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SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

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

BY

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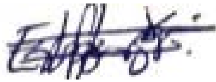
DEDICACE

This work is dedicated to my mother (Sokolo Traore), I also dedicate it to my father (Adama Doumbia) and all my family.

Signature:….

Cheick Oumar Doumbia, MPH student

Academic supervisor

Signature …  14th June 2021

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LIST OF ABBREVIATIONS

CHPS	Community-Based Health Planning and Services
CHWs	Community Health Workers
IDI	In-Depth Interview
IPTi	Intermittent Preventative Treatment in Infant
IPTp	Intermittent Preventative Treatment Pregnant woman
IRS	Indoor Residual Spray
ITNs	Insecticide Treated Nets
RA	Research Assistants
SMC	Seasonal Malaria Chemoprevention
UER	Upper East Region
UWR	Upper West Region
WHO	World Health Organization

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ABSTRACT

Background: Seasonal malaria chemoprevention (SMC) was recommended in 2012 for young children in the Sahel during the peak malaria transmission season.

Since 2015, SMC with amodiaquine–sulfadoxine–pyrimethamine (AQ–SP) has been implemented during the high malaria transmission season in three region of Ghana. Adherence to the SMC is one of the key determinant for a successfull protection of children under five. In Ghana, there is limited evidence of factors associated with adherence to SMC.

Objective: To explore the coverage and the risk factors associated with adherence to Seasonal Malaria Chemoprevention (SMC) among caregivers in Builsa North District.

Methods: In four (4) sub-district households in the Builsa North District, a cross-sectional study was conducted. The district was stratified into six, and 4 subdistricts were selected using simple random sampling. The 438 participants were recruited via balloting using random sampling. Illustrative summary statistics performed for frequencies. The knowledge of caregivers on Malaria and SMC were assess through scoring of correct answers question related to malaria and SMC. The association between SMC adherence and independent variables were tested using Pearson's chi-square test and Fisher Exact Test. Simple and multiple logistic regressions performed to determine associations and strength of associations between SMC adherence and the independent variables with all results interpreted at 95 % confidence level.

Results: The SMC coverage and adherence rates among the caregivers in the Builsa North District were respectively 90.87% and 95.36% with an awareness at 97.94%. The reasons reported for non-adherence were child's refusal (38.46%), the child's vomiting of the drug (33.33%), the occurrence of an illness within the period of medication (15.38%), the forgetting to give the subsequent doses (12.82%). About the half (49.31%) of caregivers had a good

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knowledge of Malaria, while 66.51% had a fair knowledge of SMC. Significant predictors of SMC on multiple logistic regression were place of residence, caregivers' satisfaction, the source of knowledge.

Conclusion: The coverage of SMC of the in Builsa North District is 90.87% while the adherence is 95.36%. The keys factors that are associated with SMC Adherence are the being aware of SMC through a non-health professional source, place of residence, and the satisfaction of caregivers with the previous SMC campaign and household size.

Keywords: Malaria – Seasonal Malaria Chemoprevention – Children under five – Amodiaquine Sulfadoxine Pyrimethamine – Adherence.

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CHAPTER ONE

INTRODUCTION

1.1. Background

Malaria is a disease transmitted by mosquitoes, which in humans is caused by five protozoa: *Plasmodium falciparum, Plasmodium vivax, Plasmodium malariae, Plasmodium ovale,* and *Plasmodium knowlesi*. It is a real public health problem globally and is endemic in most countries in the Sahelian regions (Snow, 2015).

Multiple measures have been implemented to reduce the incidence of malaria in endemic countries including Ghana. Intermittent preventative treatment of Infant malaria (IPTi) and pregnant woman (IPTp), indoor residual spray (IRS), long-term insecticide treatment of bed nets (ITNs), and early diagnosis and treatment of confirmed malaria cases with active Artemisinin combination therapies are the current malaria control program in Ghana (Stelmach, Colaço, Lalji, McFarland, & Reithinger, 2018).

Intermittent Preventive Treatment in infants is a primary health intervention designed to prevent malaria in children under five years of age during the period of high malaria transmission, which is during the rainy season. This intervention is commonly known as Seasonal Malaria Chemoprevention (SMC). During this period, successful malaria treatment has been shown to prevent malaria and mortality in children. The implementation of this chemoprevention is done through routine immunization services by admitting a combination of sulfadoxine-pyrimethamine and amodiaquine in children aged 3 to 59 months, regardless of whether the child is infected with malaria.

The World Health Organization has recommended this combination since March 2012 for children living in areas of highly seasonal malaria transmission in the Sahel subregion of

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Africa. ("WHO | World Malaria Report 2012," 2014). After then, in 2014, seven countries in sub-Saharan Africa (Burkina Faso, Chad, Mali, Niger, Nigeria, Gambia, and Guinea) have adopted this malaria control strategy (York, 2017). According to the World Health Organization, 15.7 million children in 12 countries in Africa's Sahel subregion were protected through seasonal malaria chemoprevention (SMC) in 2017. This intervention is effective, cost-effective, safe, and feasible for the prevention of malaria in children under 5.

In Ghana, the National Malaria Control Program started the implementation in 2015 in the Upper West Region (UWR). Following the implementation of SMC in UWR, an impact assessment showed that the efficacity of SMC was 45%. Based on this success, the intervention was extended to the Upper East Region (UER) in 2016.

According to the NMCP reports, the coverage of the SMC campaign in 2018 was more than 99%, and children under five are still facing infections of malaria and its consequences. This study investigated adherence to the three-dose finalization of SMC among caregivers in Builsa North in Ghana (Chatio, Ansah, Awuni, Oduro, & Ansah, 2019)

1.2. Problem Statement

Malaria remains a public health problem in most countries. Parasites and vectors are found in areas where almost half the world's population resides. Globally, malaria affects more than 300 million people a year and seriously affects African regions (da Silva-Nunes et al., 2012).

Throughout the world, malaria continues to be a life-threatening illness. In 2017, it was estimated 219 million cases of malaria occurred worldwide. Most of these malaria cases were in the WHO African Region (200 million or 92%).

In an attempt to eradicate or control malaria in children under five, WHO recommended SMC in 2012. National Malaria Control Program (NMCP) of Ghana initiated SMC in 2015 with

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the objective of fully protecting children under five of getting malaria disease. Since then, there are limited information on the programme coverage, and some keys determinants such as caregivers' adherence to unsupervised doses.

The practical implementation of SMC involves three days of consecutive medication used by children under 5 years of age, the first doses are administered by community health workers, and the other two doses are administered by caregivers at home. For a successful implementation during the rainy season, the interventions may interfere on seasonal farm works, some targeted children are not reachable, or caregivers may not be available for home medication (Tine et al., 2013)These seasonal factors affected the coverage.

Elsewhere, it has been proven that some parents did not adhere to SMC protocol properly, which fails to respect the correct intake of the three doses of the drugs. It has been shown that sociodemographic characteristics, community leaders, community health workers, the media, the community members' perception about SMC, awareness, knowledge of malaria, households' past experiences, and seasonal factors can have influenced the adherence of SMC. There is no information about the adherence to unsupervised daily treatment doses of Ghanaian communities.

Most of the studies have analyzed the efficacity, impact, accessibility, availability, and coverage of SMC, and few studies examining hidden sociodemographic, operational, individual, and seasonal factors within the household that predict, encourage, or prevent the adherence to SMC (Druetz et al., 2018), (Chatio et al., 2019). These challenges in the non-adherence results in the failing to protect the child to from malaria infection. This interrupted protocol may induce the development of AQ-SP resistant which has devastating consequences of the burden of malaria in children under 5. The prevalence, morbidity, and mortality of malaria in children under 5

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would be more likely to be perpetuated if studies are not delved into to identify such factors or predictors that are associated with the adherence of SMC within caregivers, for appropriate recommendations and amendments, advocacy be tabled to control the situation.

It is also necessary to understand why some children under the age of five suffer malaria despite having a high coverage of SMC implementation. This study aimed to use a quantitative method to assess factors associated with the adherence to unsupervised daily treatment doses of SMC within the selected communities.

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1.3. Conceptual Framework

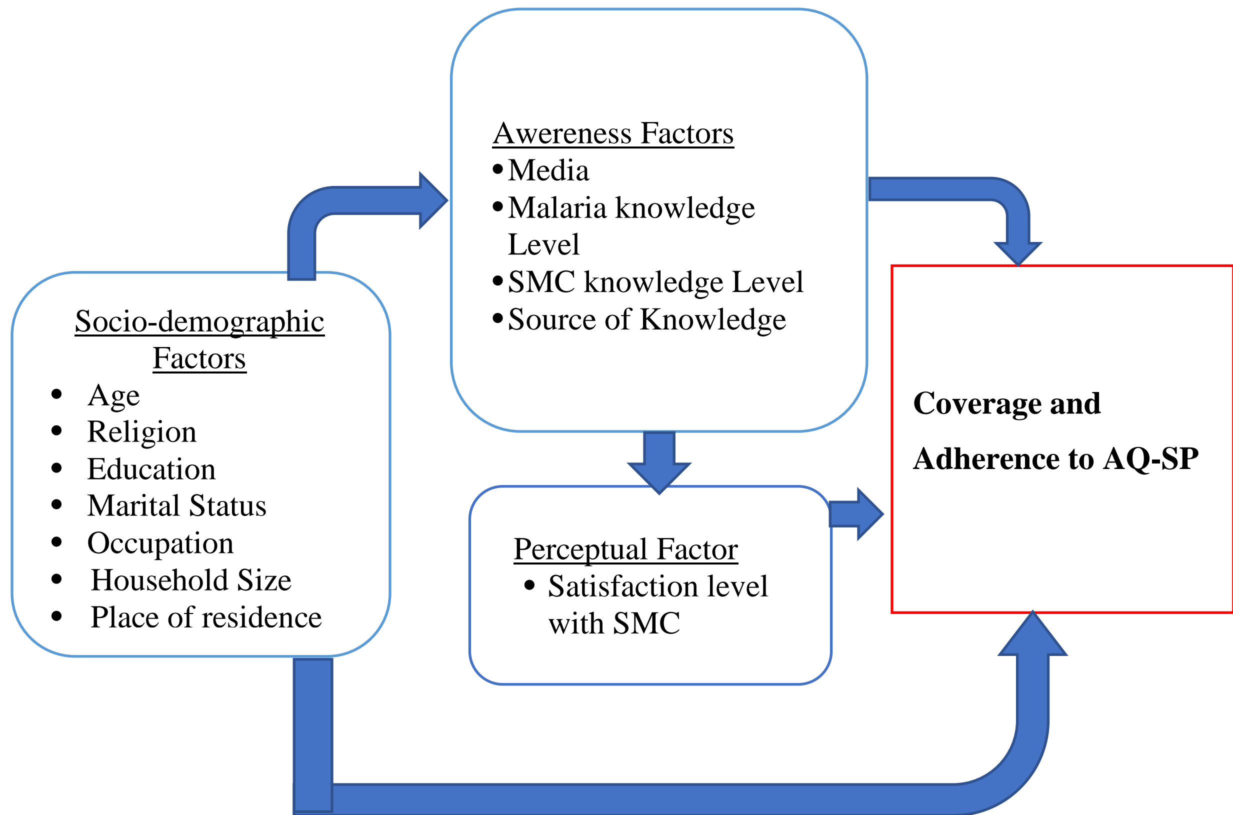

Figure 1 Conceptual Framework

1.4. Narration of Conceptual Framework

The framework demonstrates the interaction between the independent (predictor) variables and the dependent variable (Adherence).

According to the model, some distinguishing factors can contribute to or determine the adherence to SMC by an individual.

These characteristic factors are considered as the independent variables in this study. They are categorized into three (3):

1. Predisposing factors
2. Awareness related factors and
3. Perceptual factor

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The dependent (or outcome) variable is the adherence to SMC, which means the completion of the three doses.

The predisposing factors are those sociodemographic characteristics that might cause some people to adhere or not to SMC and others. These sociodemographic characteristics in this study include age, education, ethnicity, religion, marital status, household size, place of residence, and the number of children under five. Lower educational background is sometimes correlated to difficulty to understand and believe in public health intervention like SMC, so those with a low educational background might not adhere to SMC. Some ethnics groups still refusing all orthodox medication. In a household where the number of people is higher might have higher number of caregivers to be involved in child's medication, in contrast the lower household size might have only the primary caregivers in charge of child's medication, the dynamic of adherence to SMC might change between the two types of household. The sociodemographic factors are very diversified and encompass lot specificities in terms of residence, marital status, age, all those factors might have a specific influence on the adherence to SMC.

The awareness related factors assume how important an individual is aware of malaria and SMC. The awareness related factors in this study include the malaria knowledge level, SMC knowledge level, source of knowledge. It has been shown elsewhere that those who have a very good knowledge on SMC adhere likely to adhere. This can be explained by the fact they know the benefits of completing the three doses of AQ-SP for the children. Being informed inappropriately might be the reason for some caregivers to believe and adhere to SMC.

The perceptual factor is based on showing keen insight into SMC. The only perceptive factor in this study is the satisfaction level with SMC. Those who report they are satisfied might be more likely to adhere to SMC.

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1.5. Study Justification

This study focused on the factors associated with the adherence to SMC among the caregivers in the District of Builsa North. Therefore, identifying the factors associated with adherence to SMC and the reason of non-adherence among caregivers in Builsa North District could help the the health District authorities to better target them.

These findings could be use in planning for health promotion activities, particularly for future SMC and campaigns and malaria control in children under five.

The results of this study will also serve as background information for setting the tone for future research into malaria control in Builsa North District and beyond. These findings would be a source of inspiration for communities that are implementing SMC.

1.6. Research Question

What is the adherence level to SMC in Builsa North District?

What are the reasons for non-adherence to SMC?

What are the sociodemographic factors associated with adherence to SMC?

What are the effects of awareness related factors on the adherence to SMC?

1.7. Research Objectives

1.7.1. General Objective

To explore the coverage and risk factors associated with adherence to Seasonal Malaria Chemoprevention (SMC) in Builsa North District.

1.7.2. Specific Objectives

1. To determine the coverage and the adherence level of caregivers to SMC.
2. To identify the reason for nonadherence to SMC.
3. To determine the sociodemographic factors associated with the adherence to SMC.

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4. To examine the effect of awareness factors associated with adherence to SMC.

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CHAPTER TWO

LITERATURE REVIEW

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2.2. Malaria Epidemiology

Malaria is a preventable and curable disease that spreads by the bite of a female anophele mosquito. Hundreds of thousands of lives are lost each year as a result of malaria and a higher proportion of these deaths occur in Sub-Saharan Africa where disease is the number one cause of death for children under the age of five. According to Snow (2014), malaria is a dangerous illness that manifests itself as a swarm of signs, degrees of seriousness and indirect morbidity.

Globally, the prevalence of malaria has declined as seen by the 2015 figures relative to the 2000 figures (WHO, 2016). The burden of malaria remains intolerable. About 200 million new cases are reported worldwide per year (WHO 2018). An estimated 216 million cases of malaria were registered in 91 countries in 2016. This showed a rise of around 5 million cases over 2015 (WHO, 2017). Malaria mortality in 2016 was 445,000 relatives to a similar figure of 446,000 in 2015. The year 2017 also saw a rise of around 3 million cases from 2016, with the death rate dropping by 10 000. While the number of deaths has declined, it has declined at a much slower rate over the last 10 years (WHO, 2018).

The WHO African areas have a disproportionate share of the global burden, with about 70 % of the global burden in eleven nations. Ten of these countries are situated in sub-Saharan Africa. These high burden nations are home to nearly 151 million and 275 000 cases of malaria and mortality, respectively (WHO, 2018). An estimated 3.5 million and 403,000 (93 percent of global deaths) cases and deaths were registered in Africa in 2017 (WHO, 2018).

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A higher proportion of all these deaths occur in children under five years of age (Phillips, 2001). Every day, 720 children die of this preventable and curable disease (WHO, 2018) About 15 % of children who can survive this hazard suffer from neurological disorders such as partial blindness, delayed voice, general exhaustion and malaise, and seizures (Schönfeld et al., 2007). In cases where special care is not paid to these infants, these deficiencies impair their learning and growth, such as dyslexia.

Children under the age of five are more vulnerable to malaria infection (WHO, 2018) because their immune system is not completely established. Breastfeeding is a source of immunity for infants, but they become more susceptible after three months. This will last until the age of five years in hyper-endemic environments. Immunity can vanish in a matter of years if there is no re-infection (Eddleston et al, 2008). In addition, children under five years of age face the major burden of malaria as they are typically riddled with other parasites and malnutrition. They add to the lower immune system, which results in a greater chance of malaria. Malaria and malnutrition are the causes for the increasing burden of anemia in children (Greenwood, Bojang, Whitty, & Targett, 2005b).

In Ghana, malaria appears to be the major cause of morbidity and mortality (NMCP, 2013) 10.4 million people reported malaria in different health facilities, accounting for around 39 per cent of all OPD cases. This reflects a 2.5% growth in cases relative to the same period in 2015 (GHS, 2017). On average, 28,607 cases of malaria were registered nationally in all health facilities, with 25 percent and 4 percent of all admissions and deaths related to malaria in 2016 (GHS, 2017). Out of 1,264 malaria deaths in 2016, 590 were infants under the age of five. Children under the age of five are at higher risk of malaria (Phillips, 2001). In 2017, 10.2 million cases of malaria were reported, with a decrease of about 2% compared to 2016 (NMCP, 2018).

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Malaria accounted for around 34 per cent of all OPD cases in Ghana and 19 per cent and 2 per cent of overall admissions and total deaths. This curable illness is linked to 54% of children under the age of five (NMCP, 2018). Table 1 indicates the prevalence of malaria in Ghana in 2017.

2.2.2. Geographical distribution

Malaria transmission is high in the intertropical zone, so it is possible to draw a broad line on the geographical distribution of malaria worldwide. It is also essential to understand that due to the epidemiological factors influencing malaria transmission (distribution of Anopheles, vectorial capacity, biological characteristics of the different Plasmodium species) the geographical distribution varies from one continent to another, from one region to another, from one country to another and even from one village to another.

North America is free of malaria. On the other hand, it exists in Central America (mainly *P. vivax*), but the Caribbean islands are free except Haiti. There is no transmission in the Lesser Antilles: Guadeloupe, Martinique. There are significant outbreaks of *P. falciparum* (resistant to 4-amino-quinoline) and *P. vivax*. Malaria is still rife in French Guiana but mainly along rivers and in forests. All American cities are safe except the Amazon ("Tips Manual of Travel Medicine and Health | Public Health | Medical," n.d.).

As in Africa, malaria occurs moderately in Asia Minor (Turkey), the Indian peninsula (mainly *P. vivax*), and intensely in Burma, southern China, Thailand, Vietnam, Cambodia, and Laos (mainly *P. falciparum*, with chemo resistant strains) ("Malaria | WHO | Regional Office for Africa," n.d.). Transmission in Asia occurs in the form of scattered outbreaks in rural areas in wooded hillside areas. All major Asian cities are unharmed except Indian cities (Singh Parihar et al., 2019).

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In WHO African Region, Malaria has been eradicated in Algeria, Lesotho, Mauritius, and La reunion ("WHO | Environmental Management for Vector Control," 2016). Temporary reintroductions may occur, and isolated cases may occur (airport malaria). But it is mainly imported malaria (traveler's malaria) that is rampant.

Transmission is heterogeneous. Some islands are affected (New Guinea, Solomon Islands, Vanuatu); others are entirely devoid of them: French Polynesia, New Caledonia, Wallis and Futuna, Fiji, Hawaii, Australia, and New Zealand are unharmed.

Malaria is weakly present in North Africa, where the species *P. vivax* and *P. malariae* are found. It is widespread throughout intertropical Africa where *P. falciparum, P. ovale,* and, to a lesser extent, *P. malariae* coexist. In some areas of East Africa, there are also *P. vivax*. Transmission is intense in Madagascar, where all four species coexist. Generally, the areas of high endemics in Africa start in the Sahara sub-region and extend to the equatorial zone (Prevention, 2020).

In Ghana, the seasonal malaria transmission is high in northern regions. 50-59% of clinical malaria cases occur for 4 months (July-October) in the Savannah regions: Northern, Upper East, Upper West regions. Of the five Plasmodium species currently known to infect humans, only *Plasmodium falciparum, Plasmodium ovale,* and *Plasmodium malariae* are documented in Ghana (Yankson, Anto, & Chipeta, 2019).

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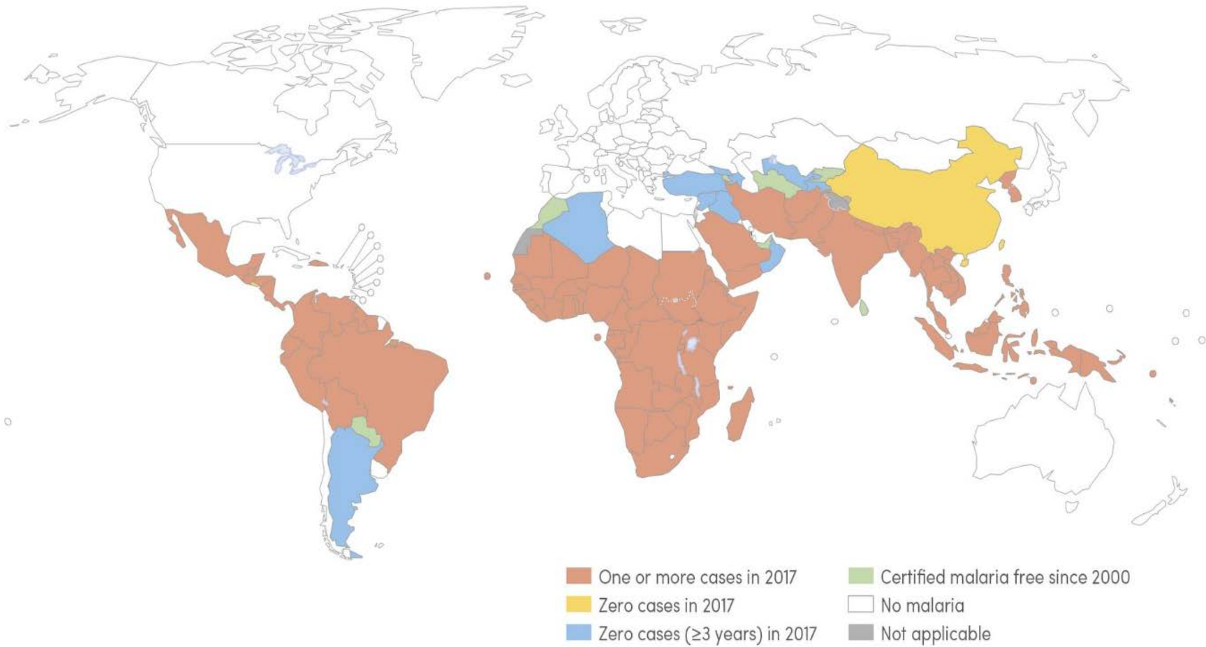
Countries with indigenous cases in 2000 and their status by 2017 Countries with zero indigenous cases over at least the past 3 consecutive years are considered to be malaria free. All countries in the WHO European Region reported zero indigenous cases in 2016 and again in 2017. In 2017, both China and El Salvador reported zero indigenous cases. *Source: WHO database.*



WHO: World Health Organization.

Source: WHO, 2017 report ("Malaria_003.Png (1913×1370)," n.d.)

Figure 2:Geographical distribution of malaria.

2.2.3. Pathogen

Plasmodium is protozoa belonging to the phylum of sporozoan, *Haemosporida*, the class Haemosporidae, and the family Plasmodiidae. They show sexual multiplication in female Anopheles and asexual multiplication in males (Yaeger, 1996)

Five plasmodial species are subordinate to man:

✓ *Plasmodium falciparum*: responsible for the third malignant fever, it is the most dreaded and widespread species. It is responsible for almost 11 million deaths from malaria. It attacks

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both young (reticulocytes) and older erythrocytes. P. falciparum is most prevalent in intertropical areas where malaria is endemic.

✓ *Plasmodium malariae*: represents 10 to 14% of the parasite formula; it is the agent responsible for quarte fever. It is a parasite with an affinity for older red blood cells and is mainly found in Africa and Asia. This species is not fatal but can lead to relapses up to 20 years after the primary infection due to the presence of pre-erythrocytic forms (latent or hypnogogic forms) expressed during aggression, such as splenectomy(Owusu, Brown, Grobusch, & Mens, 2017)

✓ *Plasmodium ovale:* represents less than 1%. It is responsible for mild third stage fever, which occurs mainly in areas where P. vivax is absent or rare (Black Africa). This species does not kill but causes relapse several years (2 to 5 years) after sporozoan inoculation(Owusu et al., 2017).

✓ *Plasmodium vivax:* is not present in Ghana. This species is also responsible for mild third stage fever. It has long been considered a Duffy dependent antigen, but recent studies show *P. vivax* in Duffy malicious individuals (Owusu et al., 2017).

✓ *Plasmodium knowlesi*: species whose inferiority to man has recently been demonstrated. The *P. knowlesi* is found in South Asia; it represents up to 70% of cases in Southeast Asia(Pongvongsa et al., 2018)

A sixth species, *Plasmodium cynomolgi*, an animal strain, has been accidentally described in human infections.

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2.2.4. Malaria Control Strategies

Vector control programs aims to stop or at least reduce human vector contact and subsequently stop malaria transmission ("WHO | Core Vector Control Methods," 2020). This method consists of eliminating Anopheles, both in the larval and adult stages of the vector mosquito.

The application of vectors control strategies includes the promotion of hygiene and environmental sanitation, the drying of irrigation canals, and insecticide-treated mosquito nets. The chemical means are also applied by using chemical derivatives in intra or extra home spraying, the spreading of mineral oils mixed with 1% insecticides (DDT, Dihedron) on the surface of standing water, to asphyxiate mosquito larvae, but also the use of contact insecticides ("WHO | Environmental Management for Vector Control," 2016).

The vectors control strategies at individual level consist of protecting oneself from mosquito bites. Protective measures include insecticide-impregnated mosquito nets, wearing clothing that covers exposed areas, repellents, insecticide tablets, and spirals.

Chemoprevention of malaria in pregnant women consist to provide the choice of molecules for chemoprophylaxis depends on the country and the recommendations in force. Sulfadoxine-Pyrimethamine (SP) is the combination of choice for chemoprophylaxis in pregnant women in African countries with moderate and intense transmission. The NMCP recommends administering at least three doses of SP starting in the second trimester of pregnancy, with one dose of SP at least one month apart until delivery. The NMCP recommends that the patient should be given at least three doses of SP starting in the second trimester of pregnancy, with one dose of SP at least one month apart until delivery. The NMCP recommends that the patient

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should be given at least three doses of SP starting in the second trimester of pregnancy, with one dose of SP at least one month apart until delivery.

People living in non-endemic areas, lack anti-malaria immunization, and are in an endemic malaria area. They are, therefore, exposed to the risk of severe and complicated malaria. There is no ideal prophylactic regimen. The choice of chemoprophylaxis should be discussed and adapted to each traveler. It depends on the zone visited (intensity of transmission and level of resistance to antimalarial drugs), the season, and the subject concerned (age, pregnant woman). There are 3 groups:

➢ Group 1: Chloroquine-free zone: this group mainly concerns Central America, Haiti, and the Dominican Republic.

➢ Group 2: Isolated chloroquine-resistant zone. Partly India and Sri Lanka are concerned.

➢ Group 3: Area of a high prevalence of chloroquine resistance and multidrug resistance. The number of countries classified in this group is continuously increasing. It now includes all the countries of sub-Saharan Africa, including Ghana (Preventiona, 2019b).

Chemoprevention of malaria in children under five concerns both children living in non-endemic areas and children under 5 years of age in malaria-endemic areas. In endemic areas with periods of high transmission, according to recent WHO recommendations, all children under 5 years of age should be given a curative dose of antimalarial treatment during the period of high transmission. It is called Seasonal Malaria Chemoprevention (SMC) ("WHO | World Malaria Report 2012," 2014)

Faced with the emergence of Plasmodium strains resistant to various antimalarial drugs, the alternative remains the search for an antimalarial vaccine. Vaccines are being tested worldwide. RTS, S is the vaccine candidate with the most advanced clinical studies ("RTS,S |

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PATH's Malaria Vaccine Initiative," n.d.). RTS, S is the first, and to date, the only vaccine that has demonstrated it can significantly reduce malaria in children. In clinical trials, the vaccine was found to prevent approximately 4 in 10 malaria cases, including 3 in 10 cases of life-threatening severe malaria. The pilot study was officially launched in Ghana on the 30 April 2019 by the Ghanaian Minister of Health, World Health organization ("Malaria Vaccine Pilot Launched in Ghana | WHO | Regional Office for Africa," n.d.). Ghana is one of three African countries in which the vaccine, known as RTS,S, would be made available to children up to 2 years of age; the others countries are Kenya, Malawi(van den Berg, Ogutu, Sewankambo, Biller-Andorno, & Tanner, 2019)

2.3. The concept of Seasonal Malaria Chemoprevention

Seasonal Malaria Chemoprevention (SMC) is defined as the intermittent administration of comprehensive antimalarial treatment to children in areas of highly seasonal transmission during the malaria season("WHO | Seasonal Malaria Chemoprevention (SMC)," 2017).

In the Sahel sub-region, malaria mortality and morbidity among children are highest during the rainy season, which is generally short. Studies have shown that administering a full course of treatment with an effective antimalarial drug at appropriate intervals during this period prevents malaria morbidity and mortality in young children.

The evolution of malaria epidemiology has led to a gradual shift from a single mode of treatment to malaria control strategies that target specific populations and locations for maximum effectiveness; in line with this approach and based on new evidence, WHO now recommends an additional intervention to control Plasmodium falciparum malaria: seasonal malaria chemoprevention (SMC) ("WHO | World Malaria Report 2012," 2014). It is effective,

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inexpensive, safe, and feasible for preventing malaria in children under five years of age in areas of high seasonal malaria transmission.

2.3.3. Purpose of SMC

The objective is to maintain therapeutic concentrations of antimalarial drugs in the blood during the period when the risk of contracting malaria is higher.("World Malaria Report 2019," n.d.)

In addition to this primary objective, which has set itself a few specific objectives, which are:

To reduce the number of cases of severe and straightforward malaria,

to reduce the number of hospitalizations due to malaria,

to reduce malaria-related under-five mortality.

2.3.4. Indication and period of use of the SMC

SMC is indicated in countries with high seasonal transmission. The period of administration of the SMC should be defined to target the period during which children are most at risk of contracting malaria. Deployment of the SMC is recommended in the regions:

where more than 60% of the annual incidence of malaria is recorded over four months.

where malaria morbidity accounts for the majority of morbidity in children (incidence > 10 cases of malaria per 100 children during the transmission season);

where the anti-malarial efficacy of SP and AQ is maintained.

In Ghana, most malaria cases generally occur from July to November. During this period.

The duration of the activities is 4 months/year to reduce the risk of resistance development.

2.3.5. Molecules and Dosages

For the choice of drugs for chemoprophylaxis, WHO recommends the use of two effective antimalarial drugs different from the national policy for the treatment of uncomplicated cases. The molecules used in the countries south of the Sahara are Sulfadoxine-Pyrimethamine (SP) +

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Amodiaquine (AQ). The combination of SP + AQ was chosen for SPC for the following reasons ("WHO | World Malaria Report 2012," 2014).

Clinical trials have shown that the combination of SP + QA provides better protection than other drug combinations. The use of two drugs in combination limits the risk of selection of resistance to SP or QA, unlike using these antimalarial drugs as monotherapy.

SP and AQ remain effective in Sahelian and sub-Sahelian transmission areas seasonal where SPC is appropriate.

Treatment with SP + AQ is safe, well-tolerated, and relatively inexpensive.

The combination of SP + AQ does not contain artemisinin derivatives because artemisinin-based combinations are reserved for treating malaria episodes. The rapid onset of action of an artemisinin derivative is most useful.

There are two (2) forms of presentation:

Sulfadoxine 500 mg - Pyrimethamine 25 mg (SP) and Amodiaquine 150 mg (AQ) or

Sulfadoxine 250 mg - Pyrimethamine 12.5 mg (SP) and Amodiaquine 75 mg (AQ).

The recommended dosage and frequency of administration are age-dependent:

For infants 3 to 11 months of age, it is one SP 250/12.5 mg tablet in a single dose and one AQ 75 mg tablet daily for 3 days.

For children 12-59 months old, it is a single dose SP 500/25 mg tablet and AQ 150 mg daily for 3 days.

Protocol for the administration of SP/AQ of the NMCP in Ghana.

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Table 1 Protocol for the administration of SP/AQ

Age groups		
Days	3 to 11 months	12 to 59 months
J0	1 Cp SP 250/12.5 mg + 1Cp AQ 75mg	1 Cp SP 500 mg/25 + 1 Cp AQ 150 mg
J1	1 Cp of AQ 75 mg	1 Cp of AQ 150 mg
J2	1 Cp of AQ 75 mg	1 Cp of AQ 150 mg

2.3.6. Contraindication of SMC

SMC should not be administered to:

a child with an acute febrile illness or severe illness cannot take oral medication,

an HIV-positive child receiving cotrimoxazole as a preventive treatment.

a child who is allergic to SP or AQ. (*World malaria report 2019*, n.d.-b)

2.3.7. SMC Drug Delivery

SMC drugs can be dispensed door to door or by gathering the children in a place agreed in advance in each area of residence. Combine SMC with community case management has unique advantages: there are more possibilities to make up for missed doses; critical cases can be diagnosed and treated, information on the SMC; and using the same person to provide the SMC and provide more economical diagnostics and treatments. SMC can also be delivered in programs in health facilities, e.g., in the proximity clinics.

They have expanded the immunization program. Field tests have shown, however, that such programs are less effective at achieving high coverage.

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During the rainy season, many homes have been isolated and challenging to access. This approach alone would require a large, resourced task force to deliver, manage, and monitor all households. An arrangement to leave medications with non-primary mothers facilitates drug administration while primary mothers are not at home, so CHW's medical training could reassure caregivers and further improve treatment.(Antwi et al., 2016a)

2.3.8. Importance of adherence to the 3-day treatment regimen

SMC offers protection up to 1 month after each full course (3 days). Therefore, Children must receive SMC every month during the main risk period and for maximum protection. Good adhesion also reduces the risk of selecting drug-resistant parasites. Health workers should give a dose of SMC. The first dose of AQ to children under their direct observation should inform the caregivers on how to give the second and third doses to the child at home.

2.4. Status of Seasonal Malaria Chemoprevention in Ghana

In 2018, of the 31 million children living in SMC-eligible areas, 19 million (62%) were given this preventive malaria therapy during the high-transmission rainy season("World Malaria Report 2019," n.d.). The implementation of Seasonal malaria chemoprevention in Ghana is more recent than in several countries. Several studies have proven the effectiveness of this intervention in Ghanaians' children.(Tagbor et al., 2016)

According to a qualitative study based on Community Health Workers (CHWs), during household visits after the third day of each monthly SMC dosage, the CHW reported (based on the residual tablets of some mothers) that 10–20 % of mothers had not given the monthly cycle on day two and day three. It indicates, as seen previously, that it may have been impossible for some parents to follow the three-day monthly dosing regimen. All found the five regular monthly intervals to be well balanced and easy to follow. Usually, mothers were unsure of how many

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monthly doses they had received but assumed that when told by CHWs, they collected doses. CHWs indicated that inadequate advertisements affected the mothers' acceptance.(Antwi et al., 2016b)

2.5. Determinants of Seasonal Malaria Chemoprevention intervention effectiveness

SMC is a program that couples the distribution of medications at the community level with the mothers of children under five years of age in the medication. The main factors that can determine the success or failure of this program are coverage, acceptability, adherence/compliance, cost-effectiveness. These determinants have been of interest to researchers many researchers before and after the adoption of SMC in 2012.

2.5.1. Coverage

Indicators of SMC coverage illustrate the degree to which people in need currently benefit significant SMC interventions. The data shows that the global coverage of SMC has increased since 2012.In the Sahelian region, the coverage. There are substantial differences between countries, however. The primary sources of coverage data are household polls and feedback from respondents to interaction questions. Coverage in each region depends on the mass distribution strategies. The numerator and denominator used to calculate drug coverage is frequently discussed by academics. Some researchers refer to the number of individuals receiving the drug as the numerator, while others use the number of individuals taking the drug as a metric and divide this information by either the total population, the eligible population, or the number of individuals receiving the drug (Shuford et al . , 2016).

Alexander stated out that in displaying the proportion of people at risk of coverage by the MDA program, using the total population as the denominator may be more helpful, while using the

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qualifying population may be more useful in assessing the efficacy of the MDA program (Alexander, 2015).

Health workers use various strategies to improve coverage. These strategies included immunization campaigns and health education. While mass campaigns can be politically attractive and many have provided high coverage rates, several problems have been encountered. These

to include low coverage among those most in need of attention in Malawi, in Ghana.

Different distributions methods can be used for SMC within a community. SMC distribution by community health staff has proved to be a highly successful method for adopting SMC's strategy (Barry et al., 2018). Two research contrasted the distribution of SMC in Ghana and The Gambia by community health workers and health facilities(Bojang et al., 2011; Kweku et al., 2009). Higher coverage of SMC was observed in the Gambia study when SMC was provided by community health workers (CHW) at a fixed-point relative to personnel attached to Reproductive and Child Welfare trekking clinics(Bojang et al., 2011), while comparable coverage of SMC was obtained in Ghana when CHW or health care staff administered SMC (69% community delivery and 66% facility delivery). In these experiments, children were invited to drug administration at each round at a fixed point in the village.

SMC coverage at each round was described in a study conducted in Mali by Diawara et al. as the proportion of children aged 3-59 months at the time of SMC who obtained the SMC 3-day treatment during that particular round. The proportion of children aged 3-59 months who received the full 3-day course of care across all four SMC rounds was described as full SMC coverage (Diawara et al., 2017). The highest coverage 84% recorded in this research was that of the. The first round is conducted by health staff, followed by a decrease in the subsequent rounds,

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where 67% was reported in the fourth round. The percentage of children who received all three days of therapy for all four rounds was 53.4%, according to the caregiver interview they did. Often travel and not being 43.1% aware 37.9% were the reasons recorded for this decline (Diawara et al., 2017). The same study concluded that the effect of SMC could be further strengthened by enhancing coverage through social mobilization and communication (Diawara et al., 2017).

2.5.2. Cost-effectiveness

Studies have shown that various delivery models of different malaria control strategies are cost-effective (i.e., they represent a fair use of the resources of society). Conteh et al.(Conteh et al., 2010) and Ross et al. (Ross, Maire, Sicuri, Smith, & Conteh, 2011) present the cost-effectiveness of various strategies for delivering child and infant intermittent preventive treatments. Once again, evidence exists that strategies for diagnosing malaria and treatment present value for money to society. These and other studies have shown that the approach recommended by the WHO to use trained community health volunteers to diagnose and treat uncomplicated fevers (including malaria) in children near their homes is cost-effective.

Although IPTc has been demonstrated to be cost-effective elsewhere (Conteh et al., 2010) and in Ghana (Ross et al., 2011), as recommended by the WHO in 2012, there is a lack of studies assessing the cost-effectiveness of SMC in its current approach (and using the combination of antimalarials). Conteh et al.(Conteh et al., 2010)'s study focused on IPTc delivery strategies using SP or AS (Artesunate)–AQ, while SMC uses SP plus AQ.

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2.5.3. Adherence

Adherence and compliance are two terms that are often used in medicine, and it is quite common to see similar meaning use of them. In the context of SMC and most of the Public health intervention, they are used as synonyms.

Adherence to malaria therapy is very critical for effective malaria treatment results, which is taking all the doses given. Non-adherence to SMC medication may contribute to the failure of prevention of the diseases, the spread of drug-resistant parasites, making the drug in the future less effective against the parasites (Ding et al., 2020a).

Numerous researches have been done in the Sahel region investigating the adherence of seasonal malaria chemoprevention (Medzihradsky et al., 2018; Pell et al., 2017; Roschnik et al., 2019; Somé et al., 2020).

The design, meaning and standard of treatment delivered from the point of view of the patient may all have implications for adherence. If intervention is considered appropriate, patients are more likely to obey care recommendations and benefit from better health outcomes(Kringos et al., 2015)

2.5.4. Factors associated with adherence to SMC

Malaria prevention programs must consider the role of populations in the implementation of effective strategies. The awareness, behaviors and practices of these populations must also be addressed when planning strategies. Patient adherence to malaria medicines has been related to awareness of malaria, access to information on malaria medicines, perceived benefit from medicines, and perceived obstacles to treatment(Okuboyejo & Eyesan, 2014).

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Studies have shown that the level of education is linked to adherence to immunization campaign including SMC. The more educated a caregiver are, those who accept and adhere to in any medication targeting their children.

Researchers have found that participation rates of rural residents are low compared to urban residents. (Diawara et al., 2017) indicated that the SMC membership rate is similar to 95%, but the reliability in this regard is uncertain (Diawara et al., 2017). Although this is not the case with SMC, a study comparing different malaria prevention regimens in Ugandan children showed that adherence to a three-day course of dihydroartemisinin-piperazine was significantly higher when reported by the caregiver (~100%) than when the drug concentration was unbiased (Bruxvoort et al., 2015). A longitudinal study conducted in Nigeria by (Ward et al.) found a lower rate of adherence, with their research revealing that adherence was 83.8% (Ward et al., 2019b). A study in southern Ghana and other African countries using AS+AQ also found high levels of adherence (81% - 97%) among caregivers (Asante et al., 2009).

A randomized, placebo-controlled trial of SMC in Ghana showed nearly 100% adherence over three days of SMC in all research communities. However, it was found that some caregivers had residues of MCC tablets that had not been administered (Bigira et al., 2015). Another way to measure adherence is to test drug levels in children's blood over a follow-up period (Bigira et al., 2015).

In Mali (Diawara et al., 2017) it was found that caregivers' views on SMC were very positive. 99.9% of the parents stated that they considered the strategy as good or very good and 99% were in favour of continuing the intervention. SMC's strong support and positive opinion are important assets for the continuation and extension of the intervention (Diawara et al., 2017).

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Having good knowledge is an essential predisposition for adhering to the three doses of AQ-SP. (Mazigo et al., 2010).

2.5.4. Reason for non-adherence to SMC

Side effects and treatment regimens have been found to be important determinants of patient commitment, perception, and acceptability of clinical intervention and will influence adherence(Asante et al., 2009)

A study conducted in Mali on the effect of SMC recorded that on the first day, a significant proportion 21.3% of children spat out or vomited SMC medication. The percentage of day 1 spitting or vomiting replacement dose was lower 8% and similar to the percentage of day 2 spitting or vomiting given at home by parents 6.2% and 6.5 % (Diawara et al., 2017). This may be due to the composition of the amodiaquine-containing tablets, according to the authors (Cissé et al., 2016; Diawara et al., 2017).

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CHAPTER THREE

METHODS

3.1. Study Design

It was a cross-sectional study. Data were collected with in households.

A household cross sectional survey was conducted in four sub districts of the Builsa North district using a semi-structured questionnaire prospectively to assess the coverage and the adherence with SMC among caregivers.

3.2. Study Area

The study was conducted in the Builsa North District, one of the nine (9) districts in the Upper East Region of Ghana.

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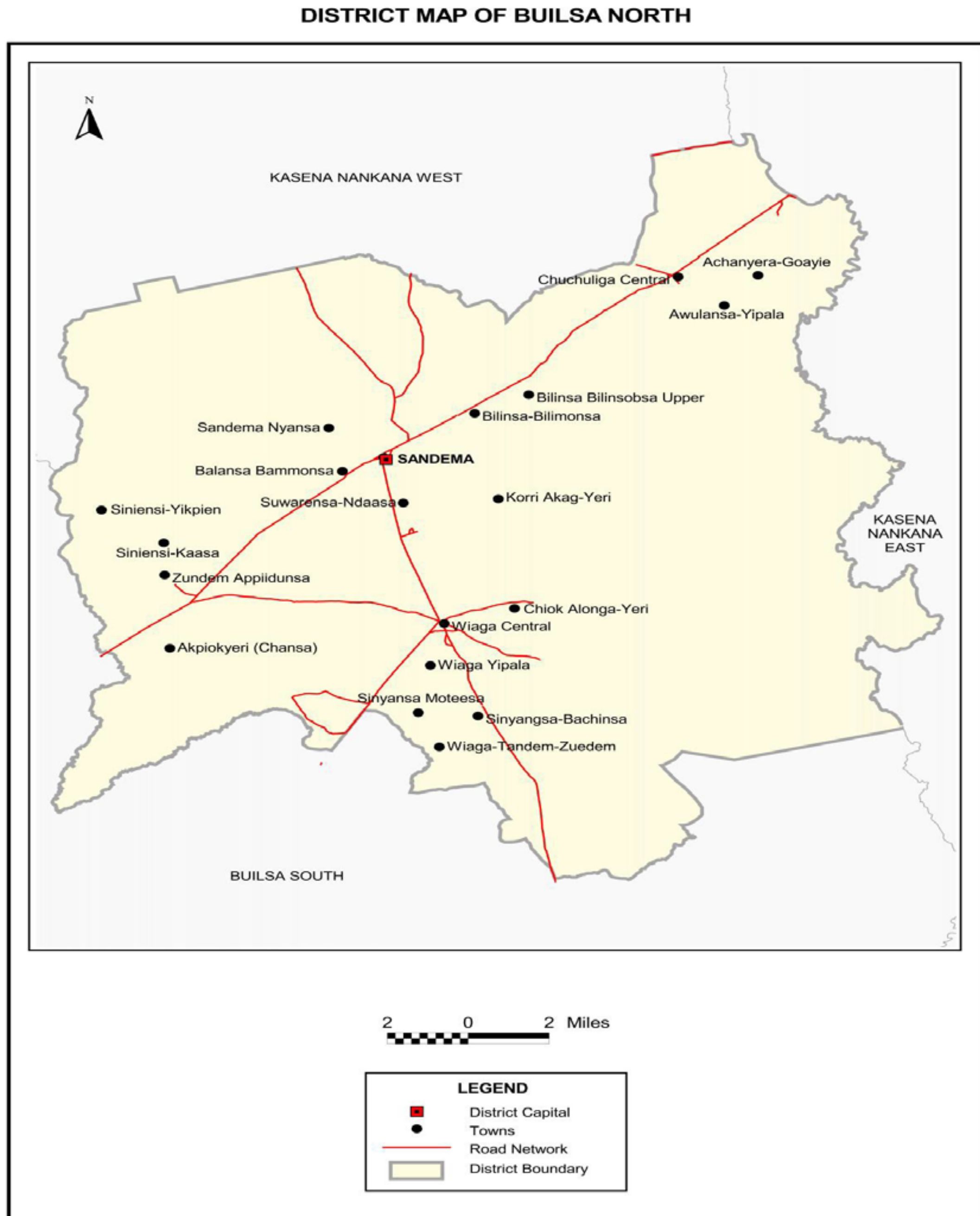

Figure 3:Map of Builsa North ("Census 2010 Builsa North District - Bing," n.d.)

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3.3. Description of Study Site

3.3.1. Demographic characteristics

The population of Builsa North District encompasses 98 communities. Builsa North District is predominantly rural, with agriculture as the main economic activity undertaken by self-employed farmers. The capital is Sandema. It is situated about 58 km from Bolgatanga, the regional capital city of Upper East Region. The Builsa North District shares boundaries with Kassena–Nankana West District to the North, to the West with Sissala East District, to the East with Kassena–Nankana East Municipal south with Builsa South District. The district covers an estimated land area of 816.44030 km2, which lies between longitudes 10 05‟West and 10 35‟ West and latitudes 100 20‟ North.

The District has a hospital (District Hospital - Sandema) and 7 health centers: Lucas Catholic Health Center, Presby Health Center-Sandema, Chuchuliga Health Center, Doninga Health Center, Fumbisi Health Center, Kanjarga Health Center. The District has 10 Community-Based Health Planning and Services (CHPS) zones: Bachonsa, Chansa, Gbedema, Gbedemblisi, Kadema, Kalijiisa, Kori, Kunkwak, Musidema, Muteensa, Namonsa.

3.3.2. Study Population

All caregivers in the Builsa North district were included in the study population. The projected population of this targeted household in the District for 2017 was 10,872 projected from the 2010 population census data as in the Builsa North district health administration profile.

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3.4. Variables

Table 2 Study Variables

Variable	**Operational definition**	**Scale of measurement**	**Source of data**
Age	Age at last birthday in years	Continuous-discrete	interview
Educational level	Highest level of education attained	Categorical No formal education Primary Secondary Tertiary	interview
Marital status	Whether married, single, divorced or widowed	Categorical Single Married Divorced widowed	interview
Occupation	Current Employment status	Categorical Housewife Unemployed Formal Work others specify	interview

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Religion	Religious belief/faith	Categorical Christian Muslim African Traditionalist Other	interview
Residential address/ Location	The name of sub-district	Categorical Sandema Central Wiaga Central Chuchuliga Central Siniensi-Yikpien	interview
The number of people in the Household	The total of all the people currently living in the house at the moment of the survey	Discrete	interview
The number of children under 5 years in the household	The total number of all the children under 5 years old living in the household at the moment of the survey	Discrete	interview

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Awareness of malaria	The awareness of the existence of malaria	Dichotomous Yes No	interview
Knowledge about the causes of malaria	The ability of respondent to know the cause of Malaria	Categorical Mosquito bites fly bites eating fat food drinking dirty water being in the sun no idea others specify	interview
Knowledge about effects of malaria on children under five	The ability of respondent to know the common symptoms of Malaria	Categorical Anaemia Convulsion Mental confusion Death other	interview
Knowledge about use for prevention methods of malaria	The ability of respondent to know some prevention methods of Malaria	Categorical Bed nets IRS ITPp Vaccine no idea other	interview

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Being informed about seasonal malaria chemoprevention	The awareness of respondent about SMC	Dichotomous Yes No	interview
Source of knowledge about SMC	All the source used by the care givers/parents to inquire information about health	Categorical TV Radio CHWs Health Centers Community Leaders Friends	interview
Knowledge of the purpose of SMC	The awareness of respondent about the purpose of SMC	Dichotomous Yes No	interview
Knowledge of the number of dose of SMC	The awareness of respondent about the number of SMC dose for a child during SMC campaign	Dichotomous Yes No	interview
Knowledge of the number of days for a child	The awareness of respondent about the number of days	Dichotomous Yes No	interview

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	a child should complete SMC dose		
Knowledge of the minimum age required for SMC	The awareness of respondent about the minimum age required for a child to be eligible to swallow AQ+SP.	Dichotomous Yes No	interview
Malaria knowledge Level	The total score of the respondents' knowledge on Malaria	Categorical Poor Low Good Very Good	interview
SMC knowledge Level	The total score of the respondents' knowledge on SMC	Categorical Poor Low Good Very Good	interview
Reception of SMC from durg distributors	The number of children who received AQ+SP	Dichotomous Yes No	interview
Adherence	Numbers of children under five who	Dichotomous Yes	interview

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	completed the three days medications	No	
Reason of nonadherence	The reason for why the caregivers did not give AQ+SP supplements doses	Categorical Radio CHWs Health Centers Community Leaders Friends	interview

3.5. Inclusion Criteria

All caregivers :

- who had been resident in the District for the past six months
- who were present in community during the first round of SMC in 2020.
- who were attended randomly within the period of data collection.
- who had at least one child under five during the study period.

3.6. Exclusion Criteria

All caregivers who were not present in their household during the study.

All caregivers who have refused to participate.

3.7. Sampling

3.7.1. Sample Size

Because of the large population, we determined sample size using the Cochran formula.

$$N0 = \frac{Z \times Z \times P \times Q}{e \times e}$$

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Where N0 z e p is the required sample size,

Z is the abscissa of the normal curve that cuts off an area α at the tails,

e is the desired level of precision (set at 5% for this arm because of the attendance proportion is high),

p=50%, since the proportion of the parents/caregivers who adhere with the SMC, is unknown, we will assume by default 50%.

q=1-p (equal 1-0.5 for this study)

Thus $N0 = (1.96)^2 \times (0.5) \times (1-0.5) / (0.05)^2 = 384$

Using a 5 % markup for non-response, the final required sample size was 400.

3.7.2. Sampling Method

Multi-stage sampling was used. As several sampling methods, it was used at various stages to get multiple sampling units right from the district level to the last smallest sampling unit–the respondents at the different households.

District Level

At the district level, the Builsa North District has been stratified into six (6) sub-districts (Sandema Central, Bilinsa-Bilimonsa,Wiaga Central, Chuchuliga Central, Siniensi-Yikpien, Suwarensa-Ndaasa) to ensure fair representation of some of the population's essential characteristics. At this point, simple random sampling by non-replacement balloting was used to select four (4) communities from the six (6) strata by balloting where the names of the different sub-districts or communities were written on pieces of paper, folded, and placed in a bowl.

Eyes closed; a hand was dipped into the bag to choose a folded paper without replacement. The sub-districts selected in this way were used as study sites where caregivers were recruited for the

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study. A proportionate sampling approach has been used to assess the number of participants included per population.

Community level

Each community was stratified by four areas, east, west, south and north. Starting from the community chief's house, the researcher selected randomly the direction of movement. Depending on the direction selected, for instance, to the west, the researcher went from house to house in that direction, then to the south, east and north in the same area.

Household Level

In each house, a caregiver who was 18 years of age or older and accepted to take part in the study and lived in a household and fulfilled all the inclusion criterion was interviewed. In the case that a house had more than one household, one of them was chosen randomly to complete a questionnaire. In the event that the sample size was not obtained from one area due to a lack of eligible participants on the population of each area, data collection proceeded in the next enumeration area. This method was repeated until the final size of the sample was collected.

The number of interviews to be performed in each sub-district depended in each sub-district on the approximate proportion of women of reproductive age. We assumed that women around reproductive age (18-49) were the primary caregivers for drug administration during SMC campaigns, then for this study. In this study, we chose the age groups (15-54) as the target population. We used the World Bank demographic data on the distribution of age groups by sex ("Ghana Overview," n.d.)(Table3). Then we calculated the number of women of reproductive age in each sub-district (table 4) (table 5).

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Table 3: The estimated population of Ghana in 2018

Age groups	Proportion	Male	Female	The total population of a female between (15-54)
0-14	37.44%	5,524,932	5,460,943	
15-24	18.64%	2,717,481	2,752,601	7,930,560
25-54	34.27%	4,875,985	5,177,959	
55-64	5.21%	743,757	784,517	
65>	4.44%	598,387	703,686	

The total is about 29 640,248.

Hence, The proportion of female population form (15 to 54) $= \frac{7,930,560}{29,640,248} X100$ =26.76%

Table 4 The estimated population of (15-54) age group in each sub-district

Sub-districts	Total Population of Subdistricts	Estimated Population of women between (15-54) in subdistricts
Sandema Central	5,226	5,226 x 26.76% = 1398.271
Wiaga Central	1,406	1,406 x 26.76% = 376.19
Chuchuliga Central	1,122	1,122 x 26.76% = 300.20
Siniensi-Yikpien	1,094	1,094 x 26.76% = 292.71
Total	8,848	8,848 x 26.76% = 2,367.37

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Table 5:The required sample size for each sub-district

Sub-districts	Estimated Population of women between (15-54) in subdistricts	Sample size calculation for each subdistrict	Sample Size required
Sandema Central	1398.271	400×1398.2÷2367.3=236.2	236
Wiaga Central	376.19	400×376.19÷2,367.3=63.56	64
Chuchuliga Central	300.20	400×300.2÷2,367.3=50.72	51
Siniensi-Yikpien	292.71	400×292.7÷2,367.3=49.45	49
Total	2,367.37	-	400

3.7.3. Data Collection Techniques / Methods and Tools

This study used a semi-structured questionnaire to collect data from the 400 participants from the four (4) sub-districts using a face-to-face interview. The questionnaire was designed or constructed in simple English to reflect the study variables and allow easy translation by research assistants (RAs) or data collectors. However, questions were asked or translated into local dialects Buli language, Kantonsi language, Fulanis language, Dagomba language, Mossi language, agari language for better understanding, especially for participants who did not receive formal education during the administration process opposite to face. The questions in the questionnaire focused on specific vital demographic characteristics of the respondents, the general knowledge about malaria, general knowledge about SMC. The tool was pre-tested with

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ten (20) households in Navrongo, Upper East Region of Ghana, where the ambiguities concerning supervision and asking questions were corrected.

3.8. Data Collection Procedure

In households, a simplified presentation was done, including the risk and benefits of participation, as described in the participant information sheet.

After then, the respondents were invited to participate in the study. Those who agree to participate were asked to fill and sign two copies of the consent form. So, the research assistant gave one copy of the consent form to the respondent and one copy of the participant information sheet. A structured questionnaire directed the interview for each respondent who took, on average 15 minutes' time. A total of twenty-four questions of three sub-sections were used to get answers on sociodemographic characteristics, knowledge of SMC malaria and satisfaction of SMC, and AQ+SP reception during the SMC previous campaign and adherence to the SMC.

3.9. Quality Assurance

Research assistants were trained for 2 days on the protocols and data collection procedure by the PI. The training covered; understanding and interpretation of data collection tools, interviewing techniques and techniques, privacy, and confidentiality issues, how to translate the questions from the English language into the local dialects.

Pretesting of the questionnaire was also carried out before actual data collection began with the Research Assistants. The PI supervised the four sub-districts during the data collection and resolved any risen concerns on the operation. After filling a questionnaire, quality control was performed on the information gathered before selecting further respondents.

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3.10. Data Processing and Analysis

The raw data of the field, after having been manually cross-checked to ensure completeness, was entered in Kobocollect using tablets, then downloaded as a Microsoft Excel file before being exported to STATA version 16 (Stata Corporation, College Station, Texas) for further management and analysis. To ensure accuracy and completeness, the data was further cleaned up by running the frequencies of all variables to verify incorrect coding using STATA.

The coverage of the SMC campaign was estimated using the number of children five who received the AQ+SP divided by the targeted number of children under five counted across the survey. The proportion of caregivers who adhered to SMC reported in proportion by dividing the number of caregivers who reported that their children completed the three doses of AQ+SP. Basic descriptive statistics were obtained on the sociodemographic characteristics of the respondents and the knowledge variables.

Two derived variables on the malaria knowledge level and SMC knowledge level were generated in STATA by scoring the knowledge dichotomous knowledge variables while a correct answer given was scored as 1, and a wrong answer was scored as 0. Then total scores were categorized into four groups: poor knowledge, insufficient knowledge, good knowledge, and very good knowledge.

The results were presented in frequencies and percentages using tables and graphs. Frequencies were generated to describe categorical variables, while continuous variables were expressed as arithmetic means and standard deviations for normally distributed variables, median, and quartiles for variable not following the binominal distribution.

Pearson's chi-square test was used to compare the proportions in cross tables with high observed observation, and the Fisher exact test was used to compare the proportions with low

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observed observation. The bivariate analysis (Fisher exact test and Chi-square test) were used to assess the crude association between potential predictors of the adherence, while univariate analysis was performed to estimate the strength of associations between the adherence and its predictors after controlling for the covariates. After then, all the key potential factors (residence, marital status, satisfaction level, number of children, occupation, SMC knowledge level, knowing the purpose of the SMC, Source of knowledge on SMC, household size) were used to perform different regressions models, the Bayesian Information Criteria (BIC) was used to choose the best-fitted model, among others.

3.11. Ethical Consideration

3.11.1. Ethical Clearance

The protocol was submitted to the Ethics Review Committee of the Ghana Health Service for ethical clearance to conduct the study. On the field, the study will be presented to the chiefs and elders of the selected communities for their approval before any data collection.

3.11.2. Benefits

There were no direct benefits to participants for being included in this study. However, participation in this study may help the Builsa North District, Upper East Region, and NMCP and its partners to adopt strategies that would make SMC more effective in preventing malaria. The community may benefit indirectly from the study since the outcome of the research could inform future policy direction on SMC as an intervention.

3.11.3. Risks

Participating in this study presented a minimal risk for the participants.

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The study had been carried out during the COVID 19 pandemic. So, to ensure the study participants and research assistants' protection, here are the safety measure the study adopted.

Due to the COVID-19 pandemic, the study participants were supplied with an alcohol-based hand sanitizer and a new mask before the interview started. They always needed to wear during the interview. The participants also were informed about best practices about how to dispose of the reusable mask care mask. The study ensured that the interviews maintain a social distance of at least 6 feet (about 2 arm lengths). The research team also maintained appropriate hygiene standards through handwashing and using an alcohol-based sanitizer. Face masks were still worn and changed every 3 hours after.

3.11.4. Confidentiality

Study participants' personal information never discussed with anyone outside the study. Information about participants and their households will be kept private and confidential.

3.11.5. Voluntary Participation

Participating in this study was entirely voluntary, and a respondent's decision to participate or not to participate was not affected by their household members. Participants who did not accept participating in this study still could refuse to answer any of the questions that made them feel uncomfortable.

3.11.6. Rights to Refuse or Withdraw

Respondents had the right to withdraw from participating in the study at any point in time. There was not any form of penalty whatsoever to respondents who decided not to continue an interview.

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Informed consent was obtained from household heads and study participants. Informed consent forms were given to all the participants. They were allowed to seek clarifications on clauses in the consent form that did not seem clear. Those who accepted to participate in the study signed or thumb printed beneath the form to indicate their acceptance. For participants who could not read and understand the clauses in the consent form, a witness was present, while the clauses in the consent form read to the participant. Both the participant and the witness signed, or thumb printed beneath the form to indicate their acceptance. Copies of the consent form were given to the participant for his/her records.

3.11.7. Data Storage and Usage

Data from this study have been stored in a cabinet and locked. Access to data will be limited to only the Principal Investigator and his Supervisor. No one, other than these two persons will have access to the data. The data will be used solely for purposes of research and not to any other use.

3.11.8. Declaration of Conflict of Interest

The Principal Investigator, his supervisor, or Research Assistants do not have any personal or financial interest in this study.

3.12. Funding Information

This research project was funded by the World Health Organization Special Program on Tropical Disease Research (WHO/TDR) through the African Regional Training Center (ARTC) and Office of Research Innovation and Development (ORID) at the University of Ghana.

3.13. Dissemination of Results

The finding of this study will be presented to the School of Public health, the University of Ghana, the Builsa North districts, the Upper East Regional health directory, the Ghana National

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Malaria Control Program (NMCP), and WHO/TDR. Presentations will also be made to present the findings of the study and manuscripts submitted for review and publication in academic journals.

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CHAPTER FOUR

RESULTS

4.1. Sociodemographic characteristics of Study Participants

All the 436 respondents of children under five who were asked to participate in the study consented and completed the interviews (100 % response rate). The median age of respondents was 29 years (range: 33). About half (47.71%) were between 20 to 29 years old.

More than half of the respondents were married 60.78 % (265/436) (Table 6) following that Single 18.35% (80/436), cohabiting 13.76% (60/436), divorced 3.9 % (17/436) and widowed 3.21 (14/436) represented the rest of the study population.

Builsas ethnic group formed 78.67 % (343/436) of the study population, with 37.39 % (163/436) having no formal education, 49.31 % (215/436) being a housewife without any other specific occupation. About 64.45% (281/436) of the respondents had only one child, while the rest of the 35.55% (155/436) had at least two children. The mean household size was estimated to be 5.24 people living in a household ± 1.63 standard deviations (SD), as stated in table 6.

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Table 6: Sociodemographic characteristic of caregivers in the Builsa North District

Sociodemographic Characteristic	Frequency	Percentage %
Age		
Median (minimum-maximum)	29(17-50)	-
<20	19	4.36
20 - 29	208	47.71
30 - 39	164	37.61
40 - 49	45	10.32
Marital Status		
Never married	80	18.35
Married	265	60.78
Cohabiting	60	13.76
Divorced	17	3.9
Widowed	14	3.21
Religion		
Christian	357	81.88
Muslim	55	12.61
Traditional	24	5.5
Ethnic		
Builsa	343	78.67
Mossi	40	9.17
Sissala	28	6.42
Others*	25	5.74
Educational Status		
No formal education	163	37.39
Primary	77	17.66
Secondary	99	22.71
Higher	97	22.25
Occupation		
Unemployed/Housewife	215	49.31
Formal work	122	27.98
Others**	99	22.71
Number of Children under five		
One child	281	64.45
Two children and more	155	35.55
Household Size		
Mean (± Standard deviation)	5.24 (±1.63)	-
Median (minimum-maximum)	5 (3 - 8)	-
3 – 4	163	37.39
5 – 6	164	37.61
7 – 8	109	25.00

* : Fulani, Akan, dago, others; **:artisan, hairdressing, farming, buying and selling.

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4.2. Coverage and adherence level to the SMC first round in 2020

Most of the caregivers interviewed 90.87% (388/436) reported that all their children received the AQ+SP from drug distributors during the first round of 2020, as shown in Figure 5. The adherence rate to SMC among caregivers those whose children were covered during the drug distribution of the first round was measured. Among them, 4.63% (18/388) reported that all the children had not completed the three regimens of AQ+SP. The findings are seen in Figure 6.

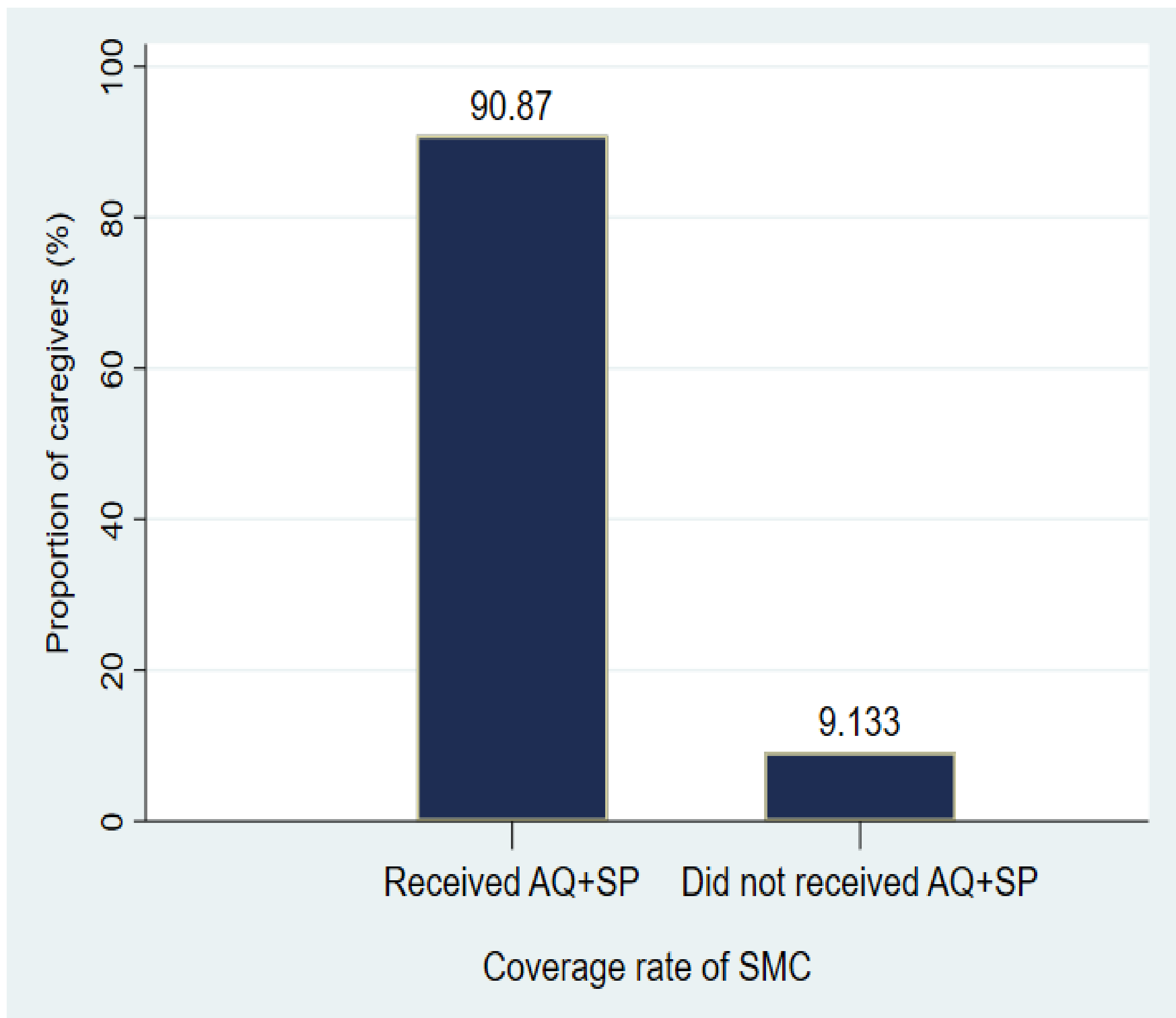

Figure 4: Coverage rate of any dose of SMC during the first round in Builsa North District 2020

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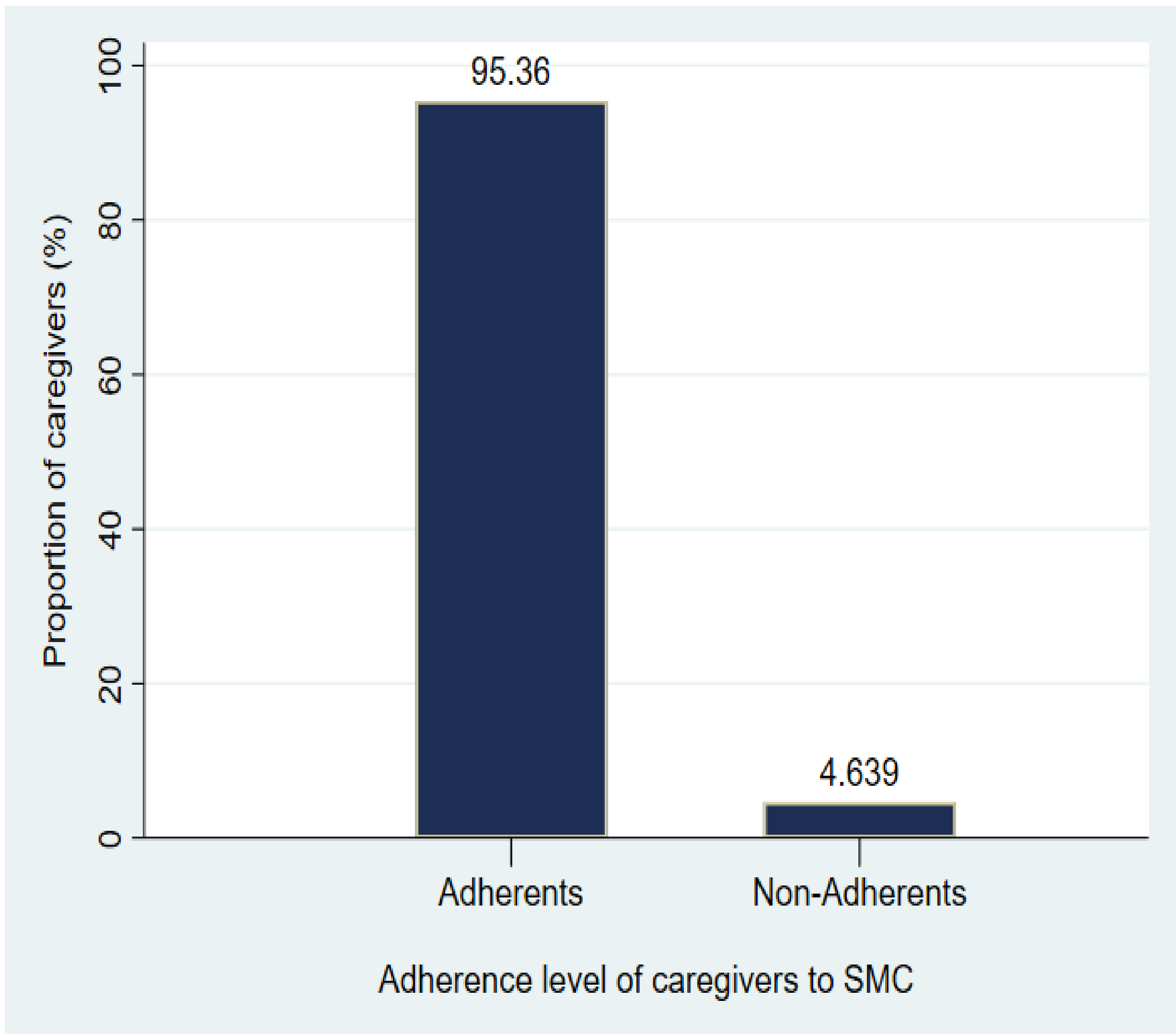

Figure 5: Adherence level of caregivers to the recommended dose of SMC during the first in Builsa North District 2020

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4.3. Reasons for non-adherence

Four main reasons were reported by the 18 caregivers who did not adhere to SMC during the first round of drug distribution. The primary cause they reported for non-adherence was the child's refusal 38.46% (7/18), followed by the child's vomiting of the drug 33.33% (6/18), the occurrence of an illness within the period of medication 15.38% (3/18), adding to that some reported that they forgot to give the drugs the subsequent two days 12.82% (2/18). These results are shown in Figure 7 below.

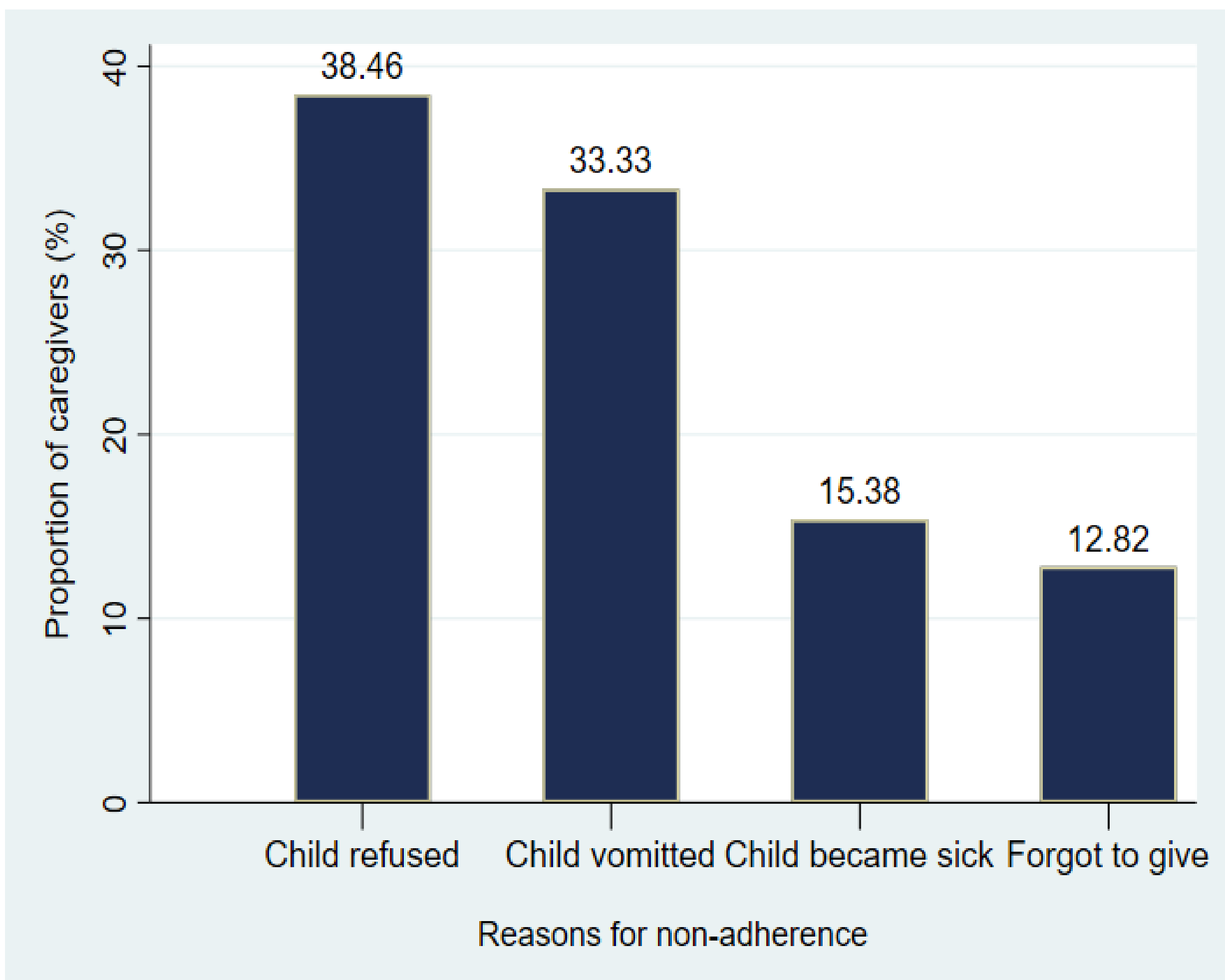

Figure 6: Reasons for non-adherence to unsupervised daily treatment doses of SMC

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4.4. Awareness and Knowledge

Almost all the respondents, 97.94% (427/436) reported having ever heard of SMC, as seen in Figure 8. Among those aware of SMC, the responses collected from the knowledge assessment on Malaria in children and SMC are summarized in table 7. The knowledge on Malaria was assessed using three questions, Knowledge of the cause of malaria was high (98.62%) through a mosquito bite. Anemia, convulsion, and mental confusion were mentioned respectively by 90.60%, 93.81%, 91.74%, 91.97% of caregivers as the effect of untreated malaria on the child. Most (92%) of caregivers mentioned insecticide-treated nets and mosquito repellent as malaria preventive methods, while among malaria preventive methods, 46.67% mentioned IRS. The knowledge of SMC caregivers was also evaluated using five questions. Of the 436 caregivers, 288 (78.69%) mentioned that AQ+SP administration is intended to prevent malaria in children. More than half of them mentioned that the number of regimens is 3 doses for each child during a round of distribution. Only 18 caregivers mentioned the minimum age required for AQ+SP medication.

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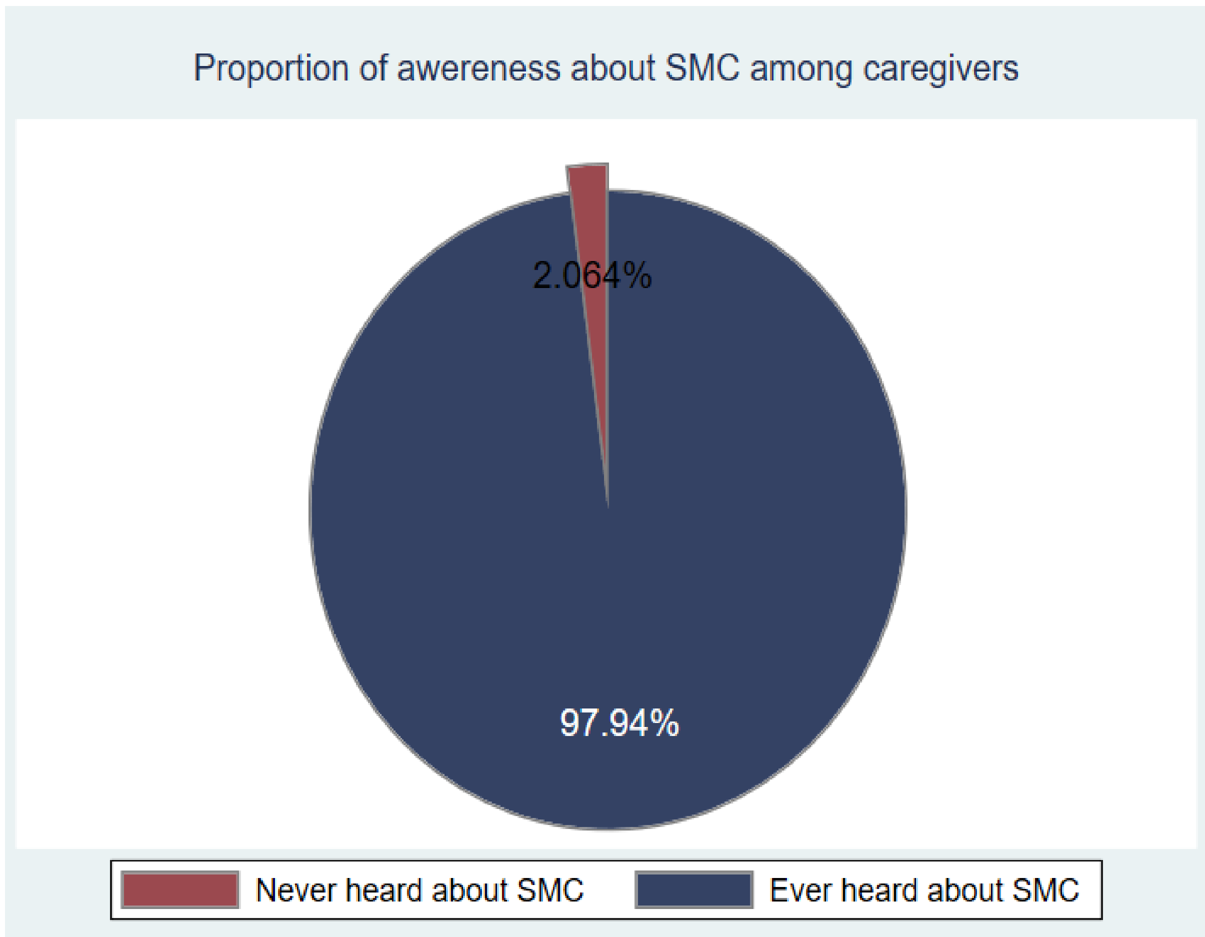

Figure 7: Levels of awareness of Seasonal Malaria Chemoprevention

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Table 7: Knowledge of Malaria and SMC among caregivers

Knowledge Variables	Responses	Frequency (%)
Malaria		
Cause of malaria		
	Mosquito bite	430 (98.62)
Effect of untreated malaria on child		
	Anemia	395 (90.60)
	Convulsion	409(93.81)
	Mental Confusion	400 (91.74)
	Death	401 (91.97)
Malaria Preventive methods		
	Insecticide Treated Nets	403 (92.43)
	Daily use of mosquito repellent	405 (92.89)
	IRS during raining season	203 (46.67)
Seasonal Malaria Chemoprevention		
Purpose of SMC	Prevent malaria in children under five	288 (78.69)
Number of regimens	3 doses	242 (66.12)
Intervention season in the year	Only raining season	255 (69.67)
Number of days for a child	3 days	295 (80.60)
Minimum age required for SMC medication	3 months	18 (4.92)

Generally, half of the respondents, 49.31% (215/436), had good knowledge of malaria in children, while 2.29% (10/436) had poor knowledge. The Knowledge level on SMC was mainly fair for respondents 66.51% (290/436), while a few of them had good knowledge of 8.26% (36/436). Those who had very good knowledge of SMC represented the minority 4.13% (18/436) Table 8.

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Table 8: Level of Knowledge of caregivers on Malaria and SMC

	Malaria	SMC
Level of Knowledge	**Frequency (%)**	**Frequency (%)**
Poor knowledge	10 (2.29)	92 (21.10)
Fair knowledge	59 (13.53)	290 (66.51)
Good knowledge	215 (49.31)	36 (8.26)
Very good knowledge	152 (34.86)	18 (4.13)

Nearly half of the respondents, 43.56%, reported that local radios are their source of knowledge on SMC, followed by health centers 29.04% and community health workers 11.71%. However, some minorities of them reported public announcement, through friends, and TV as their source of knowledge on SMC presented in Figure 9.

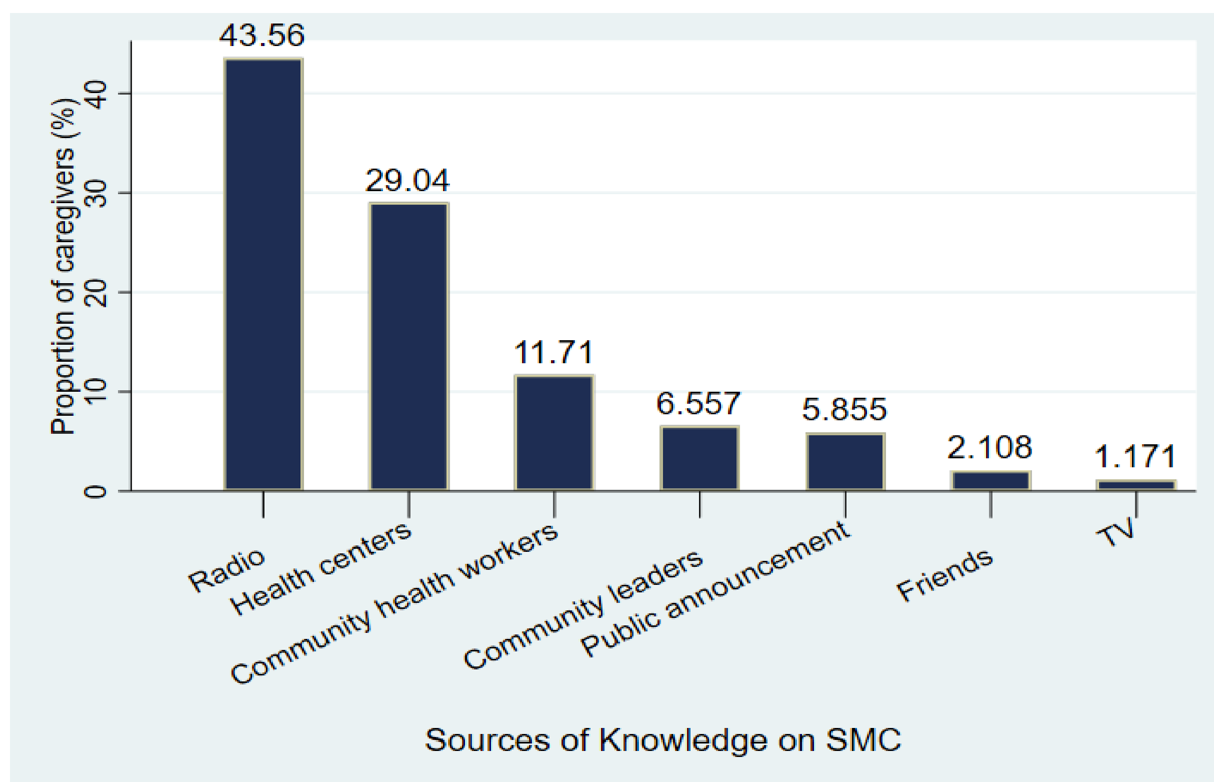

Figure 8: Source of Knowledge on SMC

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4.5. Bivariate association for adherence to unsupervised daily doses of SMC

4.5.1. Sociodemographic and adherence to unsupervised daily treatment doses

Respondents under the age of 20 (5.26 %), Muslims (10.42 %), married (61.34 %) trained (35.51 %), single and widowed (8.33 %), those with primary education (7.04 %), housewife (5.38 %), those residing in smaller households (5.88 %) and those with two or more children were more likely to be non-adherent. However, there was no statistically significant relationship between age, gender, marital status, race, educational degree, profession, family size, number of children under five, and adherence (all p-values > 0.05). The findings are listed in table 9 below.

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Table 9:Sociodemographic factors and adherence to unsupervised daily treatment doses of SMC

Characteristics	Total (%)	Adherence		p-value
		No (%)	Yes (%)	
Age				0.99*
<20	19 (100)	1 (5.26)	18 (94.74)	
20 - 29	187 (100)	9 (4.81)	178 (95.17)	
30 - 39	145 (100)	7 (2.70)	138 (95.17)	
40 - 49	37 (100)	1 (2.70)	36 (97.30)	
Religion				0.14*
Christianity	321(100)	13(4.05)	308(95.95)	
Islam	48(100)	5(10.42)	43(89.58)	
Traditional	19(100)	0(0.00)	19(100)	
Marital Status				0.38*
Never married	72 (100)	6 (8.33)	66 (17.84)	
Married	238 (100)	9 (3.78)	229 (96.22)	
Cohabiting	50 (100)	2 (4.00)	48 (96.00)	
Divorced	16 (100)	0 (0.00)	16 (100)	
Widowed	12 (100)	1 (8.33)	11 (91.67)	
Ethnic				0.33*
Builsa	301 (100)	12 (3.99)	289 (96.01)	
Mossi	37 (100)	3 (8.11)	34 (91.89)	
Sissala	26 (100)	1 (3.85)	25 (96.15)	
Others	24 (100)	2 (8.33)	22 (91.67)	
Education				0.75*
No formal	139 (100)	6 (4.32)	133 (95.68)	
Primary	71 (100)	5 (7.04)	66 (92.96)	
Secondary	96 (100)	4 (4.17)	92 (95.83)	
Higher	82 (100)	3 (3.66)	79 (96.34)	
Occupation				0.78*
Housewife/Unemployed	186 (100)	10 (5.38)	176 (94.62)	
Formal Work	113 (100)	4 (3.54)	109 (96.46)	
Others	89 (100)	4 (4.49)	85 (95.51)	
Household Size				0.78**
3 – 4	136 (100)	8 (5.88)	128 (94.12)	
5 – 6	153 (100)	6 (3.92)	147 (96.08)	
7 – 8	99 (100)	4 (4.04)	95 (95.96)	
Number of Children under five in household				0.54**
One child	242 (100)	10 (4.13)	232 (95.87)	
Two children and more	146 (100)	8 (5.48)	138 (94.52)	

*: Fisher Exact Test, **: Chi-Square of Pearson

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4.5.2. Awareness related factors and adherence to unsupervised daily doses

Four independent variables were involved in this analysis. Malaria Knowledge level, SMC knowledge level, and SMC Source of Information concerned the Participants who indicated they are aware of SMC. Those with children covered by SMC during the first round of 2020 were concerned with assessing the level of satisfaction with the drug distributors. Respondents with low knowledge of malaria (5.45%), low knowledge of SMC (5.66%), and whose knowledge source is their friend (33.33%) and dissatisfied with drug distributors (20.69%) were most likely to be non-compliant. There was statistical significance for adherence with source of knowledge (p-value = 0.007) and satisfaction level (p-value = 0.000). The other two variables were not statistically significant with adherence (their p-value is greater than 0.05). These results are illustrated below in Table 10.

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Table 10: Awareness related factors and adherence to unsupervised daily treatment doses of SMC

Characteristics	Total (%)	Adherence		Fisher exact test p-value
		No (%)	Yes (%)	
Malaria Knowledge Level				0.72
Poor	6 (100	0 (0.00)	6 (100)	
Low	55 (100)	3 (5.45)	52 (94.55)	
Good	189 (100)	7 (3.70)	182 (96.30)	
Very good	138 (100)	7 (5.07)	131 (94.93)	
SMC knowledge Level				0.77
Poor	72 (100)	2 (2.78)	70 (97.22)	
Low	265 (100)	15 (5.66)	250 (94.34)	
Good	33 (100)	1 (3.03)	32 (96.97)	
Very good	18 (100)	0 (0.00)	18 (100)	
Source of knowledge on SMC				0.007**
Health Center	110(100)	4(3.64)	106(96.36)	
Community Health Workers	46(100)	0(0.00)	46(100)	
Community Leaders	24(100)	1(4.17)	23(95.83)	
Public announcement	22(100)	2(9.09)	20(90.91)	
Friend	9(100)	3(33.33)	6(66.67)	
Local Radio	172(100)	7(4.07)	165(95.93)	
TV	5(100)	1(20.00)	4(80.00)	
Satisfaction level with AQ-SP				<0.01**
Very satisfied	83(100)	2(2.41)	81(97.59)	
Satisfied	272(100)	8(2.94)	264(97.06)	
Dissatisfied	29(100)	6(20.69)	23(79.31)	
Very dissatified	4(100)	2(50.00)	2(50.00)	

**: p-value <0.05

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4.6. Multivariable logistic regression analysis for adherence to SMC

Table 11 shows the results of MLR SMC adherence analysis and selected independent variables. Data from the 388 caregivers in Builsa North District who said they received the AQ+SP in July 2020 were used to perform this logistic regression model.

Place of residence, level of satisfaction, marital status, number of children under five, occupation, SMC Level of knowledge, knowledge of the purpose of SMC, source of knowledge on SMC, household size were used to perform a simple and logistic regression.

The place of residence, the level of satisfaction, knowing SMC through a friend, residing in a household of at least five other persons were found to be affecting the SMC adherence.

The odds of adherence are 2.62 times higher among caregivers residing in urban areas than caregivers residing in rural areas, this finding was not found to be significant while unadjusted, but it was found to be statistically significant when adjusting for other factors (Adjusted OR = 2.62, 95% CI= [0.96, 7.14]).

Participants who reported being very dissatisfied with drug distributors had 98% lower adherence odds than those who reported being very satisfied (Crude OR=0.02; 95% CI = [0.00-0.27]).

Respondents reporting their knowledge source as a friend had 93% lower odds of adherence than those reporting their knowledge source as health centers (Crude OR=0.07, 95% CI = [0.01-0.41]).

Respondents who indicated that their household composition is six or more is 3.24 times more likely to adhere than those who indicated that their household size is less than six (Crude OR=3.24, 95% CI = [1.04-10.04]).

Table 11: Factors associated with adherence to SMC for logistic regression

Characteristics	Observations		Crude Odd Ratio		Adjusted Odd Ratio	
	Non-Adherent	Adherent	OR (95% CI)	p-value	OR (95% CI)	p-value
Place of residence						
Rural (Ref.)	12	160	1		1	
Urban	6	210	2.62 (0.96 - 7.14)	0.059	3.59 (1.02 - 12.56)	0.045**
Satisfaction Level						
Very satisfied (Ref.)	2	81	1		1	
Satisfied	8	264	0.81 (0.17 - 3.91)	0.798	0.74 (0.13 - 4.10)	0.735
Dissatisfied	6	23	0.09 (0.01 - 0.50)	0.006**	0.10 (0.01 - 0.74)	0.024**
Very dissatisfied	2	2	0.02 (0.00 - 0.27)	0.003**	0.02 (0.00 - 0.37)	0.008**
Marital Status						
Single (Ref.)	6	66	1		1	
Married	9	229	2.31 (0.79 - 6.73)	0.124	3.68 (0.93 - 14.60)	0.063
Cohabiting	2	48	2.18 (0.42 - 11.28)	0.352	4.45 (0.49 - 40.03)	0.183
Divorced /Widowed	1	27	2.45 (0.28 - 21.36)	0.416	1.67 (0.15 - 18.35)	0.673
Number of Children Under five						
One child (Ref.)	10	232	1		1	
Two and more child5 under five	8	138	0.36 (0.28 - 1.92)	0.542	0.51 (0.15 - 1.69)	0.272
Occupation						
Unemployed (Ref.)	10	176	1		1	
Formal work	4	109	1.54 (0.47 - 5.06)	0.469	2.7 (0.55 - 13.05)	0.216
Others	4	85	1.20 (0.36 - 3.96)	0.756	1.57 (0.36 - 6.84)	0.546
SMC Knowledge Level						
Low knowledge (Ref.)	17	320	1		1	
Good knowledge	1	50	2.65 (0.34 - 20.40)	0.348	1.93 (0.18 - 20.03)	0.582
Knowing the purpose						
No (Ref.)	4	53	1			
Yes	14	317	1.70 (0.54 - 5.38)	0.361	1.03 (0.20 - 5.31)	0.966

Source of knowledge on SMC						
Health Centers (Ref.)	4	106	1		1	
Community Leaders	0	46	0.86 (0.09 - 8.12)	0.901	0.43 (0.03 - 5.56)	0.519
Public annoucement	1	23	0.37 (0.06 - 2.20)	0.279	0.30 (0.02 - 3.30)	0.327
Friends	2	20	0.07 (0.01 - 0.41)	0.003**	0.04 (0.00 - 0.51)	0.013**
Radio	3	6	0.88 (0.25 - 3.11)	0.855	0.36 (0.08 - 1.62)	0.187
TV	7	165	0.15 (0.01 - 1.67)	0.124	0.72 (0.02 - 19.33)	0.85
Household Size						
< six people (Ref.)	10	232	1		1	
Six people and more	8	138	3.24 (1.04 - 10.04)	0.041**	8.26 (1.81 - 37.62)	0.006**

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CHAPTER FIVE

DISCUSSION

This study has identified some factors that significantly influenced the adherence to unsupervised daily treatment doses of SMC among caregivers in Builsa North District during the first SMC campaign in 2020.

The study shows that adherence rate to the SMC equal to 95.36%. This study also provides further evidence that, having more than one child under five, inquiring information on SMC through any other sources deafferents from health professionals, and being dissatisfied with the SMC are associated with a decrease of odds of adherence to SMC.

This research demonstrated that SMC is delivered effectively on a large scale in Builsa North District and achieved a high coverage with good adherence.

The coverage obtained from this study is 90.7 %. This coverage is lower than the coverage 83% from a randomized clinical trials conducted in Senegal by (Cissé et al.) while higher coverage 96% was found during and household survey in Negeria (Ward et al., 2019a). These differences in proportion could be related to the method of calculation. An alternative calculation of coverage is, counting all the children under five who received AQ-SP divided by total number of children under five (Cissé et al., 2016). In Mali (Diawara et al., 2017) found that, coverage was 80%. This was estimated by interviewing caregivers or counting through SMC card the number of children under five who received at least the first dose of SMC treatment.

In this study, the caregivers who adhered to SMC represented 95.36%. (Diawara et al.) reported that self-reported adherence to SMC is similar 95%, but the reliability in this regard is uncertain

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(Diawara et al., 2017). While this was not in the setting of SMC, a study comparing various malaria preventive regimens in Ugandan children showed that adherence to a 3-day course of dihydroartemisinin-piperaquine was much higher when reported by the caregiver (~100%) compared to the unbiased concentration of drugs (Bruxvoort et al., 2015). A lower adherence was found using a longitudinal study in Nigeria by (Ward et al.), their research found that the adherence was 83.8% (Ward et al., 2019b). Several factors may explain these observations, and it is likely that a mix of these reasons rather than one alone is responsible. First, there may have been a good understanding of SMC in Ghanaian community than Nigerian, because they Ghanaian health system is better in term of coverage than Nigerian's (Amu, Dickson, Kumi-Kyereme, & Maafo Darteh, 2018) . It is possible that the SP-AQ intervention improvements over the years contributed to increase the adherence in Builsa North District by reducing the frequency and/or severity of infections among participating children. A similar study in southern Ghana and other African countries using AS+AQ also found a high level of adherence (81% – 97%) among carers(Asante et al., 2009). These findings indicate that a high level of adherence to AS+AQ can be reached in remote areas where a successful treatment education program is in place. However, the adherence rate found in this sample could be an overestimation.

A randomized, placebo-controlled SMC trial in Ghana showed nearly 100% self-reported adherence to SMC's 3-day course across all research communities. However, some caregivers were found to have residual SMC tablets that had not been administered (Bigira et al., 2015). Another way to measure the adherence is by testing the levels of medications in the blood of children during a follow-up period (Bigira et al., 2015)

To reduce the incidence of malaria in children under five within an endemic community, a high proportion of adherence to SMC is indispensable. The adherence demonstrated by this study is

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associated with mainly to the good knowledge of SMC, the knowledge of the purpose of SMC, the larger household size, the place of residence, the satisfaction of caregivers with previous SMC, the source of knowledge of caregivers about SMC.

The study revealed that the respondents demonstrated a better awareness of malaria and SMC. This result is not different from what (Mazigo et al., 2010) and (Ingabire et al., 2015) reported on the knowledge of SMC. Having a good knowledge is an essential predisposition for committing to adhere with all the three doses of AQ-SP.

There is a tremendous need to intervene in the communication channels related to the SMC. The caregivers who reported that there have been introduce to SMC through their friend are likely to not adhere to the 3-days protocol while those introduced through professional sources are likely to adhere. This factor may be explained by lot of rumors that go from one to another about all the mass drug administration (MDA). Some people do not trust any free medication. In some remote areas people still trusting only traditional medicine. This gap of knowledge may explain the lack of importance of those who reported they forgot to give medicine to children.

There was a difference in household size observed in this study, Households composed of more than 5 people are more likely to adhere to SMC; this may be due to the increased number of people (sisters, brothers) to take care children besides the primary caregivers, this funding is inconsistent with the literature.

The perceptive factor assessed in this study is the satisfaction level with SMC. Most of caregivers reported that they are satisfied with SMC.

However, the study found that the tendency to adherence varied significantly with the level of satisfaction of caregivers, the more they are satisfied more they adhered to SMC. In Mali (Diawara et al., 2017) found that the opinions of parents about SMC were very positive, with

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99.9% of parents reporting that they felt the strategy was good or very good, and 99% of them were in favour of continuing the intervention. SMC's strong support and favorable opinion are major assets for continuation and scale-up (Diawara et al., 2017).

The reasons for non-adherence in this study were the child's refusal to swallow the drug, vomiting, illness after the first dose, and the mother's forgetting about the medication. In Niger, (Ding et al., 2020b) found that children refusing to take drug; suboptimal health worker instructions; small children spitting out medication, even if it is dissolved; vomiting within 30 minutes of dosing; caregiver saving medication for the treatment of another family member with acute malaria later on; caregivers sharing/giving medication to older children who were not eligible for SMC; fathers not allowing the medicine to be taken; and fatigue of giving medication, mainly when the child is not sick were the main reason for non-adherence cited by study participants were the main reasons of non-adherence to SMC (Ding et al., 2020b).

Ultimately, an integrated approach to funders, policymakers, health workers, applied health social scientists, drug distributors, community members, and all stakeholders will be appropriate for achieving the goal of the National Malaria Control Program in the Upper East region of Ghana.

5.4. Limitations of the study

Study results were based on the opinions and experiences of a representative Builsa North District subdistricts not for all the Upper East Region of Ghana. Therefore, the results can be generalized only to the sampled population in the district and not to the whole regional or national level.

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The present study adopted a quantitative approach only. A mixed approach (both quantitative and qualitative) would help define the deep reasons behind the non-adherence influencing factors.

The sex of household head and the distance to health facilities are important factors known to be associated with preventive treatments but were not assessed in this study.

5.5. Strength of the study

The strengths of this study include the fact that the study was carried out by a research team that was not involved in the implementation of the SMC.

There is a possibility for selection and observer bias as with any observational study. Study participants were selected at random to eliminate these biases.

The potential of recall bias could not be omitted; to minimize them, the survey was conducted in the four sub-districts about 1 week after the first round of SMC 2020.

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CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The present study found the coverage rate of SMC was 90.87% with an adherence rate at 95.36% in Builsa North District, Upper East Ghana.

The main reason for non-adherence is the child's refusal to take drug, the child vomiting, the occurrence of a disease, the caregiver's forgetting about medication.

Caregivers with good knowledge, those who have obtained extensive information about SMC from health care providers, those who have only one child, those who live in Town are likely to adhere to SMC.

The results of this study indicate that the caregivers in the district of Builsa North have a very good knowledge of the cause of malaria, its consequences on children, and its preventive methods. It also shows that more than half of caregivers in the district are aware of Seasonal Malaria Chemoprevention.

There has been considerable progress in Ghana's implementation of SMC at the distrct level. However, some factors regarding SMC like child refusal to take medicine, still have a bad effect on adherence rate to unsupervised doses. If specific strategies are not implemented to control them, they could spread and undermine all attempts made so far to achieve the reduction of the burden of malaria in children under five may be spread.

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6.2. Recommendation

Based on the results of this study, we recommend:

- Builsa North District:
  - ✓ Strengthening SMC health education and the importance of SMC before and during campaigns.
  - ✓ Use innovative tools like social media to educate caregivers on the importance of SMC.
- Drug distributors: To achieve a high level of drug coverage as much as possible and to ensure that the caregivers give the subsequent daily doses.
- Community members: to rceport to drug distributors all witnessed adverse event and to encourage children to take drugs.
- Researchers: To undertake further SMC research studies in the Ghanaian communities using both quantitative and qualitative approaches and involving many more communities in order to investigate other factors that may interfere with SMC adherence and to develop effective strategies for a sustainable successful SMC implementation in Ghana.

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ANNEX

APPENDIX A: PARTICIPANTS INFORMATION SHEET

Title of Study:

Factors Influencing the implementation of Seasonal Malaria Chemoprevention in Builsa North District, Upper East Region of Ghana.

Introduction

My name is Cheick Oumar Doumbia; I am a graduate student at the School of Public Health, University of Ghana, Legon, Accra. I am Staying at Valco Trust Hostel Phase 2 and can be contacted on 0202377195. Email: doumbiacheickoumar@yahoo.fr

Background and Purpose of research

The purpose of the research is to assess the factors influencing the implementation of Seasonal Malaria Chemoprevention in Builsa North districts, Upper East Region, Ghana.

Nature of research

This study is assessing the the factors associated with the compliance to unsupervised daily treatment doses of Seasonal Malaria Chemoprevention (SMC) among caregivers/parents. Four

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Hundred and Twenty-four (400) caregivers/parents whose children were in the SMC age range will be included in this study. Questionnaire will be used to collect information that will be used to assess the Seasonal Malaria Chemoprevention coverage as well as the perception of caregivers regarding SMC and indirectly children' perception by asking caregivers.

Participants involvement:

Duration /what is involved: all the participants will have to do is to listen and give the answers to the questions asked. It will take about 30 minutes.

Potential Risks: Participating in this study will present minimal risk for the participants. However, because of the COVID-19, you will be provided with alcohol- based hand sanitizer and a new face mask to protect you from COVID-19. You will always be required to wear the mask during this interview. You will be required to maintain social distance of at least 6 feet (about 2 arm length) during the interview.

Benefits: There are no direct benefits from taking part in this study. The possible benefit may be indirect, but the results are likely to inform the political decision-making that would determine the design and approach of SMC in Ghana from which respondents could benefit.

Costs: There will be no costs incurred by the participant.

Compensation: Participants will not be given compensation for their participation.

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Confidentiality: The name and personal information of the study participants will be completely confidential. Access to all collected data will be limited to the main investigator of the study and his supervisors.

Voluntary participation/withdrawal: Your participation in this research is completely voluntary. You have the right at any time to decline or withdraw from the study. If you choose to withdraw, the information you provided will not be used in this study. Your withdrawal will not result in any penalties or negative consequences.

Outcome and Feedback: After the study, the team will come back to the communities and presents the result of the study.

Appropriate alternative Procedures and Treatment: not applicable

Funding information: This research is fully funded by my scholarship, WHO/TDR.

Sharing of participants information/Data: The investigator is the sole owner of the data that will be collected.

Provision of information and Consent for participants: A copy of the information sheet and consent form will be given to you after it has been signed or thumb-printed to keep.

Who to Contact for Further Clarification/Questions: I hope that you will participate fully. If you want to ask any questions or seek for further clarifications about the study, I would be ready to provide an answer.

For further clarification or information on this study, please contact Cheick Oumar Doumbia (0202377195). You may also contact the Ethics Review committee administrator Nana Abena Apatu on 0503539896 for ethical issues and rights for participation.

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APPENDIX B: CONSENT FORM

CONSENT FORM

STUDY TITLE: Factors influencing the implementation of Seasonal Malaria Chemoprevention in Builsa North District, Upper East Region of Ghana

PARTICIPANTS' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the Participants' Information Sheet read and all questions satisfactorily explained to me in a language I understand:

Buli language,

Kantonsi language,

Fulanis language,

Dagomba language,

Mossi language,

agari language.

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I fully understand the contents and any potential implications as well as my right to change my mind (i.e. withdraw from the research) even after I have signed this form.

I voluntarily agree to be part of this research.

Name of Participant…………………………..

Participants' Signature ……………………...

Date:………………………………….

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INTERPRETERS' STATEMENT

I interpreted the purpose and contents of the Participants' Information Sheet to the afore named participant to the best of my ability in:

Buli language,

Kantonsi language,

Fulanis language,

Dagomba language,

Mossi language,

agari language.

to his proper understanding.

All questions, appropriate clarifications sort by the participant and answers were also duly interpreted to his/her satisfaction.

Name of Interpreter……………………………

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Signature of Interpreter………………………..

Date:………………………

Contact Details :………………………….

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APPENDIX C: QUESTIONNAIRE

Interviewer: ____

Date of interview: _____ /_____/__________

PART ONE

BASIC DEMOGRAPHIC DATA OF CARE GIVERS

Q1. Residence? _______________

Q2. Age of care givers? _______________

Q3. Marital Status?

Single ☐ Married ☐ Divorced ☐ Cohabiting☐ Widowed☐

Q4. Type of marriage?

Monogamous ☐ ; Polygamous ☐

Q5. Educational status?

No formal education ☐ Primary ☐ Secondary ☐ Tertiary☐

Q6. Occupation ?

housewife ☐ unmployed ☐ farmer ☐ fomal work ☐ others specify____

Q7. Religion?

Christian ☐ ; Muslim ☐ ; African traditionalist ☐

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Q8. How many people are you Household? ____

Q9. Ethnic?

Builsa ☐; Sissala ☐; Mossi ☐; Other_____________________

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

PART TWO

AWARENESS RELATED INFORMATIONS

Q11. What is the cause of malaria?

Through the bite of a mosquito ☐; Dirty environment☐; Stuffy room ☐ Ancestors ☐.

Q12. What are the effects of malaria on children under five?

Can cause anaemia ☐; Convulsion ☐; Mental confusion☐; Can cause death ☐; Nothing don't know ☐; Other, specify ____________________

Q13. Have you ever heard about SMC?

Yes ☐, No ☐.

Q14. What ways can a ones prevent himself from getting malaria?

Insecticide Treated Nets ☐ ; Daily use of mosquito repellent ☐; IRS during raining season ☐ Wear protective clothing, especially at night ☐;. Don't know ☐; other specify____________________

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Q15. Have you been informed about SMC?

Yes [ ]; No [ ]

Q16. What is the purpose of SMC?

Prevent malaria in children under five [ ]; Treat Malaria in children under five [ ]; Don't know [ ], other ______________________

Q16. What is the number of dose of SMC during a round?

1 [ ]; 2 [ ]; 3 [ ]; 4 [ ]; 5 [ ]; Don't know [ ]; other_________

Q17. Which season in the year are AQ-SP given?

Raining Season [ ], Dry season [ ], all year round [ ]; I don't know [ ]; other____________

Q18. What is the number of day for a child to complete the number of dose of AQ-SP?

1 [ ]; 2 [ ]; 3 [ ]; 4 [ ]; don't know; other__________________

Q19. What is the minimum age required for AQ-SP medication?

3 months [ ]; 1 year [ ]; 2 years [ ]; 3 [ ]; don't know [ ]; other____

Q20. How did you did you get this knowledge on SMC?

TV [ ]; Radio [ ]; CHWs [ ]; Health Centers [ ]; Friend [ ]; Community Leaders [ ] others specify_____________________

PART THREE

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COVERAGE AND ADHERENCE

Q21. How many of your child(ren) received the AQ-SP last week?

None ☐; 1 ☐; 2 ☐; 3 ☐; 4☐; 5 ☐; other______________

Q22. How many of your child(ren) completed the all the SMC doses?

None ☐; 1 ☐; 2 ☐; 3 ☐; 4☐; 5 ☐; other______________

Q23. If your child(ren) did not complete the SMC doses, what are the reasons?

Please specify______________________

Q24. How satisfy are you with the drug distribution?

Very satisfied ☐; satisfied ☐; dissatisfied ☐; Very dissatisfied ☐

We have finished the discussion.

Thank you for your time and cooperation.

University of Ghana http://ugspace.ug.edu.gh

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
GPS Address: GA-050-3303
Tel: +233-302-681109
Fax + 233-302-685424
Email: ethics.research@ghsmail.org

My Ref. GHS/RDD/ERC/Admin/App /20/212
Your Ref. No.

23rd June, 2020

Cheick Oumar Doumbia
University of Ghana
School of Public Health
Legon, Accra

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

GHS-ERC Number	**GHS-ERC 034/02/20**
Project Title	Factors Influencing the Implementation of Seasonal Malaria Chemoprevention in Bulsa North District, Upper East Region of Ghana
Approval Date	23rd June, 2020
Expiry Date	22nd June, 2021
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of 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.........

Dr. James Akazili
(Head, Ethics & Research Management Department)

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

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