.0)	6 (4.1)	6 (1.3)
9	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.7)	1 (0.2)
12	1 (0.8)	0 (0.0)	2 (2.6)	5 (3.4)	8 (1.7)
24	0 (0.0)	0 (0.0)	1 (1.3)	5 (3.4)	6 (1.3)
36	1 (0.8)	2 (1.7)	3 (3.9)	5 (3.4)	11 (2.4)
48	0 (0.0)	0 (0.0)	5 (6.5)	1 (0.7)	6 (1.3)
60	0 (0.0)	0 (0.0)	19 (24.7)	5 (3.4)	24 (5.2)
Are there any problems with the SMC drug that you know					
Yes	35 (28.9)	17 (14.0)	16 (20.3)	56 (37.3)	124 (26.3)
No	86 (71.1)	104 (86.0)	63 (79.7)	94 (62.7)	347 (73.7)
Are you happy with the SMC					
Yes	115 (95.0)	121 (100.0)	76 (96.2)	148 (98.7)	460 (97.7)
No	6 (5.0)	0 (0.0)	3 (3.8)	2 (1.3)	11 (2.3)
Will you advise people to let their child(ren) take the SMC medicine					
Yes	115 (95.0)	121 (100.0)	79 (100.0)	150 (100.0)	465 (98.7)
No	6 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (1.3)

(M): Multiple choice responses

4.5 Adherence to SMC

Adherence is defined as those caregivers who administered both the second-day and third day doses of the SMC drug to their children after receiving the first day dose from the CHVs during the last round of the 2022 SMC campaign. In this study, adherence to SMC was assessed using several questions as shown in Table 8 below. About 97.4% (455/471) correctly recognized the SMC drug is taken 3 days in a month, whiles 57.7% (266/471) correctly recognized the SMC drug is given 4 times in a year. About 95.3% (449/471) reported they administered the drug on the second day whiles 91.7% (432/471) reported they administered the drug on the third day. Forgetfulness (65.2%), side effects of drug (27.8%), bitter taste of the drug (10.4%), child refusing to take drug (43.5%), were the reasons caregivers gave for missing doses of the SMC drug.

Table 8: Adherence to SMC among caregivers

Variables	Subdistricts				Total
	Lamashegu N=121	Changli N=121	Tishegu N=79	Gumbihini N=150	N=471
How many times is SMC drug given in a year					
1	0 (0.0)	2 (1.7)	1 (1.3)	1 (0.7)	4 (0.9)
3	9 (8.0)	34 (28.1)	26 (32.9)	122 (81.9)	191 (41.4)
4	103 (92.0)	85 (70.2)	52 (65.8)	26 (17.4)	266 (57.7)
How many days is the SMC drug taken in a month					
1	0 (0.0)	1 (0.8)	2 (2.5)	0 (0.0)	3 (0.6)
2	0 (0.0)	0 (0.0)	2 (2.5)	0 (0.0)	2 (0.4)
3	120 (99.2)	119 (98.3)	73 (92.4)	143 (97.9)	455 (97.4)
4	1 (0.8)	1 (0.8)	2 (2.5)	3 (2.1)	7 (1.5)
How many of your child(ren) received the SMC during the last exercise this year					
0	4 (3.3)	0 (0.0)	0 (0.0)	2 (1.4)	6 (1.3)
1	73 (60.3)	67 (55.4)	27 (34.2)	11 (7.5)	178 (38.1)
2	35 (28.9)	51 (42.1)	35 (44.3)	23 (15.8)	144 (30.8)
3	8 (6.6)	3 (2.5)	16 (20.3)	49 (33.6)	76 (16.3)
4	1 (0.8)	0 (0.0)	1 (1.3)	49 (33.6)	51 (10.9)
5	0 (0.0)	0 (0.0)	0 (0.0)	12 (8.2)	12 (2.6)
How many of your child(ren) completed all the SMC doses					
0	12 (9.9)	1 (0.8)	0 (0.0)	6 (4.0)	19 (4.0)
1	72 (59.5)	66 (54.5)	31 (39.2)	12 (8.0)	181 (38.4)
2	33 (27.3)	51 (42.1)	32 (40.5)	25 (16.7)	141 (29.9)
3	4 (3.3)	3 (2.5)	16 (20.3)	43 (28.7)	66 (14.0)
4	0 (0.0)	0 (0.0)	0 (0.0)	50 (33.3)	50 (10.6)
5	0 (0.0)	0 (0.0)	0 (0.0)	12 (8.0)	12 (2.5)
6	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.3)	2 (0.4)
How many of your child(ren) did not complete the SMC doses					
0	97 (80.2)	119 (98.3)	60 (75.9)	127 (84.7)	403 (85.6)
1	21 (17.4)	1 (0.8)	18 (22.8)	4 (2.7)	44 (9.3)
2	3 (2.5)	1 (0.8)	1 (1.3)	7 (4.7)	12 (2.5)
3	0 (0.0)	0 (0.0)	0 (0.0)	6 (4.0)	6 (1.3)
4	0 (0.0)	0 (0.0)	0 (0.0)	5 (3.3)	5 (1.1)
5	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.7)	1 (0.2)
Did you administer the SMC medicine to your child(ren) on the second day					
Yes	111 (91.7)	120 (99.2)	70 (88.6)	148 (98.7)	449 (95.3)
No	10 (8.3)	1 (0.8)	9 (11.4)	2 (1.3)	22 (4.7)
Did you administer the SMC medicine to your child(ren) on the third day					
Yes	109 (90.1)	120 (99.2)	56 (70.9)	147 (98.0)	432 (91.7)
No	12 (9.9)	1 (0.8)	23 (29.1)	3 (2.0)	39 (8.3)
Do you sometimes miss administering the SMC drug to your child					
Yes	18 (14.9)	3 (2.5)	55 (69.6)	39 (26.0)	115 (24.4)
No	103 (85.1)	118 (97.5)	24 (30.4)	111 (74.0)	356 (75.6)
Reasons for missing SMC medication (N=115) [M]					
Forgetfulness	5 (27.8)	0 (0.0)	46 (83.6)	24 (61.5)	75 (65.2)
Side effects of drug	13 (72.2)	3 (100.0)	2 (3.6)	14 (35.9)	32 (27.8)
Bitter taste of the drug	0 (0.0)	0 (0.0)	6 (10.9)	6 (15.4)	12 (10.4)
Child refuse to take drug	0 (0.0)	0 (0.0)	45 (81.8)	5 (12.8)	50 (43.5)
Other	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)

[M]: Multiple choice responses

4.5.1 Adherence to SMC administration guidelines by caregivers

The study identified adherence rate of 90.1% to SMC among caregivers in the Tamale Central District with a 95% confidence interval estimate from 87.9% to 93.3% (Figure 7).

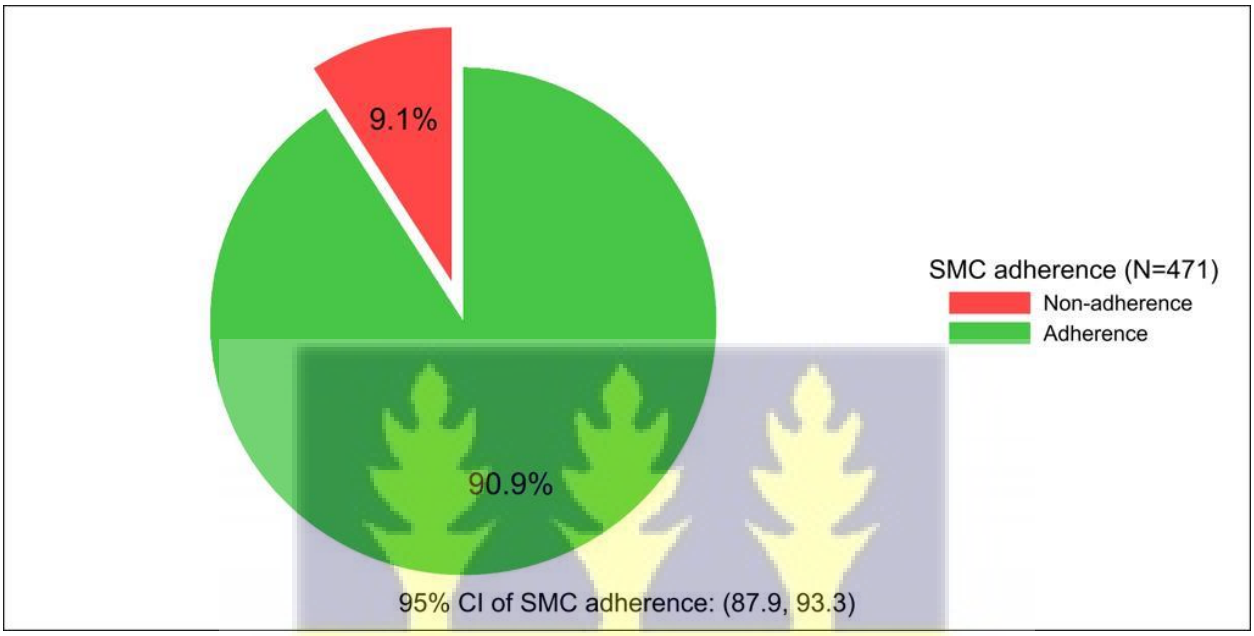


Figure 7: Adherence to SMC by caregivers.

4.5.2 Adherence by Subdistricts

Adherence was lowest in the Tishegu Subdistrict (68.4%) whilst Lamashegu Subdistrict had 90.1% adherence rate, Gumbihini recorded 96.7% adherence rate and Changli recorded the highest adherence rate of 99.2% (Figure 8).

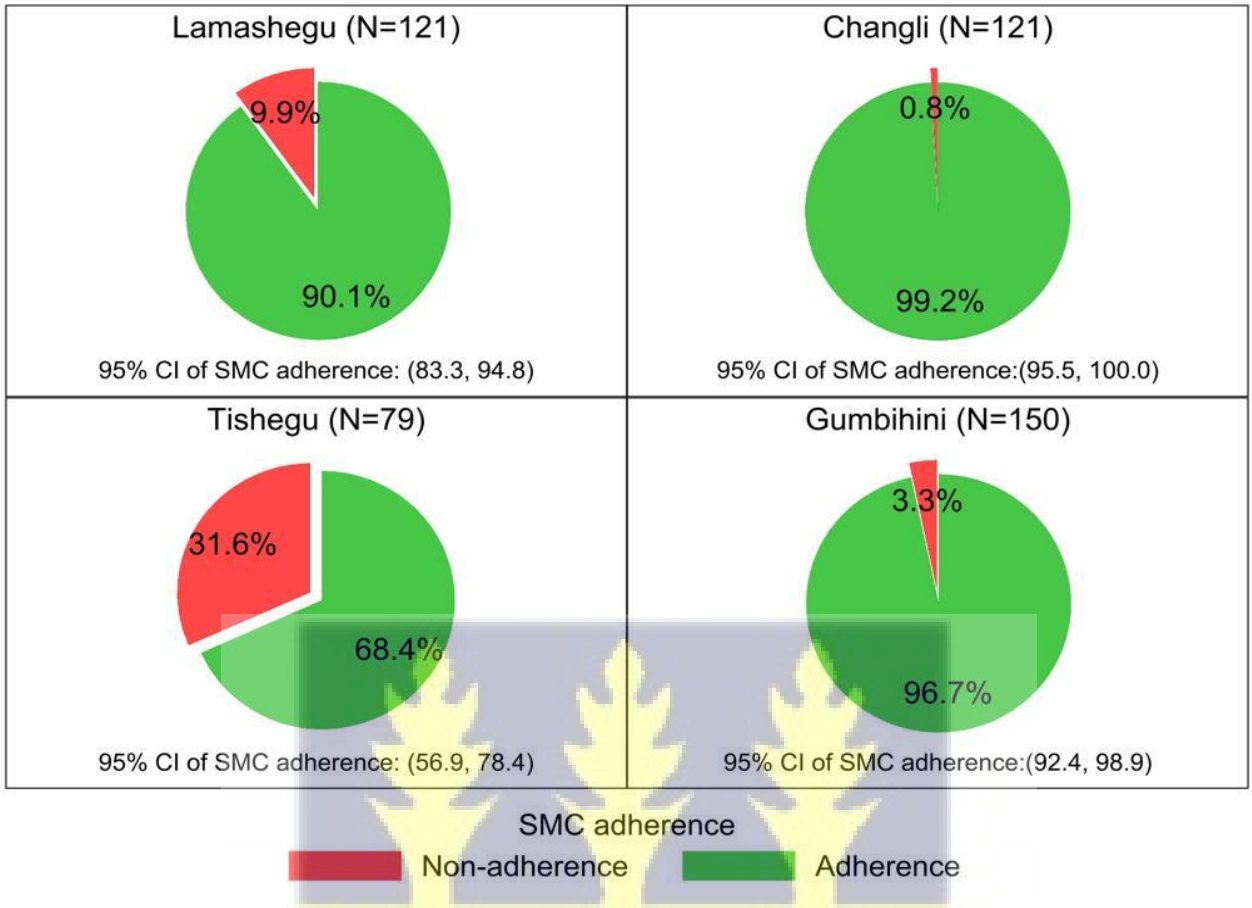


Figure 8: Adherence to SMC by subdistricts

4.6 Community health volunteers' factors

Nearly all (97%) (457/471) respondents said they were comfortable with the volunteers coming to their homes to administer the SMC medicine. They reported identifying the volunteers through several means like wearing SMC T-shirts (51%) (240/471), volunteer self-introduction (48.8%) (230/471), wearing identification tags (47.8%) (225/471), and 43.9% (207/471) said SMC volunteers are members of the community. Only 5.3% (25/471) of respondents reported the volunteers did not observe the child take the first dose of the SMC drug. Some 8.3% (39/471) of respondents said the volunteers did not educate them o the adverse effects of the drug and how to

manage them, and 13.4% (63/471) also said the volunteers did not visit their homes again after the initial dose of the SMC drug. Generally, respondents were happy with the work of volunteers (91.9%) (433/471), as shown in Table 9 below.

Table 9: Community health volunteers' factors by Subdistricts

Characteristics	Subdistricts				Total
	Lamashegu N=121	Changli N=121	Tishegu N=79	Gumbihini N=150	N=471
Are you comfortable with volunteers coming to administer SMC to your child					
Yes	118 (97.5)	121 (100.0)	68 (86.1)	150 (100.0)	457 (97.0)
No	3 (2.5)	0 (0.0)	11 (13.9)	0 (0.0)	14 (3.0)
How do you identify SMC volunteers when they visit the house [(M)]					
They are members of the community	71 (58.7)	90 (74.4)	32 (40.5)	14 (9.3)	207 (43.9)
They wear SMC T-shirts	102 (84.3)	2 (1.7)	43 (54.4)	93 (62.0)	240 (51.0)
They wear ID tags	26 (21.5)	11 (9.1)	55 (69.6)	133 (88.7)	225 (47.8)
Volunteer self-introduction	26 (21.5)	39 (32.2)	19 (24.1)	146 (97.3)	230 (48.8)
Other	120 (99.2)	121 (100.0)	79 (100.0)	150 (100.0)	470 (99.8)
Did the volunteer observe the child take the first dose of the drug					
Yes	108 (89.3)	121 (100.0)	71 (89.9)	146 (97.3)	446 (94.7)
No	13 (10.7)	0 (0.0)	8 (10.1)	4 (2.7)	25 (5.3)
Did the volunteer educate you on the adverse effects of the drug and how to mana					
Yes	96 (79.3)	119 (98.3)	67 (84.8)	150 (100.0)	432 (91.7)
No	25 (20.7)	2 (1.7)	12 (15.2)	0 (0.0)	39 (8.3)
Did the volunteer visit your house again after administering the first dose of S					
Yes	97 (80.2)	117 (96.7)	47 (59.5)	147 (98.0)	408 (86.6)
No	24 (19.8)	4 (3.3)	32 (40.5)	3 (2.0)	63 (13.4)
Are you satisfied with the work of the volunteer					
Yes	114 (94.2)	120 (99.2)	59 (74.7)	140 (93.3)	433 (91.9)
No	7 (5.8)	1 (0.8)	20 (25.3)	10 (6.7)	38 (8.1)

[(M)]: Multiple choice responses

4.7 Bivariate analysis of the adherence to SMC

4.7.2 Sociodemographic characteristics and adherence

Caregivers less than 20 years (14.3%), married (10.2%), being in open relationship (11.3%), those with no formal education (15.5%), being a trader (14.6%), a household size of 4-6 members

(10.8%), households with two children under 5 years (12.6%), were likely not to adhere. That notwithstanding, there was no statistical significance between adherence and age, marital status, type of marriage, educational status, occupation, religion, ethnicity, household size, number of children under 5 in a household, and relationship with the child. All *p*-values were > 0.05 shown in Table 10 below.

Table 10: Association between adherence to SMC and sociodemographic characteristics of caregivers

	Adherence to SMC administration		
	Non-adherence N=43	**Adherence N=428**	
Characteristics	**n/N (%)**	**n/N (%)**	**Chi-square *p*-value**
Age of respondent; median (IQR)	36 (32-41)	36 (29-42)	0.990
Age of respondent			0.330
<20 years	1/7 (14.3)	6/7 (85.7)	
20-29 years	7/118 (5.9)	111/118 (94.1)	
30-39 years	23/188 (12.2)	165/188 (87.8)	
40-49 years	8/89 (9.0)	81/89 (91.0)	
50-59 years	4/51 (7.8)	47/51 (92.2)	
60+ years	0/18 (0.0)	18/18 (100.0)	
Marital status			0.800
Single	5/73 (6.8)	68/73 (93.2)	
Married	28/275 (10.2)	247/275 (89.8)	
Cohabiting	2/34 (5.9)	32/34 (94.1)	
Divorced	5/46 (10.9)	41/46 (89.1)	
Widowed	3/43 (7.0)	40/43 (93.0)	
Type of marriage			0.200
Monogamous	16/196 (8.2)	180/196 (91.8)	
Polygamous	11/70 (15.7)	59/70 (84.3)	
Open relationship	1/9 (11.1)	8/9 (88.9)	
Educational status			0.140
No formal education	13/84 (15.5)	71/84 (84.5)	
Primary	5/72 (6.9)	67/72 (93.1)	
JHS	10/88 (11.4)	78/88 (88.6)	
Secondary	10/139 (7.2)	129/139 (92.8)	
Tertiary	5/88 (5.7)	83/88 (94.3)	
Occupation			0.130
Housewife	8/119 (6.7)	111/119 (93.3)	
Unemployed	4/83 (4.8)	79/83 (95.2)	
Farmer	2/42 (4.8)	40/42 (95.2)	
Formal work	8/76 (10.5)	68/76 (89.5)	
Trader	19/130 (14.6)	111/130 (85.4)	
Other	2/21 (9.5)	19/21 (90.5)	
Religion			0.630
Islam	31/313 (9.9)	282/313 (90.1)	
Christian	9/95 (9.5)	86/95 (90.5)	
African Traditional religion	2/38 (5.3)	36/38 (94.7)	
No Religion	1/25 (4.0)	24/25 (96.0)	
Ethnicity			0.590
Dagbani	27/254 (10.6)	227/254 (89.4)	
Hawsa	6/100 (6.0)	94/100 (94.0)	
Twi	7/82 (8.5)	75/82 (91.5)	

Characteristics	Adherence to SMC administration		
	Non-adherence N=43 n/N (%)	Adherence N=428 n/N (%)	Chi-square *p*-value
Other	3/35 (8.6)	32/35 (91.4)	
Household size: median (IQR)	5 (4-5)	5 (3-6)	0.990
Household size			0.470
<4 members	10/136 (7.4)	126/136 (92.6)	
4-6 members	27/251 (10.8)	224/251 (89.2)	
7+ members	6/79 (7.6)	73/79 (92.4)	
Children <5 years; median (IQR)	2 (1-3)	2 (1-3)	0.800
Children <5 years			0.290
One child	13/181 (7.2)	168/181 (92.8)	
Two children	18/143 (12.6)	125/143 (87.4)	
Three children	7/76 (9.2)	69/76 (90.8)	
>Three children	4/67 (6.0)	63/67 (94.0)	
Relationship to the child(ren)			0.310
Parent	32/353 (9.1)	321/353 (90.9)	
Uncle/Aunt	7/45 (15.6)	38/45 (84.4)	
Grandparent	3/35 (8.6)	32/35 (91.4)	
Sibling	0/25 (0.0)	25/25 (100.0)	
Others	1/13 (7.7)	12/13 (92.3)	

4.7.3 Knowledge on malaria and adherence

Caregivers' knowledge on causes, signs and symptoms, effects of malaria, and ways caregivers can prevent themselves and their children from malaria were included in the analysis below. Respondents who did not know malaria is caused through the bite of an infected mosquito bite were more likely not to adhere.

Knowledge of headache ($p<0.001$) and diarrhoea ($p<0.001$) were significantly associated with adherence to SMC administration among the caregivers. Also, knowledge of child's inability to attend school ($p=0.002$) and child's refusal to play ($p<0.001$) as effect of malaria on children were also significantly associated with adherence to SMC administration. (Table 11)

Caregiver knowledge of the use of mosquito sprays ($p=0.015$), mosquito coil ($p<0.001$) and wearing of protective clothes ($p=0.003$) as a way of preventing themselves from malaria were significantly associated with adherence to SMC administration. The caregiver's awareness of the

use of mosquito coil to prevent child from getting malaria was also significantly associated with adherence to SMC administration. (Table 11)

Table 11: Association between adherence to SMC and knowledge of caregivers on causes, signs and symptoms, effects, and prevention of malaria

	Adherence to SMC administration		
	Non-adherence N=43	Adherence N=428	Chi-square
Characteristics	**n/N (%)**	**n/N (%)**	***p*-value**
Cause of malaria			0.200
By infected mosquito bites	30/383 (7.8)	353/383 (92.2)	
Dirty environment	10/70 (14.3)	60/70 (85.7)	
Ancestors	2/14 (14.3)	12/14 (85.7)	
Other	1/4 (25.0)	3/4 (75.0)	
Signs and symptoms of malaria known (M)			
The body feels warm	33/43 (76.7)	370/428 (86.4)	0.110
Vomiting	25/43 (58.1)	179/428 (41.8)	0.052
Headache	29/43 (67.4)	169/428 (39.5)	<0.001
Poor appetite	15/43 (34.9)	179/428 (41.8)	0.420
Diarrhoea	15/43 (34.9)	53/428 (12.4)	<0.001
Other	3/43 (7.0)	20/428 (4.7)	0.460
Effects of malaria on children (M)			
Child refuse to eat	38/43 (88.4)	375/428 (87.6)	1.000
Child cannot go to school	25/43 (58.1)	145/428 (33.9)	0.002
Child refuse to play	27/43 (62.8)	125/428 (29.2)	<0.001
Convulsion	8/43 (18.6)	67/428 (15.7)	0.660
Can cause anaemia	4/43 (9.3)	28/428 (6.5)	0.520
Death	7/43 (16.3)	51/428 (11.9)	0.460
Other	5/43 (11.6)	33/428 (7.7)	0.370
Ways one can prevents themselves from getting malaria (M)			
Use of Insecticide Treated Nets	34/43 (79.1)	367/428 (85.7)	0.260
Use of mosquito sprays	28/43 (65.1)	192/428 (44.9)	0.015
Use of mosquito coil	34/43 (79.1)	160/428 (37.4)	<0.001
Wearing Protective clothing	14/43 (32.6)	57/428 (13.3)	0.003
Don't know	0/43 (0.0)	8/428 (1.9)	1.000
Other	1/43 (2.3)	12/428 (2.8)	1.000
Ways one can prevents child(ren) from getting malaria (M)			
Use of Insecticide Treated Nets	37/43 (86.0)	348/428 (81.3)	0.540
Use of mosquito sprays	23/43 (53.5)	192/428 (44.9)	0.340
Use of mosquito coil	25/43 (58.1)	147/428 (34.3)	0.003
Through SMC	28/43 (65.1)	264/428 (61.7)	0.740
Wearing Protective clothing	5/43 (11.6)	38/428 (8.9)	0.580
Don't know	0/43 (0.0)	2/428 (0.5)	1.000
Other	2/43 (4.7)	9/428 (2.1)	0.270

(M): Multiple choice responses
%: Column percentages for multiple choice response questions
%: Row percentages for single choice response question

4.7.4 Adherence and awareness of the benefits of SMC

With respect to the association between adherence and awareness of the benefits of SMC, there was a statistical significance relationship between all the variables assessed except those whose source of information on SMC was TV and from friends.

Table 12: Association between adherence and awareness of the benefits of SMC

	Adherence to SMC administration		
	Non-adherence N=43	**Adherence N=428**	**Chi-square**
Characteristics	**n/N (%)**	**n/N (%)**	***p*-value**
Source of information on SMC (M)			
TV	5/43 (11.6)	208/428 (48.6)	<0.001
Radio	23/43 (53.5)	166/428 (38.8)	0.073
Community volunteer	39/43 (90.7)	338/428 (79.0)	0.073
Health worker	11/43 (25.6)	117/428 (27.3)	1.00
Friends	16/43 (37.2)	85/428 (19.9)	0.011
Worship place	2/43 (4.7)	47/428 (11.0)	0.29
Other	0/43 (0.0)	4/428 (0.9)	1.00
What season of the year is SMC given			0.85
Rainy season	41/445 (9.2)	404/445 (90.8)	
Dry season	0/5 (0.0)	5/5 (100.0)	
All year round	1/7 (14.3)	6/7 (85.7)	
Don't know	1/14 (7.1)	13/14 (92.9)	
What are the benefits of SMC			0.004
Prevent malaria in children under 5 years	29/400 (7.2)	371/400 (92.8)	
Treat malaria in children under 5 years	13/63 (20.6)	50/63 (79.4)	
Don't know	0/4 (0.0)	4/4 (100.0)	
Other	1/4 (25.0)	3/4 (75.0)	
Are there any problems with the SMC drug that you know			0.015
Yes	18/124 (14.5)	106/124 (85.5)	
No	25/347 (7.2)	322/347 (92.8)	
Are you happy with the SMC			<0.001
Yes	36/460 (7.8)	424/460 (92.2)	
No	7/11 (63.6)	4/11 (36.4)	
Will you advice people to let their child(ren) take the SMC medicine			<0.001
Yes	37/465 (8.0)	428/465 (92.0)	
No	6/6 (100.0)	0/6 (0.0)	

(M): Multiple choice responses
%: Column percentages for multiple choice response questions
%: Row percentages for single choice response question

4.7.5 Adherence to SMC and Community health volunteer factors

In the analysis below, the differences in adherence to SMC administration guidelines by caregivers in the Tamale central district were statistically significant with the variables which showed supportive care received from the volunteers. The variables "Did the volunteer observe the child take the first dose of the drug" (p=0.052), those who reported they identify the SMC volunteers through the SMC T-shirt (p=0.110), volunteers are members of the community (p=0.260) and other (p=1.00) ways of identification, were the only variables which failed to reach significance.

Table 13: Association between adherence to SMC and community volunteers related factors.

	Adherence to SMC administration		
	Non-adherence N=43	**Adherence N=428**	**Chi-square**
Characteristics	**n/N (%)**	**n/N (%)**	***p*-value**
Are you comfortable with volunteers coming to administer SMC to your child			<0.001
Yes	35/457 (7.7)	422/457 (92.3)	
No	8/14 (57.1)	6/14 (42.9)	
How do you identify SMC volunteers when they visit the house (M)			
They are members of the community	28/43 (65.1)	236/428 (55.1)	0.260
They wear SMC T-shirts	16/43 (37.2)	215/428 (50.2)	0.110
They wear ID tags	13/43 (30.2)	233/428 (54.4)	0.004
Volunteer self-introduction	32/43 (74.4)	209/428 (48.8)	0.001
Other	0/43 (0.0)	1/428 (0.2)	1.000
Did the volunteer observe the child take the first dose of the drug			0.052
Yes	38/446 (8.5)	408/446 (91.5)	
No	5/25 (20.0)	20/25 (80.0)	
Did the volunteer educate you on the adverse effects of the drug and how to manage it			0.046
Yes	36/432 (8.3)	396/432 (91.7)	
No	7/39 (17.9)	32/39 (82.1)	
Did the volunteer visit your house again after administering the first dose of SMC			<0.001
Yes	28/408 (6.9)	380/408 (93.1)	
No	15/63 (23.8)	48/63 (76.2)	
Are you satisfied with the work of the volunteer			<0.001
Yes	30/433 (6.9)	403/433 (93.1)	
No	13/38 (34.2)	25/38 (65.8)	

(M): Multiple choice responses
%: Column percentages for multiple choice response questions
%: Row percentages for single choice response question

4.8 Multivariate binary logistic regression analysis for adherence to SMC.

Table 14 below shows multivariate logistic regression analysis of the factors associated with adherence to SMC. For the adjusted odds ratio, secondary and tertiary education, those who reported the child refuses to play as effects of malaria, use of mosquito coil as a way of preventing child from malaria, those whose source of information on SMC is from friends, and those who are happy with SMC are found to affect adherence to the administration guidelines of SMC among caregivers.

The odds of adherence to SMC administration were 76% less among caregivers who were aware that child refusal to play is an effect of malaria (AOR: 0.24, 95% CI: 0.08-0.76, p=0.015). The odds of adherence to SMC administration were 80% less among caregivers who were aware the use of mosquito coil prevents a child from malaria (AOR: 0.20, 95% CI: 0.07-0.60, p=0.004).

The odds of adherence to SMC administration were 68% less among caregivers whose source of information on SMC was friends (AOR: 0.32, 95% CI: 0.13-0.76, p=0.010). Also, the odds of adherence to SMC administration were 93% less among caregivers who were happy with the SMC (AOR: 0.07, 95% CI: 0.01-0.47, p=0.007). (Table 14)

Table 14: Multivariable binary logistic regression model of factors associated with adherence to SMC among caregivers.

Characteristics	Adherence to SMC administration n/N (%)	Unadjusted model		Adjusted model	
		COR [95% CI]	*p*-value	AOR [95% CI]	*p*-value
Educational status					
No formal education	71/84 (84.5)	1.00 [reference]		1.00 [reference]	
Primary	67/72 (93.1)	2.45 [0.83, 7.26]	0.105	4.12 [0.87, 19.58]	0.075
JHS	78/88 (88.6)	1.43 [0.59, 3.46]	0.430	2.95 [0.89, 9.80]	0.078
Secondary	129/139 (92.8)	2.36 [0.98, 5.66]	0.054	6.17 [1.87, 20.33]	0.003
Tertiary	83/88 (94.3)	3.04 [1.03, 8.95]	0.044	7.41 [2.03, 27.00]	0.002
Knowledge level on malaria					
Low	317/335 (94.6)	1.00 [reference]		1.00 [reference]	
Moderate/High	111/136 (81.6)	0.25 [0.13, 0.48]	<0.001	1.90 [0.52, 6.88]	0.328
Known Signs and symptoms: The body feels warm					
No	58/68 (85.3)	1.00 [reference]		1.00 [reference]	
Yes	370/403 (91.8)	1.93 [0.90, 4.14]	0.089	2.11 [0.71, 6.22]	0.178
Known Signs and symptoms: Vomiting					
No	249/267 (93.3)	1.00 [reference]		1.00 [reference]	
Yes	179/204 (87.7)	0.52 [0.27, 0.98]	0.042	0.69 [0.29, 1.64]	0.398
Known Signs and symptoms: Headache					
No	259/273 (94.9)	1.00 [reference]		1.00 [reference]	
Yes	169/198 (85.4)	0.32 [0.16, 0.61]	0.001	1.08 [0.41, 2.82]	0.879
Known Signs and symptoms: Diarrhoea					
No	375/403 (93.1)	1.00 [reference]		1.00 [reference]	
Yes	53/68 (77.9)	0.26 [0.13, 0.53]	<0.001	1.17 [0.33, 4.18]	0.804
Effects of malaria on children: Child cannot go to school					
No	283/301 (94.0)	1.00 [reference]		1.00 [reference]	
Yes	145/170 (85.3)	0.37 [0.19, 0.70]	0.002	0.71 [0.30, 1.66]	0.428
Effects of malaria on children: Child refuse to play					
No	303/319 (95.0)	1.00 [reference]		1.00 [reference]	
Yes	125/152 (82.2)	0.24 [0.13, 0.47]	<0.001	0.24 [0.08, 0.76]	0.015
Prevent child from malaria: Use of mosquito sprays					
No	236/251 (94.0)	1.00 [reference]		1.00 [reference]	
Yes	192/220 (87.3)	0.44 [0.23, 0.84]	0.013	0.68 [0.28, 1.65]	0.395
Prevent child from malaria: Use of mosquito coil					
No	268/277 (96.8)	1.00 [reference]		1.00 [reference]	
Yes	160/194 (82.5)	0.16 [0.07, 0.34]	<0.001	0.20 [0.07, 0.60]	0.004

Characteristics	Adherence to SMC administration n/N (%)	Unadjusted model		Adjusted model	
		COR [95% CI]	*p*-value	AOR [95% CI]	*p*-value
Prevent child from malaria: Wearing Protective clothing					
No	371/400 (92.8)	1.00 [reference]		1.00 [reference]	
Yes	57/71 (80.3)	0.32 [0.16, 0.64]	0.001	0.48 [0.16, 1.44]	0.187
Prevent self from malaria: Use of mosquito coil					
No	281/299 (94.0)	1.00 [reference]		1.00 [reference]	
Yes	147/172 (85.5)	0.38 [0.20, 0.71]	0.003	0.74 [0.30, 1.82]	0.507
Source of information on SMC: TV					
No	220/258 (85.3)	1.00 [reference]		1.00 [reference]	
Yes	208/213 (97.7)	7.19 [2.77, 18.63]	<0.001	2.51 [0.77, 8.16]	0.126
Source of information on SMC: Radio					
No	262/282 (92.9)	1.00 [reference]		1.00 [reference]	
Yes	166/189 (87.8)	0.55 [0.29, 1.04]	0.064	1.06 [0.41, 2.77]	0.900
Source of information on SMC: Friends					
No	343/370 (92.7)	1.00 [reference]		1.00 [reference]	
Yes	85/101 (84.2)	0.42 [0.22, 0.81]	0.010	0.32 [0.13, 0.76]	0.010
SMC prevent child from getting malaria					
No	57/71 (80.3)	1.00 [reference]		1.00 [reference]	
Yes	371/400 (92.8)	3.14 [1.57, 6.31]	0.001	1.02 [0.31, 3.42]	0.973
Are there any problems with the SMC drug that you know					
Yes	106/124 (85.5)	1.00 [reference]		1.00 [reference]	
No	322/347 (92.8)	2.19 [1.15, 4.17]	0.017	2.37 [0.97, 5.82]	0.059
Are you happy with the SMC					
Yes	424/460 (92.2)	1.00 [reference]		1.00 [reference]	
No	4/11 (36.4)	0.05 [0.01, 0.17]	<0.001	0.07 [0.01, 0.47]	0.007
Are you comfortable with volunteers coming to administer SMC to your child					
Yes	422/457 (92.3)	1.00 [reference]		1.00 [reference]	
No	6/14 (42.9)	0.06 [0.02, 0.19]	<0.001	0.96 [0.12, 7.71]	0.973
Identify SMC volunteer: They wear SMC T-shirts					
No	213/240 (88.8)	1.00 [reference]		1.00 [reference]	
Yes	215/231 (93.1)	1.70 [0.89, 3.25]	0.107	0.56 [0.22, 1.43]	0.228
Identify SMC volunteer: They wear ID tags					
No	195/225 (86.7)	1.00 [reference]		1.00 [reference]	
Yes	233/246 (94.7)	2.76 [1.40, 5.44]	0.003	2.27 [0.88, 5.90]	0.092
Identify SMC volunteer: Volunteer self-introduction					
No	219/230 (95.2)	1.00 [reference]		1.00 [reference]	
Yes	209/241 (86.7)	0.33 [0.16, 0.67]	0.002	0.43 [0.16, 1.17]	0.097

Characteristics	Adherence to SMC administration n/N (%)	Unadjusted model		Adjusted model	
		COR [95% CI]	*p*-value	AOR [95% CI]	*p*-value
Did the volunteer educate you on the adverse effects of the drug and how to manage it					
Yes	396/432 (91.7)	1.00 [reference]		1.00 [reference]	
No	32/39 (82.1)	0.42 [0.17, 1.01]	0.052	1.08 [0.28, 4.11]	0.908
Did the volunteer visit your house again after administering the first dose of SMC					
Yes	380/408 (93.1)	1.00 [reference]		1.00 [reference]	
No	48/63 (76.2)	0.24 [0.12, 0.47]	<0.001	0.58 [0.21, 1.59]	0.293
Are you satisfied with the work of the volunteer					
Yes	403/433 (93.1)	1.00 [reference]		1.00 [reference]	
No	25/38 (65.8)	0.14 [0.07, 0.31]	<0.001	0.37 [0.08, 1.75]	0.210

COR: crude odds ratio. AOR: adjusted odds ratio. CI: confidence interval

CHAPTER FIVE

5.0 Discussion

The study was conducted in eight communities within four sub-districts in the Tamale Central District of the Northern Region of Ghana. Within the period that the study was conducted, the last round of the SMC campaign of 2022 has ended. Adherence was assessed in those caregivers who have received and administered all three-day doses of the SMC drug to their children during the last campaign (October 2022). The study revealed that higher education, knowledge on the effects and prevention methods for malaria, source of information on SMC, and satisfaction level of caregivers with SMC, significantly associated with adherence to the three-day dose of SMC.

5.1 Adherence to SMC

The adherence rate as assessed by those caregivers who administered both the second-day and third-day doses of the SMC drug to their children after receiving the first-day dose from the CHVs during the last round of the 2022 SMC campaign, was 90.9%. A similar adherence rate (95.36%) was recently reported from cross-sectional studies conducted in the Builsa North District in the Upper East region of Ghana (Doumbia, C. O., 2021). In our study, 95.3% of caregivers reported administering the second-day medication, whiles 91.7% reported administering the third-day medication. Forgetfulness was reported the main reason by 75 out the 115 caregivers who missed SMC doses. Other reasons included the bitter taste of the drug, Side effects of the drug, and child refusing to take drug. In Mali, Diawara et al., (2017) reported similar proportion of caregivers who administered the second-day (97.5%) and third-day (94.8%) doses of SMC and similar reasons for missing SMC doses. Somé et al., 2022 also reported low proportions of non-adherence in Burkina Faso, Mali, and Niger. The factors associated with non-adherence include travel of parents, illness

of child, vomiting, child refusing to swallow medicine, forgetfulness. A randomized clinical trial conducted in the Ashanti region of Ghana, Tagbor et al., 2016 reported close to 100% adherence to the three day course of SMC. But in the qualitative component of their study, it proved to be unlikely as caregivers were found with unadministered SMC drug (Tagbor et al., 2016). Self-reported adherence has always showed to be higher compared to other methods of measuring adherence (Bruxvoort et al., 2015).

In a longitudinal study conducted in Nigeria, Ward et al., (2019) found a lower adherence rate of 83.8%. These differences in proportions could be due to the different methods of calculating adherence. Also, it could be because of improvements in the SMC intervention over the years of implementation. The fact that malaria infections in these areas have reduced over the years partly due to the SMC program might have increased acceptability and fidelity to the administration protocol of SMC.

5.2 Sociodemographic characteristics

The only sociodemographic factor that showed a significant association with adherence to SMC was the educational qualification of respondents. Those with secondary and tertiary education were respectively 6 times and 7 times more likely to adhere to the 3-day dose of SMC compared to those with no formal education. Age, marital status, occupation, and religion showed no statistically significant association with adherence to SMC, similar to what Doumbia, C. O., (2021) found in their study. That there was no significant association between adherence to SMC and the sociodemographic characteristics assessed except the household size of respondents. In their study, those with a household size of more than 5 people were likely to adhere to SMC. The results suggest that these sociodemographic factors may not be the focus when prioritizing SMC

interventions. In this study those with no formal education were the least to adhere, and this could be explained as illiteracy poses a threat to healthcare and hence less commitment to healthy livng. Asingizwe et al., (2015) reported a similar outcome in Rwanda, presenting that the level of education, knowledge, and attitudes exhibited a statistically significant association with adherence. From their study, Asingizwe et al. (2015) noted that respondents with less education were more likely to have poor practices towards the disease and adherence to the use of medication for healing it, same for negative attitudes compared to those with high education. Formal education is hereby an important factor that positively influences the level of adherence in the administration of the SMC and even for general health decisions, especially female education, according to Amu et al., (2018). This, among other factors, feeds into the reasons for non-adherence to SMC as a preventive measure for Malaria.

5.3 Knowledge of caregivers on malaria

According to the results obtained from the study, it was observed that the majority of the caregivers had low knowledge on Malaria, as 28.9 percent of the respondents in the sub-districts reported moderate to high knowledge of malaria. This inadequacy in knowledge might have accounted for the high prevalence of malaria in Northern Ghana. Meanwhile, majority of respondents still reported the bite of infected mosquitoes as the cause of malaria. The major known sign and symptoms of malaria reported was the body feeling of warmness. Though consistent with the WHO's symptoms for Malaria, respondents less identified other key signs and symptoms of malaria. Furthermore, the results indicate that ITNs were the mainly known approach to preventing themselves from malaria, and using insecticide sprays and coils. Yet, some respondents reported not to know any preventive measures to preventing exposure to Malaria, an indication that further

education was necessary to reduce the mosquito bites. The general preventive measures were consistent with their knowledge for preventing children from getting infected with malaria. However, significantly, 65 percent of the respondents added that the SMC was also a known measure to prevent their children from malaria, and this is similar to the findings in Mazigo et al., (2010) and Ingabire (2015) on the knowledge of SMC and Malaria. This result, although significant, indicates that there are unreached caretakers on the effectiveness of the SMC for Malaria prevention in children under 5 years. Adequate knowledge and understanding in the use of SMC is necessary for commitment and adherence to SPAQ (Doumbia, 2021). Adongo et al., (2005) revealed that local people have low biomedical knowledge on the concept of Malaria, however, live with their own traditional definitions and perceptions about Malaria, which has been created over time. The finding from this study, therefore, that caregivers who report their child refuse to play as the effect of malaria, and those who report use of mosquito coil as a way of preventing their child from malaria were likely not to adhere to SMC is acceptable. In Nigeria Bavel et al., 2020 found that knowledge of the causes, signs and symptoms and preventive measures of a disease is associated with adherence to preventive measures implemented by authorities.

5.4 Knowledge of caregivers on malaria by sub-district

Tishegu was the only sub-district that reported a high level of knowledge of Malaria, as well as the greatest percentage with a medium level of knowledge. This result looked challenging because the most educated sub-districts, Lamashegu and Changli had no report of high level of knowledge on Malaria. Further research in these sub-districts is necessary to ascertain the reason for this development. Meanwhile, unfortunately, a significant 30 percent of resident respondents in

Gumbihini sub-district held to the ancestral cause of Malaria, believing that ancestors could inflict children and other individuals with Malaria. Such knowledge, coupled with the 71.1 percent low level of knowledge about Malaria is an indication of inadequate education on the causes and effects of Malaria in the District. The results hereby explain why within the same sub-district, Gumbihini, the use of SMC for preventing Malaria was the lowest, of about 25.3 percent, unlike 90.1 percent in Lamashegu, 75.2 percent in Changli, and 68.4 percent in Tishegu. Objectively, of all the preventive measures, use of ITNs, insecticide sprays, and even coils, Gumbihini fell below 50 percent usage and knowledge of these measures.

5.5 Source of information on SMC

The study results suggest that those whose source of information on SMC is from friends are likely not to adhere to SMC, and this is consistent with other studies (Doumbia, C. O. (2021). The perceptual factors highlighted by Doumbia, C. O., 2021 could be the same reasons that accounted for this observation. A lot of our people have doubts about things that are given to them freely including medications. Rumors continue to affect mass drug administrations and this finding is thus acceptable. Dissemination of information on SMC, therefore should form a critical component of the implementation process. Caregivers with positive testimonies about SMC should be made ambassadors to champion the social and behavioral change communication (SBCC) process to complement other methods of information. In this study 80% of the respondents said their source of information on SMC was from the community health volunteer. In Nigeria, Richardson et al., 2020 found that the role of SMC drug distributors were associated with all outcomes investigated in their study and consistent with the observations by other studies that the effectiveness of health

messaging is influenced by perceptions of credibility people have about health promoters which affects their adherence to the messages delivered to them (While, 2015).

5.6 Community health volunteer factors

In our study 97% of the respondents reported they were comfortable with the volunteers coming to their homes to administer the SMC drug. Caregivers in the urban Tamale central district, mainly traders, farmers, and formal sector workers would have found it challenging to go for the SMC medicines at the health facilities and preferred the volunteers coming to administer the medicines at their homes. The volunteers not visiting caregivers subsequently after the first-day dose as reported by about 13.4 percent of the respondents, can be attributed to the reasons why caregivers mainly forgot to administer the drug on the second and third day. Elsewhere in Africa, caregivers responded their children would not accept the medicine if they are to administer it themselves and preferred that the volunteers administer it (Ward et al., 2022). Similar reason might have influenced caregivers comfort with the community health volunteers in this study.

5.7 Reasons for non-adherence to SMC

Adverse drug reactions like diarrhoea, vomiting, fever, and weakness were cited by caregivers as problems with SMC. These side effects coupled with child refusal to take the drug because of the bitter taste, among other factors, might explain the reduction in the proportion of caregivers administering the drug on the second and third day. About 26.3% of caregivers were dissatisfied with SMC because of these adverse drug reactions. This is much higher than what is reported in other studies (Ansah et al., 2021a). These symptoms were however mild and resolved within days.

It did not stop the majority of caregivers from completing the three-day treatment course and this could be because of the community volunteers educating them on the adverse drug reaction and how to manage them. Caregivers in this study responded they were happy with the SMC and would advise others to let their children take the SMC drug. These opinions were significantly related to adherence, with 92% of the respondents who are happy with SMC more likely to adhere to the three-day course of the SMC drug. A study in Mali by (Diawara et al., 2017) found similar positive opinions of parents about SMC. They opined that the positive opinions and strong support will guarantee the continuation and scale-up of the SMC program (Diawara et al., 2017).

5.8 Strengths

To the best of my knowledge, this study is one of the limited studies on SMC conducted in the Tamale metropolis in the Northern Region of Ghana to assess adherence to SMC.

As with any observational study, there is the possibility of selection bias. Participants in this study were randomly selected to eliminate this bias.

5.9 Limitations

The results were based on responses and opinions of sampled representative of the Tamale Central District and not for the entire Tamale Metropolis and Northern region of Ghana. Generalizability can only be made to the sampled population and not the regional and national level.

Self-reported adherence has always showed to be higher compared to other standard methods of measuring adherence, and this should be considered when interpreting the findings of this study.

The potential of recall bias as with any observational study might have found its way in the present study even though the study was conducted few weeks after the last round of the 2022 SMC exercise.

5.10 Conclusion

The study found an adherence rate to SMC administration protocol of 90.9% in the Tamale Central District. These caregivers administered all three-day doses of the SMC drug during the last round of the October 2022 SMC campaign. Non-adherence was associated mainly with the forgetfulness of caregivers to administer the second-day and third-day doses, vomiting, fever, weakness, diarrhoea, and some children's refusal to take medicine. This obviously resulted in a reduction in the proportion of caregivers who administered the second- and third-day medicines to their children.

The study shows that respondents with secondary and tertiary education were more likely to adhere to SMC compared to their counterparts with no formal education. All other sociodemographic characteristics showed no significant association with adherence to a three-day dose of SMC.

There was varying knowledge of malaria reported by caregivers. The subdistricts which recorded the highest score on educational qualification did not show corresponding effects on their knowledge of malaria. Knowledge on the causes, signs and symptoms, effects, and prevention of malaria was generally low.

Although less than half of the respondents correctly stated the minimum age required for the SMC drug, almost of all of them knew the drug was given in the raining season. Caregivers were aware of the benefits of SMC and reported it was used for the prevention of malaria. However, those who reported problems with SMC were likely not to adhere.

The Tamale Central District has shown trust in the work of the volunteers as evidence by the report of almost all the caregivers being happy with the work of the volunteers. The source of information on SMC from majority of these caregivers, is from CHVs. Those who had alternative source of information on SMC like from friends had less odds of adherence to the three-day dose of SMC.

The adherence rate to SMC is good in the Tamale Central District. But our study has identified some factors that affect adherence. Strategies should be put in place to consolidate these gains and ensure that the SMC program achieves its purpose of reducing malaria morbidity and mortality in children below 5 years.

5.11 Recommendation

Based on the results of the study, we recommend the following:

1. The Tamale Metropolitan Health Management Team should strengthen education and sensitization campaign on SMC and malaria in communities in the Tishegu and Gumbihini Subdistricts especially, as they recorded the lowest score on adherence and knowledge of malaria respectively. This can be done through health facilities, and through the media space- local and mass media before and during the SMC period. The education should highlight the importance of the SMC drug as a preventive instead of a curative drug for malaria, facilitators and barriers to uptake of SMC, the possible adverse drug reactions (ADRs) and how to manage and report ADRs, and the need to complete the full treatment course of SMC.
2. SMC program coordinators and supervisors should strengthen monitoring and supervision of the CHVs during campaigns to ensure they diligently perform their part of the SMC

administration protocol. If possible, supervision should be intensified at the community level - specific supervisors should be assigned to specific volunteers, who will be responsible and accountable to the district. This will maximize their work output and associated benefits of improved uptake.

3. The study results show there is the trust of the community in the CHVs. Therefore, public health authorities should make it intentional to recruit and deploy CHVs as conduits to disseminating public health messages to the community.
4. Future research involving more SMC implementing areas using both qualitative and quantitative methods to investigate other factors within Subdistricts that may influence, and proffer solutions and evidence that propels authorities to improve and sustain the SMC program nationwide and beyond.

References

Ansah, P. O., Ansah, N. A., Malm, K., Awuni, D., Peprah, N., Dassah, S., Yarig, S., Manful, C., Agbenyeri, J., Awoonor-Williams, J., Ofosu, W., & Oduro, A. R. (2021a). Evaluation of pilot implementation of seasonal malaria chemoprevention on morbidity in young children in Northern Sahelian Ghana. *Malaria Journal*, *20*(1), 1–10. https://doi.org/10.1186/s12936-021-03974-x

Ansah, P. O., Ansah, N. A., Malm, K., Awuni, D., Peprah, N., Dassah, S., Yarig, S., Manful, C., Agbenyeri, J., Awoonor-Williams, J., Ofosu, W., & Oduro, A. R. (2021b). Evaluation of pilot implementation of seasonal malaria chemoprevention on morbidity in young children in Northern Sahelian Ghana. *Malaria Journal*, *20*(1), 1–17. https://doi.org/10.1186/s12936-021-03974-x

Antwi, G. D., Bates, L. A., King, R., Mahama, P. R., Tagbor, H., Cairns, M., & Newell, J. N. (2016). Facilitators and barriers to uptake of an extended seasonal malaria chemoprevention programme in Ghana: A qualitative study of caregivers and community health workers. *PLoS ONE*, *11*(11), 1–18. https://doi.org/10.1371/journal.pone.0166951

Adongo, P. B., Kirkwood, B., & Kendall, C. (2005). How local community knowledge about malaria affects insecticide-treated net use in northern Ghana. Tropical Medicine & International Health, 10(4), 366-378.

Antwi, G. D., Bates, L. A., King, R., Mahama, P. R., Tagbor, H., Cairns, M., & Newell, J. N. (2016). Facilitators and barriers to uptake of an extended seasonal malaria chemoprevention programme in Ghana: a qualitative study of caregivers and community health workers. PLoS One, 11(11), e0166951.

Asingizwe, D., Rulisa, S., Asiimwe-Kateera, B., & Kim, M. J. (2015). Malaria elimination practices in rural community residents in Rwanda: A cross-sectional study. Rwanda Journal, 2(1), 53-59.

Amu, H., Dickson, K. S., Kumi-Kyereme, A., & Darteh, E. K. M. (2018). Understanding variations in health insurance coverage in Ghana, Kenya, Nigeria, and Tanzania: evidence from demographic and health surveys. PloS one, 13(8), e0201833.

Baba, E., Hamade, P., Kivumbi, H., Marasciulo, M., Maxwell, K., Moroso, D., Roca-Feltrer, A.,

Sanogo, A., Stenstrom Johansson, J., Tibenderana, J., Abdoulaye, R., Coulibaly, P., Hubbard, E., Jah, H., Lama, E. K., Razafindralambo, L., Van Hulle, S., Jagoe, G., Tchouatieu, A. M., … Milligan, P. (2020). Effectiveness of seasonal malaria chemoprevention at scale in west and central Africa: an observational study. *The Lancet*, *396*(10265), 1829–1840. https://doi.org/10.1016/S0140-6736(20)32227-3

Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., … Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, *4*(5), 460–471. https://doi.org/10.1038/s41562-020-0884-z

Baiden, F., Malm, K., Bart-Plange, C., Hodgson, A., Chandramohan, D., Webster, J., & Owusu-Agyei, S. (2014). Shifting from presumptive to test-based management of malaria-technical basis and implications for malaria control in Ghana. Ghana medical journal, 48(2), 112-122.

Berthold, S. M., & Libal, K. (2016). Migrant children's rights to health and rehabilitation: A primer for US social workers. *Journal of Human Rights and Social Work*, *1*(2), 85-95.

Cairns, M., Roca-feltrer, A., Garske, T., Wilson, A. L., Diallo, D., Milligan, P. J., Ghani, A. C., & Greenwood, B. M. (2012). *of seasonal malaria chemoprevention in*. https://doi.org/10.1038/ncomms1879

Chatio, S., Ansah, N. A., Awuni, D. A., Oduro, A., & Ansah, P. O. (2019). Community acceptability of Seasonal Malaria Chemoprevention of morbidity and mortality in young children: A qualitative study in the Upper West Region of Ghana. *PLoS ONE*, *14*(5), 1–12. https://doi.org/10.1371/journal.pone.0216486

Cowman, A. F., Healer, J., Marapana, D., & Marsh, K. (2016). Malaria: Biology and Disease. *Cell*, *167*(3), 610–624. https://doi.org/10.1016/j.cell.2016.07.055

Coldiron, M. E., Von Seidlein, L., & Grais, R. F. (2017). Seasonal malaria chemoprevention: successes and missed opportunities. *Malaria journal*, *16*(1), 1-4.Somé, A. F., Zongo, I., Sagara, I., Ibrahim, A., Ahanhanzo, C. D., Agbanouvi-agassi, E. E., Sayi, D. A., Toe, L. P., Kabré, Z., Nikiéma, F., Bazié, T., Ouédraogo, S., Sombié, I., Dicko, A., Adehossi, E., Ouédraogo, J. B., & Dabiré, K. R. (2022). Factors Influencing Second and Third Dose Observance during Seasonal Malaria Chemoprevention (SMC): A Quantitative Study in Burkina Faso, Mali and Niger. *Tropical Medicine and Infectious Disease*, *7*(9).

https://doi.org/10.3390/tropicalmed7090214

Diawara, F., Steinhardt, L. C., Mahamar, A., Traore, T., Kone, D. T., Diawara, H., Kamate, B., Kone, D., Diallo, M., Sadou, A., Mihigo, J., Sagara, I., Djimde, A. A., Eckert, E., & Dicko, A. (2017). Measuring the impact of seasonal malaria chemoprevention as part of routine malaria control in Kita, Mali. *Malaria Journal*, *16*(1), 325. https://doi.org/10.1186/s12936-017-1974-x

Ding, J., Coldiron, M. E., Assao, B., Guindo, O., Blessborn, D., Winterberg, M., Grais, R. F., Koscalova, A., Langendorf, C., & Tarning, J. (2020). Adherence and Population Pharmacokinetic Properties of Amodiaquine When Used for Seasonal Malaria Chemoprevention in African Children. *Clinical Pharmacology and Therapeutics*, *107*(5), 1179–1188. https://doi.org/10.1002/cpt.1707

Deccache, A. (1995). Teaching, training, or educating patients? Influence of contexts and models of education and care on practice in patient education. Patient education and counseling, 26(1-3), 119-129.

Dieng, C. C., Gonzalez, L., Pestana, K., Dhikrullahi, S. B., Amoah, L. E., Afrane, Y. A., & Lo, E. (2019). Contrasting asymptomatic and drug resistance gene prevalence of Plasmodium falciparum in Ghana: implications on seasonal malaria chemoprevention. Genes, 10(7), 538.

Doumbia, C. O. (2021). Coverage and Factors Associated with the Adherence to Unsupervised Daily Treatment Doses to Seasonal Malaria Chemoprevention in Builsa North District, Upper East Region of Ghana (Doctoral dissertation, U. of G. (2021). *Doumbia, C. O. (2021). Coverage and Factors Associated with the Adherence to Unsupervised Daily Treatment Doses to Seasonal Malaria Chemoprevention in Builsa North District, Upper East Region of Ghana (Doctoral dissertation, University of Ghana)*. (Issue June).

Druetz, T., Corneau-Tremblay, N., Millogo, T., Kouanda, S., Ly, A., Bicaba, A., & Haddad, S. (2018). Impact evaluation of seasonal malaria chemoprevention under routine program implementation: A quasi-experimental study in Burkina Faso. *American Journal of Tropical Medicine and Hygiene*, *98*(2), 524–533. https://doi.org/10.4269/ajtmh.17-0599

Fuseini, I., & Kemp, J. (2016). Characterising urban growth in Tamale, Ghana: An analysis of urban governance response in infrastructure and service provision. *Habitat International*, *56*, 109–123. https://doi.org/10.1016/j.habitatint.2016.05.002

Ghana Health Service (2009). Anti-Malaria Drug Policy 2009.

Ghana Health Service (2016) National Malaria Control Programme. Roll back malaria 2016, issue 8.

Gilmore, B., & McAuliffe, E. (2013). Effectiveness of community health workers delivering preventive interventions for maternal and child health in low-and middle-income countries: a systematic review. *BMC public health*, *13*(1), 1-14.

Ingabire, C. M., Rulisa, A., Van Kempen, L., Muvunyi, C., Koenraadt, C. J., Van Vugt, M., ... & Alaii, J. (2015). Factors impeding the acceptability and use of malaria preventive measures: implications for malaria elimination in eastern Rwanda. *Malaria Journal*, *14*(1), 1-11.

Imboumy-Limoukou, R. K., Maghendji-Nzondo, S., Ondo-Enguier, P. N., Niemczura De Carvalho, J., Tsafack-Tegomo, N. P., Buekens, J., ... & Lekana-Douki, J. B. (2020). Malaria in children and women of childbearing age: infection prevalence, knowledge and use of malaria prevention tools in the province of Nyanga, Gabon. Malaria journal, 19(1), 1-8.

Kok, M. C., Kane, S. S., Tulloch, O., Ormel, H., Theobald, S., Dieleman, M., ... & de Koning, K. A. (2015). How does context influence performance of community health workers in low- and middle-income countries? Evidence from the literature. Health research policy and systems, 13(1), 1-14.

Kuule, Y., Dobson, A. E., Woldeyohannes, D., Zolfo, M., Najjemba, R., Edwin, B. M. R. ... & Wilkinson, E. (2017). Community health volunteers in primary healthcare in rural Uganda: factors influencing performance. Frontiers in public health, 5, 62.

Koon, A. D., Goudge, J., & Norris, S. A. (2013). A review of generalist and specialist community health workers for delivering adolescent health services in sub-Saharan Africa. *Human Resources for Health*, *11*(1), 1-9.

Koko, D. C., Maazou, A., Jackou, H., & Eddis, C. (2022). Analysis of attitudes and practices influencing adherence to seasonal malaria chemoprevention in children under 5 years of age in the Dosso Region of Niger. *Malaria Journal*, 1–10. https://doi.org/10.1186/s12936-022-04407-z

Lehman, U., & Sanders, D. (2007). Community health workers: What do we know about them? The state of the evidence on programmes, activities, costs and impact on health outcomes of using community health workers. *World Health Organization: Evidence and Information for Policy, Department of Human Health Geneva*.

Mazigo, H. D., Obasy, E., Mauka, W., Manyiri, P., Zinga, M., Kweka, E. J., ... & Heukelbach, J. (2010). Knowledge, attitudes, and practices about malaria and its control in rural northwest Tanzania. *Malaria Research and Treatment, 2010*.

Mutamba, B. B., van Ginneken, N., Smith Paintain, L., Wandiembe, S., & Schellenberg, D. (2013). Roles and effectiveness of lay community health workers in the prevention of mental, neurological and substance use disorders in low and middle income countries: a systematic review. *BMC health services research, 13*(1), 1-11.

Menach, A. (2019a). Seasonal malaria chemoprevention packaged with Malnutrition University of Ghana http://ugspace.ug.edu.gh84prevention in northern Nigeria: A pragmatic trial (SMAMP study) with nested case-control. PLoS ONE, 14(1). https://doi.org/10.1371/journal.pone.0210692

Nonvignon, J., Aryeetey, G. C., Issah, S., Ansah, P., Malm, K. L., Ofosu, W., ... & Aikins, M. (2016). Cost-effectiveness of seasonal malaria chemoprevention in upper west region of Ghana. *Malaria Journal*, *15*(1), 1-13.

Orok, A. B., Ajibaye, O., Aina, O. O., Iboma, G., Adagyo Oboshi, S., & Iwalokun, B. (2021). Malaria interventions and control programes in Sub-Saharan Africa: A narrative review. *Cogent Medicine*, *8*(1). https://doi.org/10.1080/2331205x.2021.1940639

Okuboyejo, S., & Eyesan, O. (2014). mHealth: using mobile technology to support healthcare. *Online journal of public health informatics*, *5*(3).

Pell, C., Tripura, R., Nguon, C., Cheah, P., Davoeung, C., Heng, C. … Peto, T. J. (2017). Mass antimalarial administration in western Cambodia: a qualitative study of factors affecting coverage. Malaria Journal, 16(1). https://doi.org/10.1186/s12936-017-1854-4

Richardson, S., Ibinaiye, T., Nikau, J., Oresanya, O., Marasciulo, M., Roca-Feltrer, A., Rassi, C., & Adesoro, O. (2020). COVID-19 knowledge, beliefs, prevention behaviours and misinformation in the context of an adapted seasonal malaria chemoprevention campaign in six northern Nigerian States. *Tropical Medicine and Health, 48*(1). https://doi.org/10.1186/s41182-020-00288-7

Roschnik, N., Diarra, H., Dicko, Y., Diarra, S., Stanley, I., Moestue, H., … Clarke, S. E. (2019). Adherence and acceptability of community-based distribution of micronutrient powders in Southern Mali. Maternal and Child Nutrition, 15. https://doi.org/10.1111/mcn.12831

Severe Malaria Observatory, 2021. severemalaria.org

Stelmach, R., Colaço, R., Lalji, S., McFarland, D., & Reithinger, R. (2018). Cost-effectiveness of indoor residual spraying of households with insecticide for malaria prevention and control in Tanzania. *American Journal of Tropical Medicine and Hygiene*, *99*(3), 627–637. https://doi.org/10.4269/ajtmh.17-0537

Sylla, K., Kouly Tine, R. C., Sow, D., NDiaye, M., Sarr, A., Tshibola Mbuyi, M. L., Louis Abdourahim Ndiaye, I. D. J., NDiaye, D., Gaye, O., & Faye, B. (2017). Effect of Seasonal Malaria Chemoprevention (SMC) with SulfadoxinePyrimethamine (SP) and Amodiaquine (AQ) on the Acquisition of antiAMA1 and anti-MSP1_42 Antibodies among Children under 10 Years Living in the Southern part of Senegal (Velingara). *Malaria Control & Elimination*, *06*(01), 1–7. https://doi.org/10.4172/2470-6965.1000155

Tagbor, H., Antwi, G. D., Acheampong, P. R., Bart Plange, C., Chandramohan, D., & Cairns, M. (2016). Seasonal malaria chemoprevention in an area of extended seasonal transmission in Ashanti, Ghana: an individually randomised clinical trial. *Tropical Medicine and International Health*, *21*(2), 224–235. https://doi.org/10.1111/tmi.12642

Thomas S Churcher, Natalie Lissenden, Jamie T Griffin, Eve Worrall, Hilary Ranson (2016) The impact of pyrethroid resistance on the efficacy and effectiveness of bednets for malaria control in Africa eLife 5:e16090

https://doi.org/10.7554/eLife.16090

USAID President's Malaria Initiative FY 2020 Ghana Malaria Operational Plan

USAID President's Malaria Initiative FY 2021 Ghana Malaria Operational Plan

Varo, R., Chaccour, C., & Bassat, Q. (2020). Update on malaria. *Medicina Clínica (English Edition)*, *155*(9), 395–402. https://doi.org/10.1016/j.medcle.2020.05.024

Ward, C., Phillips, A., Oresanya, O., Olisenekwu, G., Arogunade, E., Moukénet, A., Beakgoubé, H., De Paul Allambademel, V., Compaoré, C. S., Traoré, A., Ouedraogo, J. B., Compaoré, Y. D., Zongo, I., Donovan, L., Decola, M. A., Smith, H., & Baker, K. (2022). Delivery of seasonal malaria chemoprevention with enhanced infection prevention and control measures during the COVID-19 pandemic in Nigeria, Burkina Faso and Chad: a cross-sectional study. *Malaria Journal*, *21*(1), 1–24. https://doi.org/10.1186/s12936-022-04091-z

While, A. E. (2015). Promoting healthy behaviours – Do we need to practice what we preach? *London Journal of Primary Care*, *7*(6), 112–114.

https://doi.org/10.1080/17571472.2015.1113716

WHO (2020). WHO 2019 malaria report. *Global Malaria Programmed*, *2011*, 1–4.

WHO, Malaria Fact Sheet, 2021. https://www.who.int/en/news-room/fact- sheets/detail/malaria, 6TH December 2021

World Health Organization. (2021). World malaria report 2021.

WHO (2022). World Malaria Report.

Ward, A., Guillot, A., Nepomnyashchiy, L. E., Graves, J. C., Maloney, K., Omoniwa, O. F., … le

WHO (2022). World Malaria Report.

World Health Organization (2021). What do we know about community health workers? A systematic review of existing reviews. Geneva.

World Health Organization (2022). Updated WHO recommendations for malaria chemoprevention among children and pregnant women. Geneva: WHO.

World Health Organization. WHO policy recommendation: seasonal malaria chemoprevention (SMC) for Plasmodium falciparum malaria control in highly seasonal transmission areas of the Sahel sub-region in Africa. Geneva: WHO; 2012.

Wongsrichanalai, C., Pickard, A. L., Wernsdorfer, W. H., & Meshnick, S. R. (2002). Epidemiology of drug-resistant malaria. The Lancet infectious diseases, 2(4), 209-218.

York A. (2017) Seasonal malaria chemoprevention in the Sahel. Lancet Infect Dis.17:588.

APPENDICES

APPENDIX 1: Research Timelines

Table 1: Study timelines

ACTIVITY	MAR. 2022	APR. 2022	MAY 2022	JUNE 2022	JULY 2022	AUG. 2022	SEPT. 2022	OCT. 2022	NOV. 2022	DEC. 2022
Proposal development										
Submission of protocol For ethical approval										
Ethical Approval										
Data Collection										
Data management and Analysis										
Report writing, Proof Reading and Supervisor consultation										
Submission of revised dissertation to department										

APPENDIX 2: Budget

Table 2: Proposed budget

Activity	**Description**	**Cost (GHC)**
Transportation	Transportation of research assistance and PI to and from enumeration areas	1,000
Research Assistants	Stipends for research assistants	1,600
Covid-19 safety protocol	Cost of facemask, hand sanitizers	500
Data analysis/Report writing	Services of a biostatistician/data analyst in the data analysis and report writing process	1,000
Stationary, Printing and Binding	Printing of Protocol, Questionnaire, Thesis	500
Miscellaneous	Unforeseen expenses	1,000
Total		5,600

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APPENDIX 3: PARTICIPANT'S INFORMATION SHEET AND CONSENT FORM

PART I: PARTICIPANT'S INFORMATION SHEET

Research Title: Adherence to the administration guidelines of the seasonal malaria chemoprevention by caregivers in the Tamale central district.

Name of Researcher: Mohammed Shamsudeen Fuseini

Introduction

I am a Master of Public Health (MPH) student at the University of Ghana conducting research on "Adherence to the administrative guidelines of the seasonal malaria chemoprevention by caregivers in the Tamale central district" as part of the requirement for the award of the MPH degree. I am inviting you to participate in this study which is entirely voluntary. The details of this consent form will help you understand what the study is about.

Background

Seasonal Malaria Chemoprevention involves the administration of full treatment doses of antimalaria medicines to children age 3 months to 59 months during the malaria season to prevent them from malaria infections and maintain therapeutic antimalarial drug concentration in the blood. It is done in the rainy season during which period Volunteers move from house to house to give these medicines. The drug has proven to be effective in the prevention of malaria in children

and it is for this reason we want to how caregivers adhere to this program SMC. I therefore seek your consent to undertake this research.

Purpose of the Study

The study aims to assess the factors influencing adherence to the administration protocol of Seasonal Malaria Chemoprevention among caregivers in the Tamale central district.

Procedure of the Study

Interviews will be conducted with participants which will last for about 30 minutes to obtain information that will be used to assess adherence to the administrative protocol of SMC. COVID-19 protocols such as wearing of nose mast, regular hand washing, use of alcohol-based hand sanitizers, and ensuring physical distance will be observed by both research assistants and participants.

Potential Risk

Participants in this study are likely to be exposed to minimal risk. It is the duty of the research team to reduce this risk as much as possible. As a result, you will be required to always observe the COVID-19 safety protocols during the course of the interview

Benefits

There are no direct benefits for participating in this study, however, findings of the study will help authorities to adapt and improve upon the SMC program which will inure to the benefits of respondents in the long run.

Costs or Payments to Subjects

There will be no costs incurred by participants in the research the same way you will not be paid to participate in the study.

Confidentiality

Your identity in this study will be protected from persons outside the research. All information gathered will be confidential and any details of your identity that will compromise anonymity will be dealt with prior to the publication of the research report. The University of Ghana School of Public Health and the Ghana Health Service will have access to the research materials.

Voluntary Participation and Withdrawal

Participating in this study is voluntary and there is no penalty for refusal. You are at liberty to withdraw from the study at any time and your information will not be included in the study.

Declaration of conflict of interest

I Mohammed Shamsudeen Fuseini as the Principal Investigator declare that as far as I am concern, there is no actual or perceived conflict of interest that may potentially arise with my involvement in this study.

Contacts for Additional Information

If you wish to ask questions about this research, you can do so now or later on the following contact details.

Mohammed Shamsudeen Fuseini

School of Public Health

College of Health Sciences

University of Ghana, Legon

Phone number: 0542380709

Email: naashamo@gmail.com

PART II: PARTICIPANTS' CONSENT FORM

I acknowledge invitation to participate in research on "Adherence to the administration guidelines of Seasonal Malaria Chemoprevention by Caregivers in the Tamale Central District". The nature and purpose of the research as well as risks and benefits have been read and explained to me in English [ ], Dagbani [ ], Hausa [ ], Twi [ ], Other ..... I have been given the opportunity to ask questions about the research and receive answers to my satisfaction. I agree voluntarily to participate in this study.

_____ _____ _____

Full name of participant Signature or Thumbprint Date

DECLARATION BY TRANSLATOR (IF THE CONTENT HAD TO BE TRANLATED INTO A LANGUAGE THAT THE PARTICIPANT UNDERSTANDS)

I interpreted the content of this document to the participant mention above to the best of my ability in Dagbani [ ], Twi [ ], Hausa [ ] Other .....Clarifications and questions asked by participants and answers are duly interpreted as well.

_____ _____ _____

Full name of translator Signature or Thumb print Date

DECLARATION BY WITNESS (FOR PARTICIPANTS WHO CANNOT READ BY HIM/HERSELF)

I am a witness to when the benefits, risks and nature and purpose of the study were read to participant in English [ ], Dagbani [ ], Hausa [ ], Twi [ ], Other .....
All questions were answered, and participant has agreed to participate voluntarily in the study.

_____ _____ _____

Full name of witness Signature or Thumb print Date

RESEARCHER'S DECLARATION

I certify that the purpose and nature of this study, the potential benefits, and possible risks associated with participation, have been duly explained to the aforementioned individual to the best of my ability. The participant was given an opportunity to ask questions about the study, and answers were given as correctly as possible. I also confirm that participant consented freely and voluntarily.

_____ _____ _____

Name of Researcher Signature Date

APPENDIX 4: QUESTIONNAIRE

Interviewer's name: _____

Date of interview: _____/_____/_____

PART ONE

SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Q1. Area of Residence? _____

Q2. Age of respondent? _____

Q3. Marital Status?

Single ☐ Married ☐ Divorced ☐ Cohabiting ☐ Widowed ☐

Q4. Type of marriage?

Monogamy ☐ Polygamy ☐ Open relationship ☐

Q5. Highest level of education?

No formal education ☐ Primary ☐ Secondary ☐ Tertiary ☐

Q6. Occupation of respondent?

Housewife ☐ Unemployed ☐ Farmer ☐ Formal Work ☐ Trader ☐

Other specify_____

Q7. Religion?

Christianity ☐ Islam ☐ African traditional religion ☐

Q8. Ethnicity?

Dagbani ☐ Hausa ☐ Twi ☐ Other_____

Q9. How many are you in this Household? ☐

Q10. How many children below 5 years are there in the household? ☐

Q11. What is your relationship to child(ren)? _____

PART TWO

KNOWLEDGE ON MALARIA

Q12. What is the cause of malaria?

By infected mosquito bites ☐ Dirty environment ☐

Ancestors ☐ Other Specify _____

Q13. What are the signs and symptoms of malaria that you know?

The body feels warm ☐ Vomiting ☐ Headache ☐ Poor appetite ☐

Diarrhea ☐ Other specify_____

Q14. What are the effects of malaria on children under five that you know?

Child refuses to eat ☐ Child cannot go to school ☐ Child refuse to play ☐

Convulsion ☐ Can cause anemia ☐ Death ☐ Other Specify_____

Q15. In how many ways can you prevent yourself from getting malaria?

Insecticide Treated Nets ☐ Use of mosquito spray ☐ Use of mosquito coil ☐

Wear protective clothing ☐ Don't know ☐ Other specify_____

Q16. In how many ways can you prevent your child(ren) from getting malaria?

Insecticide Treated Nets ☐ Use of mosquito spray ☐ Use of mosquito coil ☐

Through SMC ☐ Wear protective clothing ☐ Don't know ☐

Other specify_____

PART THREE

AWARENESS OF THE BENEFITS OF SEASONAL MALARIA CHEMOPREVNTION (SMC)

Q17. Is there a local name for SMC?

No ☐ Yes ☐ Specify _____

Q18. Where did you get information about SMC?

TV ☐ Radio ☐ Community Volunteer ☐ Health Worker ☐ Friend ☐

Worship place ☐ Other specify _____

Q19. What season of the year is SMC given?

Raining Season ☐ Dry Season ☐ All year round ☐ Don't know ☐

Q20. What are the benefits of SMC?

Prevention of malaria in children below 5 years ☐ Treatment of malaria in children below 5 years ☐ Don't know ☐ Other _____

Q21. What is the minimum age required for SMC medication?

Months ☐ Years ☐ Don't know ☐ Other_____

Q22. Are there any problems with the SMC drug that you know?

Yes ☐ No ☐

Q23. Are you happy with the SMC?

If yes, why? _____

If no, why? _____

Q24. Will you advice people to let their child(ren) take the SMC medicine?

Yes ☐ No ☐

PART FOUR

ADHERENCE

Q25. How many times is SMC drug given in a year?

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Don't know ☐ Other specify_____

Q26. How many days is the SMC drug taken in a month?

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Don't know ☐ Other specify_____

Q27. How many of your children(ren) received the SMC during the exercise last month?

None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Other_____

Q28. How many of your child(ren) completed all the SMC doses?

None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Other_____

Q29. How many of your children did not complete the SMC doses?

None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Other_____

Q30. Did you administer the SMC medicine to your child(ren) on the second day?

Yes ☐ No ☐

Q31. Did you administer the SMC medicine to your child(ren) on the third day?

Yes ☐ No ☐

Q32. Do you sometimes miss administering the SMC drug to your child?

Yes ☐ No ☐

Q33. If your child(ren) miss the SMC doses, what are the reasons?

Forgetfulness ☐ Side effects of drug ☐ Bitter taste of the drug ☐

Child refuse to take drug ☐ Other specify_____

PART FIVE

COMMUNITY HEALTH VOLUNTEER FACTORS

Q34. Are you comfortable with volunteers coming to administer SMC to your child?

Yes ☐ No ☐

Q35. How do you identify SMC volunteers when they visit the house?

They are members of the community ☐ They wear SMC t-shirt ☐ They wear ID tags ☐

Volunteer self-introduction ☐ Other specify_____

Q36. Did the Volunteer observe the child take the first dose of the SMC drug?

Yes ☐ No ☐

Q37. Did the Volunteer educate you on the adverse effects of the drug and how to manage it?

Yes ☐ No ☐

Q38. Did the Volunteer visit the house after administering the first dose of the SMC?

Yes ☐ No ☐

Q39. Are you satisfied with the work of the Volunteer?

Yes ☐ No ☐

Q40. Can you suggest alternative ways the SMC drug can be delivered to your child?

We have come to the end of our discussion.

Thanks for cooperating.

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Digital Address: GA-050-3303
Mob: +233-50-3539896
Tel: +233-302-681109
Email: ethics.research@ghsmail.org

My Ref. GHS/RDD/ERC/Admin/App 022/402
Your Ref. No.

22nd September, 2022

Mohammed Shamsudeen Fuseini
Post Office Box 345,
Tamale, Northern Region

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC: 026/09/22**
Study Title	Adherence to the Administration Guidelines of Seasonal Malaria Chemoprevention by Caregivers in the Tamale Central District
Approval Date	22nd September, 2022
Expiry Date	21st September, 2023
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of a yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

You are kindly advised to adhere to the national guidelines or protocols on the prevention of COVID -19.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
Mr. Kofi Wellington
(GHS-ERC Vice Chairperson)

Cc: The Director, Research & Developmeal Division, Ghana Health Service, Accra