SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH MALARIA VACCINE UPTAKE IN SUNYANI MUNICIPALITY

BY

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A THESIS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PUBLIC HEALTH DEGREE.

OCTOBER, 2020

DECLARATION

I declare that with the exception of references to other people's work, which have been duly acknowledged, this research work is my own work done under supervision. I also declare that this research work, partly or in whole, has not been submitted to any University for the award of any degree.

Dennis Tabiri	…….	28th October, 2020
(Student)	(Signature)	(Date)
Dr. Priscilla Nortey	……..	28th October, 2020
(Supervisor)	(Signature)	(Date)

DEDICATION

This work is dedicated to my brother Obed Abina, my uncle Charles Peprah, my parents and all my siblings for their immense support. I am forever grateful.

ACKNOWLEDGEMENT

I thank the Almighty God for his protection and guidance which has seen me through this phase and many other phases of my life.

My heartfelt gratitude goes to my supervisor, Dr. Priscilla Awo Nortey for her guidance and counselling which extended beyond the scope of this research. WHO/TDR deserves special mention for their support without which this study would not have been conducted. I appreciate the support of all TDR (University of Ghana) staff for making this study a reality.

I also acknowledge the support of all my friends especially Dr. Jean Claude Ouedraogo, whose contribution to this research was invaluable. I am also grateful to Miss Irene Prempeh for her encouragement and support through it all.

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEFI – Adverse Event Following Immunization

ANC – Ante-Natal Care

AOR – Adjusted Odds Ratio

BCG – Bacille-Calmette Guerin

CWC – Child Welfare Clinic

CHPS – Community-based Health and Planning Service

DHIS – District Health Information System

EPI – Expanded Programme on Immunization

GHS – Ghana Health Service

GVAP – Global Vaccine Action Plan

MHD – Municipal Health Directorate

MVIP – Malaria Vaccine Implementation Program

OPV – Oral Polio Vaccine

PATH – Program for Appropriate Technology in Health

PCV – Pneumococcal Conjugate Vaccine

PNC – Post-Natal Care

RTS,S - Malaria vaccine

UNICEF – United Nations Children's Fund

WHO – World Health Organization

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Introduction: Malaria has and continues to be a major disease of public health concern affecting several million people worldwide. Ghana together with two other countries started a pilot study on a malaria vaccine (RTS,S) envisaged to prevent 4 in 10 malaria cases and 3 in 10 malaria deaths. However, there was an observed downward trend in monthly coverages of the vaccine in Sunyani Municipal. This study aimed at assessing the factors associated with malaria vaccine uptake in Sunyani Municipality.

Methods: The study was a cross-sectional study employing a quantitative approach. A structured questionnaire was administered to parents/caregivers with children eligible to have taken the first three doses of the malaria vaccine by December 2019. Stratified sampling technique was used to select respondents. Ordinal logistic regression analysis was done to determine the association between independent variables and full vaccine uptake. Data was analyzed with STATA version 15 with statistical significance set at 5%.

Results: Uptake of RTS,S 1 was 94.1%. However, this figure reduced to 90.6% for RTS,S 2, and 78.1% for RTS,S 3. Timeliness of uptake was 67.7% for RTS,S 1, 51.9% for RTS,S 2 and 54.7% for RTS,S 3. Children with a parent who had been educated up to the tertiary level had 4.72 [AOR: 4.72, 95%CI: 1.27 – 17.55] increased odds of full uptake as compared to those who completed secondary education. Children with parents who thought vaccines were becoming too many for children had 71% [AOR: 0.29, 95%CI: 0.14 – 0.61] reduced odds of full uptake as compared to those who thought otherwise. Parents whose children had suffered fever as an adverse reaction were more likely to send their kids for the malaria vaccine as compared to those who children had ever suffered abscess as an adverse reaction [AOR: 2.27, 95%CI: 1.13 – 5.10].

Conclusion: Uptake of RTS,S 1 and RTS,S 2 in Sunyani Municipality meets WHO's target coverage for vaccines, however, RTS,S 3 uptake does not. Furthermore, children whose parents/caregivers thought that vaccines were becoming too many for children had comparatively reduced odds of full uptake. The Municipal Health Directorate should therefore put in measures to address this because it has the potential of eroding the gains made through childhood vaccination.

CHAPTER ONE

INTRODUCTION

1.1 Background

Malaria has and continues to be a major disease of public health concern affecting several million people worldwide. According to the 2018 world malaria report, about 219 million malaria cases occurred worldwide in 2017 (World Health Organization, 2018). The report further indicates that sub-Saharan African countries represent the region with the highest burden. Ghana, together with nine other African countries and India contributes about 70% of the world's total malaria burden. Children under 5 years of age are usually the worst affected (WHO, 2018). In 2017, 49% and 61% of malaria cases and deaths respectively occurred in this age group according to the same report (WHO, 2018).

In Ghana, 11 million suspected cases of malaria and 5.5 million cases of confirmed malaria were estimated to have occurred in 2018. Approximately 30% of these cases occurred in children under 5 (District Health Information System, 2019).

Malaria is an entirely preventable disease (WHO, 2019). A report published in The Lancet indicates that malaria can be eradicated by 2050 if the right interventions are put in place (Feachem et al., 2019). Several interventions have been introduced over the years in a bid to control malaria. Despite the proven effectiveness of these malaria control interventions, uptake remains low in some parts of the world (WHO, 2018). The free distribution of Long-Lasting Insecticide Treated Nets (LLINs), Indoor Residual Spraying (IRS), Seasonal Malaria Chemoprevention (SMC), and

Intermittent Preventive Treatment (IPT) for pregnant women are examples of such interventions. The latest intervention to be introduced is the Malaria vaccine.

The Malaria vaccine, known as Mosquirix, RTS,S/AS01, or simply RTS,S is the first vaccine proven to offer partial protection against malaria. The vaccine is designed to trigger the body's immune system against the liver stage of infection – where the parasite after entering the bloodstream moves to for further development before attacking red blood cells. The efficacy of the vaccine was established in 2014 following the completion of a phase III vaccine trial (Program for Appropriate Technology in Health, 2019). It is envisaged to prevent 4 out of 10 malaria cases and 3 out of 10 malaria deaths (WHO, 2019).

The recommended schedule of the vaccine is for children 5 months or older. It begins with an initial 3 doses which should be separated by at least 1 month and a fourth dose administered 15-18 months after the third dose (As, 2018).

WHO, however, recommends the use of the vaccine on a pilot basis to inform its broader use. Subsequently, the world body approved a phased introduction of the malaria vaccine in 2019. Ghana, Kenya, and Malawi are the countries involved in this pilot study. Selected areas within these countries have been enrolled in the study (Program for Appropriate Technology in Health, 2019).

WHO has designed a programme to deliver and monitor the use of the malaria vaccine in this pilot study. It is known as the Malaria Vaccine Implementation Programme (MVIP). Through MVIP, WHO aims to assess the impact of the vaccine on reducing childhood deaths, determine how best to deliver the 4 doses of the vaccine in routine use, and to establish the safety of the vaccine in the context of routine use (Program for Appropriate Technology in Health, 2019).

In Ghana, between 120,000 and 150,000 children in 33 selected districts/Municipalities are targeted to receive the vaccine each year. The vaccine is to be given in the 4 doses at; 6 months, 7 months, 9 months and 24 months of age through the routine Expanded Programme on Immunization (EPI) system (Ghana Health Service, 2019).

Administration of the first doses of the Malaria vaccine in Ghana begun in May 2019. However, Myjoyonline (a popular news portal in the country) reported that news of the introduction of the vaccine in Ghana was met with viral videos and messages circulating on social media by some persons calling on the public to reject the vaccine. There were claims that the vaccine was unsafe and that Ghanaians were deceptively being used for vaccine trials. This prompted a response from the Ghana Health Service (GHS) and other health agencies who refuted these allegations ("Myjoyonline", 2019).

Sunyani Municipal is one of the Municipalities in Ghana enrolled unto the MVIP. No research has yet been conducted in the Municipality since the start of the program to assess uptake of the vaccine and its associated factors in the Municipality. This study aimed at assessing these factors to improve uptake of the vaccine in the Municipality and other implementing districts/Municipalities and also inform policy on how best to scale up the use of the vaccine.

1.2 Problem Statement

Vaccines are protective. Globally, an estimated 2.5 million child deaths are prevented through vaccines yearly (WHO, 2017). From 2010 to 2015, WHO reports that vaccines averted about 10 million deaths. However, it is estimated that around 20 million children miss out on life-saving vaccines yearly resulting in the death of about 1.5 million of them (WHO, 2017). In 2014, 31%

out of the 216 districts in Ghana did not achieve the target coverage of 80% for the proxy vaccine (Penta 3), indicating that some children continue to miss out on life-saving vaccines in Ghana (Yawson et al., 2017).

The malaria vaccine introduced through the routine EPI system is expected to reach 90% of targeted children in the selected districts (WHO, 2013). However, Sunyani Municipal has recorded a downward trend in monthly coverages of the malaria vaccine since its introduction. Five hundred and thirty-three (533) children were administered the malaria vaccine in May 2019. Even though this figure represents 105% coverage, this same number of children were expected to report in June for the second dose, however, records show that only 392 children reported for the second dose indicating a dropout of 26.5% (DHIS, 2019). Similarly, all 533 children were expected to have received the third dose by the end of August, however, only 472 had received it indicating a dropout of 11.4% from the initial 533. Additionally, monthly coverages for the first dose reduced from the 105% recorded in May 2019 to 78.4%, 72.3%, and 76.4% in June, July, and August respectively (DHIS, 2019).

These coverages do not meet the target of 90% set by the WHO through the Global Vaccine Action Plan (GVAP) all childhood vaccines by 2020 (WHO, 2013). Also, the benefits of reduction in malaria morbidity and mortality associated with the vaccine will not be realized if uptake is not at the optimum level. Malaria caused the death of an estimated 266,000 children under 5 in 2017, representing 61% of malaria deaths worldwide. This translates into a child under 5 dying from malaria every two minutes. Most of these occurred in sub-Saharan Africa (WHO, 2018). Malaria has also been shown to be associated with low cognitive development especially in children who suffer it repeatedly (Tapajós et al., 2019).

Malaria morbidity and mortality will be greatly reduced if uptake of the malaria vaccine is high (WHO, 2019). This study, therefore, sought to assess the factors associated with uptake of the vaccine in the Sunyani Municipality.

1.3 Justification of the study

The introduction of the Malaria vaccine is envisaged to speed up the efforts towards eliminating malaria. However, this vision will not be realized if the vaccine does not reach the targeted children. Research is therefore needed in this area to ensure optimum uptake of the vaccine. Even though some studies have been done, whiles some are still ongoing, about the safety and effectiveness of the vaccine, none has focused on identifying the factors associated with uptake of the vaccine.

Knowledge of the factors associated with malaria vaccine uptake will enable the Sunyani Municipal health directorate and other directorates in districts on the MVIP put in measures to improve and sustain uptake of the vaccine. The GHS can also use findings from this study to strategize on how best to roll out the programme in the entire country when the time is due. Additionally, findings from this study and other similar studies will inform the WHO on its policy direction regarding the scale-up of the vaccine.

1.4 Conceptual Framework for Malaria vaccine uptake

Figure 1 is a conceptual framework depicting the relationship between factors that have the potential to affect Malaria vaccine uptake. The factors are grouped into patient/caregiver factors, health system factors, and characteristics of the child

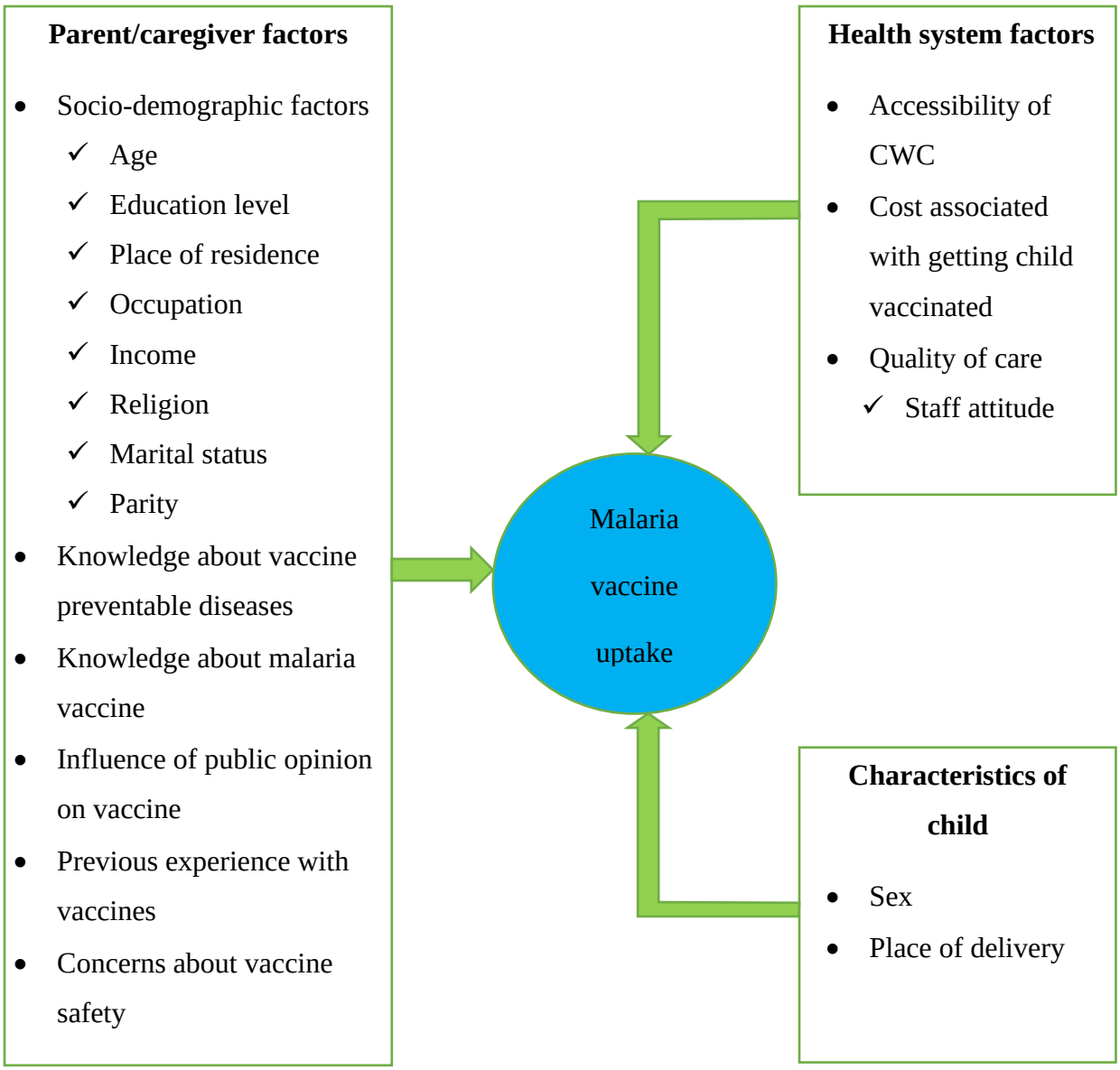

Figure 1: Conceptual framework showing factors influencing on malaria vaccine uptake.

1.4.1 Narration of Conceptual Framework

The conceptual framework (Figure 1) shows the relationship between and among factors that can ultimately influence the uptake of malaria vaccine.

The model is based on the Andersen and Newman healthcare utilization model propounded in 1973. The model proposes that utilization of health services is determined by three factors. These

are predisposing factors, enabling factors, and need factors. Predisposing factors refer to those socio-cultural and demographic factors that increase the likelihood of a person utilizing health services. Some of these factors are; race, age, health beliefs, occupation, etc. Enabling factors are those factors that facilitate access to health services. These include family support, physical access, affordability among others. Need factors represent the perceived and/or actual need for health services (Li, Nong, Wei, Feng, & Luo, 2016).

Various individual, community, and health system factors come to play to either facilitate or hinder the uptake of vaccines (Thomson, Robinson, & Vallée-tourangeau, 2016). This study looked at these factors as they relate to malaria vaccine uptake in Sunyani Municipality.

The parent/caregiver factors refer to those characteristics, behaviors, or attitudes of parents/caregivers that affect the uptake of vaccines either positively or negatively. Such factors usually are sociodemographic characteristics such as the age of the parent/caregiver, education level religion, parity, and socioeconomic status. The knowledge/awareness of the vaccine, the schedule, and the need to go for it, modified by concerns about vaccine safety also influence uptake. The health-seeking behavior of the parent/caregiver can also influence uptake. The propensity of a parent/caregiver to contact the mainstream health system for health care is likely to influence the decision to access the malaria vaccine for their children. This can be measured in their ANC attendance and place of delivery.

Health system factors refer to those factors that deliver the vaccine to the individual. The quality of service, accessibility, and/or affordability of the vaccine also influences uptake.

Some characteristics of the child can also influence uptake. The sex of the child and perceived long-term effects of the vaccine can influence uptake. Also, the number of siblings a child has, has

the potential of influencing uptake of the vaccine as well as adverse events following uptake of vaccines.

All of these factors will determine whether, for any given child, there is no, partial or complete uptake of the malaria vaccine.

1.5 Research Questions

The questions the research sought to find answers to are;

1. What is the level of uptake of malaria vaccine in Sunyani Municipality?
2. What is the timeliness of malaria vaccine uptake in Sunyani Municipality?
3. What are the factors associated with full uptake of malaria vaccine in Sunyani Municpality?

1.6 Research Objectives

Based on the research questions, the objectives formulated for the study were as follows.

1.6.1 General Objective

To assess the factors associated with malaria vaccine uptake in Sunyani Municipality.

1.6.2 Specific Objectives

1. To determine the uptake of malaria vaccine in Sunyani Municipality
2. To assess the timeliness of malaria vaccine uptake in Sunyani Municipality.
3. To determine the factors associated with full uptake of malaria vaccine in Sunyani Municipality.

CHAPTER TWO

LITERATURE REVIEW

2.1 Malaria

Malaria is an acute illness caused by a parasite known as *Plasmodium sp.* There exist five different species of the parasite, these are; *P. falciparum, P. vivax, P. malariae, P. ovale* and *P. knowlesi*. However, two of them (*P. falciparum* and *P. vivax*) cause the most burden. *P. falciparum* is known to cause about 99.7% of malaria cases in sub-Saharan Africa whereas *P. vivax* causes about 74.1% of malaria cases in the Americas (WHO, 2019). The disease is transmitted by mosquitoes (the female anopheles type). It can become life-threatening within a short while if it is left untreated especially among children, pregnant women, and non-immune individuals (WHO, 2019).

2.2 Malaria burden

WHO estimated that 219 million cases of malaria occurred in 2017 with deaths around 435,000. Out of this figure, the WHO African region, which Ghana is a part of contributed 92% of the cases and 93% of the mortalities. Ghana is part of 11 countries that contribute about 70% of the world's total malaria burden (WHO, 2018). Children under 5 are the worst affected. In 2017, 61% of malaria mortalities occurred in this age group (WHO, 2018).

Ghana recorded 5.57 million confirmed malaria cases in 2018, out of which 1.7 million occurred in children under 5 years of age; Sunyani Municipal recorded 66,000 confirmed cases of malaria in 2018, 27% of which occurred in children under 5 (DHIS2, 2019).

2.3 Malaria vaccine

There had been several attempts at developing a vaccine against malaria since the parasite was idenitified in 1897 (Mahmoudi & Keshavarz, 2018). However, these attempts have been largely unsuccessful due to how complex the parasite and its infection cycle is (Mahmoudi & Keshavarz, 2018).

RTS,S/AS01 is the first malaria vaccine proven to have a significant impact on reducing malaria burden in children (WHO, 2019). Manufacturing and development of the vaccine was started in 1987 by GlaxoSmithKline (GSK), a British pharmaceutical company. Following years of experimentation and development, the efficacy of the vaccine was established in 2014 (PATH, 2019).

The vaccine works by triggering the immune system to defend against the first stages of *Plasmodium falciparum* infection. At the first stage, the parasite through a mosquito bite enters a human host's bloodstream and infects the liver cells. From there it would mature, multiply, re-enter the bloodstream and infect red blood cells. It is the infection and rupture of the red blood cells that leads to the signs and symptoms associated with malaria (PATH, 2019).

Evidence from phase III trials conducted from 2009 to 2014 showed that there was a significant reduction in malaria and malaria-related complications in children who received 4 doses of RTS,S as compared to those who did not. Four out ten malaria cases were prevented, there was also a 30% reduction in severe malaria cases and a 60% reduction in anaemia associated with severe malaria (WHO, 2019). Reduction was also seen in hospital admissions and the need for blood transfusions which is usually associated with the management of severe malaria (WHO, 2019).

2.4 Malaria Vaccine Implementation Programme (MVIP)

MVIP as designed by WHO aims to assess the feasibility of administering the required 4 doses of the vaccine in children; the vaccine's role in reducing childhood deaths; and its safety in the context of routine use.

Ghana, Malawi, and Kenya are participating in the MVIP. Selected areas in these countries will be part of the programme (WHO, 2019).

These countries were selected based on a set of criteria established by WHO. Among the criteria were, a well-functioning malaria and immunization programme and the country's ministry of health expressing its desire to be part of the programme. These areas also had to be endemic for malaria and had to have strong implementation research experience and the ability to assess safety outcomes. If a country was involved in the phase III trial of the vaccine, it was considered to be an added advantage. Through randomization, some selected areas will first receive the vaccine before others are enrolled at a later date (WHO, 2019).

The recommended 4-dose schedule is that the first dose is given as soon as possible after 5 months of age. This is followed by doses 2 and 3 at approximately monthly intervals and the fourth dose near the child's second birthday. However, immunization authorities within the countries had to specify schedules for their respective countries (WHO, 2019).

GSK is supplying up to 10 million doses of the vaccine free of charge for the programme. The programme will run up to 2022 after which a decision on the scale-up of the vaccine use will be taken (WHO, 2019).

2.5 Expanded Programme On Immunization in Ghana

The World Health Organization (WHO) began its Expanded Programme on Immunization (EPI) in 1974 as a global effort to reach as many vulnerable people as possible with lifesaving vaccines. EPI was introduced in Ghana in 1978 with vaccines against 6 diseases. New vaccines have been added over the years. Childhood vaccines are delivered along the various structural and organizational levels in the health delivery system in the country; national, regional, district/Municipal, sub-district, and community levels (Yawson et al., 2017). The EPI schedule in Ghana is displayed in Appendix 6.

The introduction of EPI in Ghana has led to a significant decline in morbidity and mortality due to vaccine-preventable diseases in the country (UNICEF, 2019).

2.6 Uptake of childhood vaccines

Uptake of childhood vaccines varies across vaccines, districts, and countries. There was a reported coverage of 95.8% for BCG, 95.6% for Penta 1, 93.5% for Penta 2, and 89.2% for Penta 3 in Senegal. OPV 0 uptake was 70.7%, whiles coverage for OPV 1, OPV 2, and OPV 3 were 95.8%, 92.9%, and 83.7% respectively. Uptake of measles vaccine in the same country was 79.2% (Mbengue et al., 2017).

In Nigeria, a coverage of 85.5% was reported for BCG. Whiles 83.2% was recorded for OPV 0, 81.3% was recorded for OPV 1 coverage. Coverage decreased to 71.4% for OPV 3. Similarly, 84.2% was reported for DPT 1 uptake, whiles a decreased figure of 77.9% and 74.1% were reported for DPT 2 and DPT 3 respectively. Additionally, uptake for HBV decreased form 82.5%

to 80.4% to 73.3% for HBV 1, HBV2, and HBV 3 in that order. Measles and Yellow fever vaccines which are administered at 9 months recorded an uptake of 66.7% and 65.5% respectively (Adedire et al., 2016).

In a study to determine the factors associated with DPT 3 coverage in South Africa, it was found that the coverage of DPT 3 was 90.6% and 93.9% in Pietermaritzburg and Soweto respectively (Mthiyane et al., 2019). In a similar study on MR2 vaccine uptake in Tanzania (Mtwara district), an uptake of 44.2% was reported (Magodi et al., 2019).

Coverages of 98.8% (BCG), 93.6% (OPV 0), 95.6% (OPV 1), 95.2% (OPV 2), 91.6% (OPV 3) were reported from Cameroun. Additionally, 98% (Penta 1), 97.6% (Penta 2), and 92.8% (Penta 3) were reported. 91.2% was also reported as coverage for both Measles and Yellow fever vaccine (Russo et al., 2015).

In Togo, coverages reported for childhood vaccines ranged from 80.89% to 90.72%. BCG recorded the highest coverage of 90.72%. OPV 1, OPV 2 and OPV 3 recorded coverages of 88.26%, 86.52%, and 85.25 respectively. Penta 1, Penta 2, and Penta 3 also recorded coverages of 83.90%, 82.55%, and 81.21% respectively. There was also a recorded measles vaccine coverage of 80.89%. This was contained in a study conducted by Ekouevi et al. (Ekouevi et al., 2018).

A similar study conducted in Congo reported coverages as follows: BCG (83.4%), Polio 0 (49.9%), Polio 1 (91.7%), Polio 2 (84.5%), Polio 3 (65.7%). Additionally, DPT 1 (81.3%), DPT 2 (73.9%), and DPT 3 (60.6%). Measles vaccine also recorded a coverage of 71.6% (Acharya, Kismul, Mapatano, & Hatl, 2018).

In South Africa, there was a reported coverage ranging from 62% to 94% for 8 childhood vaccines per place of residence. The lowest coverage was for OPV 3 which was 87%, Penta 3 had a coverage of 88% (Fadnes et al., 2011).

Abadura et al. conducted a study in Ethiopia and reported 25.7% as coverage for full immunization (Abadura, Lerebo, Kulkarni, & Mekonnen, 2015).

A systematic review conducted by Ikilezi et al. on the uptake of DPT among sub-Saharan African countries reported coverages of as low as 13.9% in Somalia, 26.9% in Equatorial Guinea, and 40.1% in Angola. Countries like Burkina Faso, Rwanda, Cape Verde, and Eritrea recorded over 90% coverage (Ikilezi et al., 2020).

Another study conducted in Ethiopia on factors associated with full uptake of vaccines in Children reported 24.3% as the overall uptake of full immunization. Specifically, BCG recorded an uptake of 66.3%, whiles Measles, Polio 3, and DPT 3 recorded uptakes of 55.7%, 44.3%, and 36.5% respectively (Lakew, Bekele, & Biadgilign, 2015). In assessing the uptake of newly introduced Rotavirus vaccine (RVV) and Pneumococcal Conjugate Vaccine (PCV), still in Ethiopia, it was reported that full uptake was 56% and 49.1% for RVV and PCV respectively (Wondimu, Cao, Wilschut, & Postma, 2019).

In Kwabre East district, Ghana, Wemakor et al. reported coverage of 94.1% for BCG and 91.6% for OPV 0. OPV 1, OPV 2, and OPV 3 recorded coverages of 97.8%, 97.5%, and 96.9% respectively. Also, Penta 1, Penta 2, and Penta 3 recorded coverages of 97.8%, 97.5%, and 96.9% in that order. MR and yellow fever vaccine recorded 92.5% and 91.3% uptake respectively. This was found in a study to assess the factors associated with non-complete immunization (Wemakor et al., 2018).

2.6 Timeliness of vaccination

In Senegal, Mbengue et al. found a gap in the timeliness of vaccine uptake. This was in a study that aimed at assessing timeliness and coverage of immunization among children 12-23 months. For instance, for Penta 1 there was a 23.5% delay in timeliness of uptake whiles there was a 15.7% delay in timeliness of uptake for Penta 3. OPV 0, OPV 1, OPV 2, and OPV 3 recorded timeliness of uptake of 56.3%, 73.9%, 75.2%, and 73.4% in that order. Additionally, timeliness of measles vaccine uptake was delayed by 25%. (Mbengue et al., 2017).

Among Gambian children, Odutola et al. found that 63.3 % (95 % CI: 60.6–66.1 %) had a delay in the recommended time to receiving at least one type of vaccine (Odutola et al., 2015). Proportion of children who received their vaccines on time were 94.3% (95% CI: 93.0 – 95.6 %)] for BCG. DPT 1, DPT 2, and DPT 3 were 78.4% (95% CI: 76.0% - 80.8%), 49.7% (95% CI: 46.8% - 52.6%), and 39.6% (95% CI: 36.8% - 42.4%) respectively. Timeliness of OPV uptake were 74.6% for OPV 1, 50.0% for OPV 2 and 40.6% for OPV 3. For the measles vaccine, it was 80.8% (95 % CI: 78.5 %–83.1%) (Odutola et al., 2015). In a similar study in the same country to assess the barriers to uptake of birth dose vaccines on time, Miyahara et al. found that timeliness by day 28 was 58.4%. (Miyahara et al., 2016).

In a study to determine the factors associated with DPT 3 coverage in South Africa, it was found that timeliness of DPT 3 uptake was 67.4% and 74.8% in Pietermaritzburg and Soweto respectively (Mthiyane et al., 2019). In the same country, timeliness ranging from 58% to 88% was reported when uptake of 8 childhood vaccines was studied. Socio-economic factors, place of delivery, and geographical location were identified as factors associated with timely uptake of vaccines (Fadnes et al., 2011).

Assessing the timeliness of uptake of childhood vaccines, Laryea et al. found that overall, 87.3% of babies received vaccines on time. Timeliness for BCG was 88.9%, that of OPV 0 was 95.8%. OPV 1/Penta 1, OPV 2/Penta 2, and OPV 3/Penta 3 had timeliness of 89.6%, 86.5% and 83.1% respectively. Measles/yellow fever vaccines had timeliness of uptake of 50.5%. Only 5.3% received vaccines beyond 28 days of the scheduled date (Laryea, Parbie, & Frimpong, 2014).

2.7 Factors associated with vaccine uptake

In a systematic review to identify the factors associated with vaccine uptake, Thomson et al. found that all the factors can be grouped into five domains; accessibility, acceptability, affordability, awareness, and activation. Whiles accessibility refers to the physical access of clients to vaccination centres, affordability refers to their ability to afford the cost of accessing the service. Awareness refers to the knowledge clients have about the existence of the service and the benefits it offers. Acceptability is the willingness of clients to go for vaccines based on their perception of its safety, benefits, or otherwise whiles activation refers to prompters or reminders about taking vaccines (Thomson et al., 2016).

In another systematic review conducted to assess the factors associated with vaccine uptake in young children, Smith et al. discovered that knowledge about vaccines, trust of the health system, social influences and not perceiving the vaccine to have any adverse effects were all strongly associated with uptake of the vaccine. However, perceived severity of disease was not found to be associated with vaccine uptake (Smith, Amlôt, Weinman, Yiend, & Rubin, 2017).

Birth order, place of delivery, number of children, and presence or absence of a child health card, age of mother, place of residence, education, religion, marital status, and occupation were all found

to be significantly associated with immunization coverage. Similarly, paternal education, occupation, and age were also significantly associated with coverage. This was found in a study conducted in Nigeria to assess factors associated with immunization coverage (Oleribe, Kumar, Awosika-Olumo, & Taylor-Robinson, 2017).

In the Kwabre East district of Ghana, Wemakor et al. did not find any association between knowledge of mothers, place of residence and complete immunization (Wemakor et al., 2018).

2.7.1 Knowledge/awareness about malaria vaccine and uptake

In Eastern Nigeria, Chukuocha et al. in studying the awareness and intent in complying with a prospective malaria vaccine found that even though most people (89.8%) knew of malaria as a public health issue, awareness of malaria vaccine was quite low (48.4%). However, 95.6% were willing to go for such a vaccine if it existed (Chukwuocha et al., 2018).

Similarly, Febir et al. found in Kintampo, a community in Ghana involved in the malaria vaccine trials that all mothers were willing to have their children vaccinated against all diseases including malaria. Mothers also demonstrated widespread knowledge about vaccines in general. No barriers to uptake of such a vaccine were identified during the study (Febir et al., 2013).

2.7.2 Factors that positively influence vaccine uptake

In assessing the determinants of complete vaccination, Adu identified that in Ga East Municipality of Ghana, having a high level of education and adequate knowledge about vaccine-preventable diseases were positively associated with complete vaccination. Being married was also found to have a positive influence on complete vaccination (Adu, 2017). Similarly, age, occupation, knowledge, and education level of mothers were found to be key determinants of vaccine uptake in Assin North Municipality of Ghana by Ofosu's study in 2017 (Ofosu, 2017).

Canavan et al. conducted a study in East African countries to assess the correlates of complete childhood vaccination. Among their findings were that being born in a public facility was associated with higher odds of completing vaccination as compared to being delivered at home. However, sociodemographic factors associated with complete uptake were not consistent across countries (Canavan, Sipsma, Kassie, & Bradley, 2014).

Adedire et al. found in Nigeria that access to immunization information (AOR = 1.8, 95 % CI: 1.1-2.5) and mothers having good knowledge of immunization (AOR = 2.4, 95 % CI: 1.6 -3.8) were positive predictors of completed childhood immunization (Adedire et al., 2016).

Mukthar et al. studied the factors associated with Pneumococcal Conjugate Vaccine (PCV) uptake in Nairobi, Kenya. age of mother (OR = 5.8), education (OR = 5.8), parity (OR= 0.2), occupation (OR = 6.5), knowledge (OR = 6.5), and income (OR = 8.8) were the factors found to be strongly associated with uptake of the vaccine (Mukthar, Kulei, & Chege, 2015).

In the Democratic Republic of Congo, children with mothers who had secondary or higher education [AOR: 1.32; 95% CI: 1.00 - 1.81] and high income [AOR: 1.96; 95% CI: 1.18 - 3.27] had significantly higher odds of being fully immunized compared to their counterparts whose mothers were relatively poorer and less educated. Additionally, residents of the community with a higher rate of health facility delivery [AOR: 2.36; 95% CI: 1.59 - 3.51] were found to be positively associated with the full vaccination coverage (Acharya et al., 2018).

Again, being delivered at a health facility was associated with timely and complete vaccination. The study was conducted by Mvula et al.. They looked at predictors and timeliness of uptake of newly introduced vaccines (Mvula et al., 2016). In addition to being born at a health facility, Abadura et al. found that media exposure, region of residence, and a higher level of maternal education correlated with childhood full immunization (Abadura et al., 2015).

2.7.3 Factors that negatively influence vaccine uptake

In trying to find the reasons for no and low vaccination in low and middle-income countries, Rainey et al. (2011) conducted a systematic review. At the end of the review, they identified immunization systems (45%), family characteristics (26%), parents' knowledge and attitude (22%), and limitations in communication as the main factors associated with low vaccination. These same factors applied in non-vaccination although in different percentages. While immunization systems contributed 32%, parents' attitudes and knowledge, family characteristics, and communication and information contributed 42%, 21%, and 5% respectively (Rainey et al., 2011). Additionally, mothers being busy, unaware of vaccination schedules and inconvenient schedules were found to be negative predictors of uptake in Ghana (Ofosu, 2017).

In a study looking at the factors associated with non-uptake of the second dose of Measles-Rubella (MR) vaccine in Tanzania, Magodi et al. found that caretaker being unaware of the ages for MR1 and MR2 administration [AOR = 3.50; 95% CI 1.98-6.21; $p < 0.001$], fewer vaccination days per week [< 3 days: AOR = 1.50; 95% CI: 1.42-5.59; $p < 0.001$], unavailability of vaccine [AOR = 3.38; 95% CI: 1.08-10.61; $p < 0.01$] and long waiting times for vaccination services [AOR = 1.80; 95% CI: 1.08-3.00; $p < 0.01$] were associated with non-uptake of MR2 (Magodi et al., 2019).
In Cameroun, being the ≥ 3rd born child in the family (AOR: 425.4; 95 % CI: 9.6–18,808), younger mothers' age (AOR: 49.55; 95 % CI: 1.59–1544), parents' negative attitude towards immunization (AOR: 20.2; 95 % CI: 1.46–278.9), and poorer parents' exposure to information on vaccination (AOR: 28.07; 95 % CI: 2.26–348.1) were found to be associated with incomplete vaccination. However, long distance from the vaccination centres was found to be marginally significant ($p = 0.05$). This came to light following a study conducted by Russo et al. in the West region (Dschang) of the country (Russo et al., 2015).

Also, low household income (AOR = 0.73, 95% CI 0.58–0.93), parents having to walk long hours to immunization centre was associated with incomplete immunization as compared to walking shorter distance (AOR = 1.57, 95% CI 1.15–2.13) (Ekouevi et al., 2018).

In Malawi, having a lower educated or farming mother and those living farther from a clinic were associated with not being fully vaccinated or being vaccinated late. (Mvula et al., 2016).

Vonasek et al. assessed the relationship between knowledge and attitude of mothers and complete childhood vaccination in rural Uganda. The study found that 93% of mothers knew about the fact that vaccines protect against diseases. Those who could not give a similar reply were found to have a higher odds of having a child with incomplete vaccination (PR 1.354: 95% CI 1.018–1.802) (Vonasek, Bajunirwe, Jacobson, & Twesigye, 2016).

Having multiple siblings was also found to be negatively associated with childhood full immunization in Ethiopia. This was found in a study conducted in Ethiopia by Abadura et al. The study assessed individual and community-level factors associated with completed childhood immunizations (Abadura et al., 2015).

CHAPTER THREE

METHODS

3.1 Study design

The study was an analytical cross-sectional study employing a quantitative approach. Because the malaria vaccine is a newly introduced vaccine, not much literature can be found on its uptake. Literature on factors associated with uptake of previously existing childhood vaccines was therefore used to compare with factors associated with uptake of the malaria vaccine.

Structured questionnaire and an observation checklist were used to collect data on malaria vaccine uptake and related factors. Data was collected from parents/caregivers in Sunyani Municipality about themselves and their children on factors related to malaria vaccine uptake.

3.2 Study area

Sunyani Municipal is one of the 27 administrative districts in the Brong-Ahafo region of Ghana. It has an estimated population of 151,378 for 2019. Sunyani is the Municipal's capital. It lies between Latitudes 70º20'N and 70 05'N, and Longitudes 20º30'W and 20º10'W. It shares boundaries with Sunyani West district to the north, Asutifi district to the south, Tano North district to the east, and Dormaa East district to the west. The Municipality has a total land area of 829.3 square kilometres. One-third of the total land area is not inhabited or cultivated which provides arable for development.

The Municipal Health Directorate (MHD) is in charge of health administration in the district. There are 33 health facilities that provide care to inhabitants of the Municipality. The Municipality is zoned into 34 functional Community-based Health Planning and Service (CHPS) zones under 6 sub-Municipalities. The sub-Municipals are Abesim, Antwikrom, Newtown/Baakoniaba, New Dormaa, Sunyani central, and Penkwase. The CHPS zones are demarcated areas for the delivery of health services (Sunyani Municipal Health Directorate, 2019). The map of Sunyani Municipality is depicted in Figure 2.

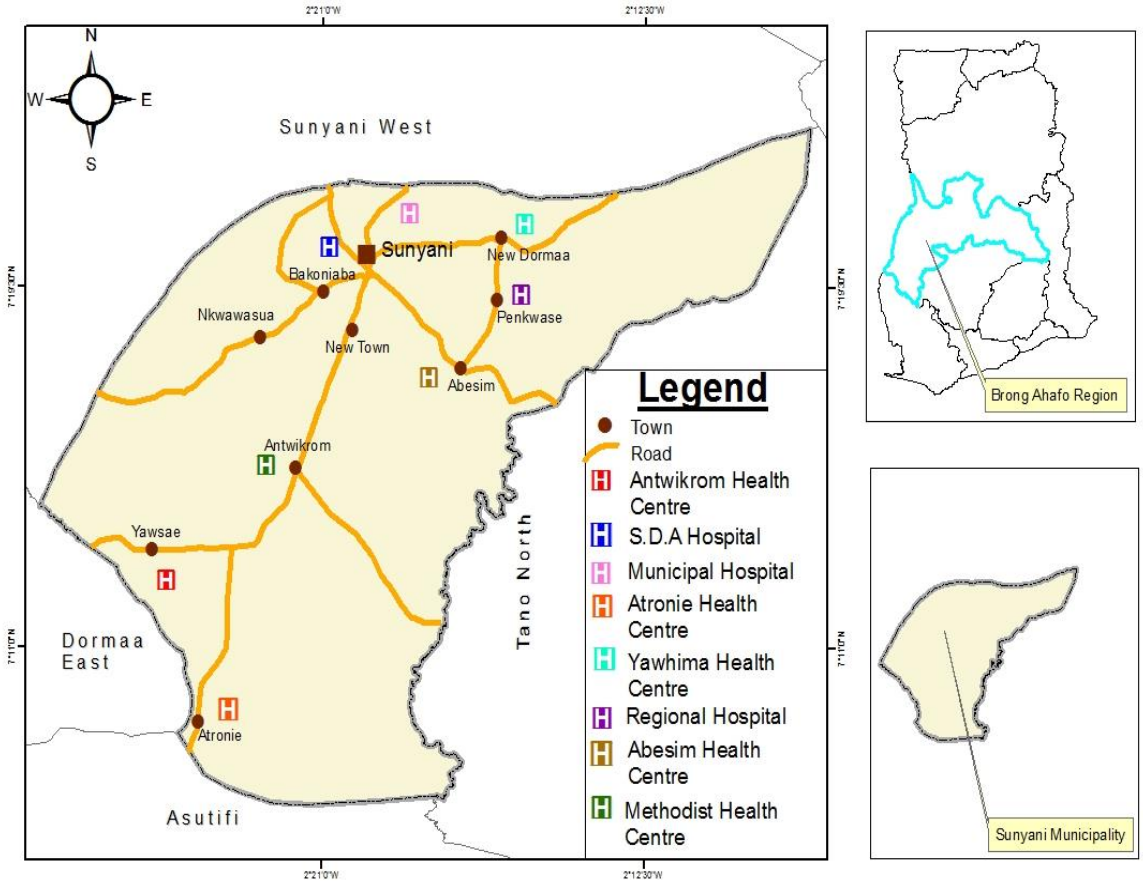

Figure 2: Map of Sunyani Municipal (source: Sunyani MHD, 2019)

3.2.1 Sunyani Municipal and Malaria

Sunyani falls within the moist semi-deciduous forest region of the country. This makes the area ripe for the breeding of Anopheles mosquitoes and therefore the spread of malaria (Sunyani Municipal Health Directorate, 2019). The Municipality recorded 66,000 confirmed cases of malaria in 2018. More than 17,000 of these cases occurred in children under 5 (DHIS2, 2019).

3.2.2 Vaccine delivery in Sunyani

Childhood vaccines are delivered at health facilities and outreach points within the Municipality. The outreach points serve to deliver vaccines at the doorsteps of beneficiaries so that physical access does not hinder uptake. The outreach points are organized under the various CHPS zones in the 6 sub-Municipalities. The Municipality is noted for being one of the best in terms of vaccine coverage in the country. It is one of the reasons why it was selected as one of the implementing districts under the MVIP (Sunyani Municipal Health Directorate, 2019).

3.3 Variables

The following variables were under consideration in this study.

3.3.1 Dependent variable

The dependent variable for this study was Malaria vaccine (RTS,S) uptake. Uptake was measured as whether or not a child had been adminsistered any or all the dose(s) of the malaria vaccine (i.e. RTS,S 1, RTS,S 2, and RTS,S 3).

RTS,S 1 represents the first dose of malaria vaccine scheduled to be given at 6 months of age. RTS,S 2 represents the second dose of malaria vaccine which is also scheduled to be given at 7 months of age. RTS,S 3 represents the third dose of the malaria vaccine which is scheduled to be given at 9 months of age.

The last dose of the malaria vaccine (RTS,S 4) which is scheduled to be given at 24 months of age was not considered in this study. This is because, by the time the research was being conducted, no child was eligible for RTS,S 4.

Uptake was measured in three levels; full uptake, partial uptake, and no uptake. Receiving all the three due vaccines was considered full uptake. Receiving only one or two of the due vaccines was considered partial uptake whiles not receiving any of the doses was considered no uptake.

Operational definition and scale of measurement of the dependent variable is shown in Table 1a below.

Table 1a: Operational definition and scale of measurement for dependent variable

Variable	Operational definition	Scale of measurement	Source of data
Uptake of malaria vaccine	Number of doses of malaria vaccine a child has received	Ordinal - Full uptake (child has received all 3 doses) - Partial uptake (child has received either 1st or 2nd dose) - No uptake (child has not received any dose)	Child's CWC card

**Malaria vaccine is given in 4 doses at 6 months, 7 months, 9 months and 24 months of age. Only the first 3 doses were considered in this study*.*

3.3.3 Independent variables

The independent variables that were under consideration in this study are: socio-demographic characteristics of parent/caregiver [age, income, educational level (both parents), marital status, parity, occupation (both parents), religion (both parents))], child characteristics (sex, place of delivery), parent/caregiver's knowledge about vaccines, parent/caregiver's knowledge about the malaria vaccine (awareness, benefits, schedule), accessibility of vaccines (closeness to Child Welfare Clinic (CWC), convenience of access), affordability (cost of transportation to CWC, other payments involved in accessing vaccine), previous bad experience with vaccines, concerns about side effects, and perception of quality of care (attitude of staff who administer vaccine).

Timeliness of vaccine uptake was also measured as the age in months at which the various doses were received. Whether or not the vaccines were received at the recommended 6 months, 7 months, and 9 months was also ascertained.

The operational definition of the independent variables considered in this study are stated in Tables 1b and 1c.

Table 1b: Operational definition and scale of measurement for socio-demographic variables

Variable	Operational definition	Scale of measurement	Source of data
Age	Age in completed years	Ratio	Interview
Sex	Being male or female	Nominal	Observation
Place of residence	Sub-Municipal in Sunyani within which parent/caregiver stays	Nominal - Abesim - Antwikrom - Sunyani central - Newtown/Baakoniaba - New Dormaa - Penkwase	Interview
Marital status	Legal status of relationship with partner	Nominal - Married - Single - Cohabiting	Interview

Variable	Operational definition	Scale of measurement	Source of data
Religion	Religious denomination	Nominal - Christian - Muslim - Traditionalist - Other	Interview
Religion of partner	Religious denomination	Nominal - Christian - Muslim - Traditionalist - Other	Interview
Educational level	Highest formal education level attained	Ordinal - None - Primary - Secondary - Tertiary	Interview
Educational level of partner	Highest formal education level attained by partner	Ordinal - None - Primary - Secondary - Tertiary	Interview
Occupation	What the individual does for a living (brings him/her regular income)	Nominal - Unemployed - Self-employed - Farming - Civil servant	Interview
Occupation of partner	What the partner does for a living (brings him/her regular income)	Nominal - Unemployed - Self-employed - Farming - Civil servant	Interview
Parity	Number of children alive	Ratio	Interview

Table 1c: Operational definition and scale of measurement for other independent variables

Variable	Operational definition	Scale of measurement	Source of data
Knowledge about RTS,S	Whether parent/caregiver has ever heard about the malaria vaccine	Binary - Yes - No	Interview
	Where parent/caregiver first heard about malaria vaccine	Nominal - CWC - Health facility announcement - Radio - Friend/relative	Interview

Variable	Operational definition	Scale of measurement	Source of data
	Knowledge of the number of times a child is supposed to be administered malaria vaccine	Binary - Correct number - Incorrect number	Interview
	Knowledge of schedule of malaria vaccine administration	Binary - Correct order - Incorrect order	Interview
Perception of vaccines becoming too many	Parent/caregiver thinks vaccines are becoming too many for children with the introduction of malaria vaccine	Binary - Yes - No	Interview
Concern about vaccine safety	Heard about any negative issue/report concerning malaria vaccine	Binary - Yes - No	Interview
Previous experience with vaccines	Whether child has ever suffered an adverse reaction following the administration of a vaccine	Binary - Yes - No	Interview
Accessibility	Minutes spent in reaching nearest CWC	Ratio	Interview
Affordability	Payment for vaccination services	Ratio	Interview
Perception of quality of vaccination service	Description of CWC nurses' attitude	Ordinal - Excellent - Very good - Good - Bad - Very bad	Interview
ANC attendance	Number of times mother attended ANC before delivery of this child	Ratio	Interview
Sex of child	Child being male or female	Nominal - Male - Female	Interview
Place of delivery	Where child was delivered	Nominal - Home delivery - Health facility	Interview
Time of uptake	Age (in months) at which child was administered any dose of malaria vaccine	Ratio	Child's CWC card

3.4 Study population

The study population was parents/caregivers with children aged 10 months – 12 months by December 2019 and residing in the Sunyani Municipality.

The first doses of the malaria vaccine (RTS,S 1) were administered in May 2019 for children aged 6 months and 7 months at the time (GHS, 2019). This implies that children aged 10 months – 12 months and residing in Sunyani Municipal should have received the first 3 doses of the malaria vaccine (full uptake) by December 2019.

3.4.1 Inclusion criteria

1. All parents/caregivers residing in Sunyani Municipal with children aged 10 - 12 months by December 2019.
2. Children have been registered in Child Welfare Clinic (CWC) registers and receive immunization services in Sunyani Municipal.

3.4.2 Exclusion criteria

1. Parents/caregivers with children aged 7 months when they were administered RTS,S 1 in May 2019.

The first batch of children who were given RTS,S in May 2019 when RTS,S immunization commenced in Ghana included children who were 7 months old at the time (GHS, 2019). These children, therefore, did not follow the regular 6 months, 7 months, and 9 months schedule for RTS,S 1, RTS,S 2 and RTS,S 3 respectively. Those children were excluded so that timeliness of uptake of the vaccine could be correctly ascertained.

3.5 Sample size calculation

Cochrane's formula was employed in calculating the sample size for this study (Cochran, 1963).

$$n = \frac{Z^2 Pq}{d^2}$$

Where n = Sample size

Z = Standard normal variate for margin of error

p = proportion of children who take RTS,S vaccine

q = 1-p

d = margin of error

Margin of error (α) was set at 5%. The malaria vaccine was introduced in May 2019 (GHS, 2019) and so no annual coverage had been computed by the time of data collection. Therefore an assumed proportion of 50% was used in calculating the sample size. Lwanga & Lemeshow (1991) propounded that if estimating proportion (p) is difficult, an assumed proportion of 50% should be used since the required sample size is largest when p = 50%. This ensures that findings from the study are as close to the population estimates as possible.

The minimum sample size was calculated thus:

$Z_{1-\frac{\alpha}{2}}$ = 1.96

p = 0.5

q = 1-0.5 = 0.5

d = 0.05

$$n = \frac{1.96^2\ (0.5)(0.5)}{0.05^2}$$

n = 385

Adjustment of 10% was made for potential non response. Non-response rates have generally been around 10% and usually result from refusals, unreturned questionnaires and incomplete responses (Mbengue et al., 2017; as cited in Ofosu, 2017).

Adjusting for a potential a non-response rate of 10%, n = 384.16 + (0.1 x 384.16)

n = 385 + 38.5 = 423.5

n = 424

3.6 Sampling technique

Stratified sampling technique proportionate to size was used in selecting participants for the study. Sunyani Municipal is segmented into 6 sub-Municipals which served as strata. There are differences in the characteristics of the sub-Municipals. Employing stratified sampling technique ensured that all sub-Municipals were represented in the sample. It also allowed comparison to be made across sub-Municipals.

Table 2 below shows the monthly EPI targets of the six sub-Municipals in Sunyani Municipality for 2019.

Table 2: Monthly RTS,S targets per sub-Municipal

Sub-Municipal	Monthly target
Abesim	80
Antwikrom	53
New Dormaa	122
Newtown/Baakoniaba	93
Penkwase	78
Sunyani central	80
Total	505

Based on the above, a sample fraction of:

K= $\frac{n}{N}$, where K is the sampling fraction, n is the sample size = 424 and N is the monthly population = 505, was applied to determine the sample size for each sub-Municipal as shown in Table 3.

Table 3: Sample size determination by sub-Municipal (proportionate to size)

Sub-Municipal	Monthly target (x)	Sample fraction * x	Sample size
Abesim	80	$\frac{424}{505}$ x 80	67
Antwikrom	53	$\frac{424}{505}$ x 53	45
New Dormaa	122	$\frac{424}{505}$ x 122	102
Newtown/Baakoniaba	93	$\frac{424}{505}$ x 93	78
Penkwase	78	$\frac{424}{505}$ x 78	65
Sunyani central	80	$\frac{424}{505}$ x 80	66
Total	505		424

Sampling of individual respondents

Systematic sampling was used to select respondents from each stratum. A sampling frame was constructed which contained the names of children who met the eligibility criteria, for each sub-Municipal. A sampling interval was determined from each sampling frame using the formula:

K= $\frac{N}{n}$, where K = sampling interval, N = the number of children in the sampling frame, and n = sample size for the sub-Municipality. Simple random sampling was used to select the first sample by writing the names of the children from one to the sampling interval, folded and mixed up in a bowl. One piece of paper was selected and the name on the paper represented the first sample. Subsequent samples were drawn by adding the sampling interval to the number of the first drawn sample until all samples required for the sub-Municipal were drawn.

The parents/caregivers of the selected children were contacted and those who agreed to be part of the study were interviewed. The sampling was done by the prinicipal investigator at the various sub-Municipals.

3.7 Data collection Technique

Data was collected through the administration of questionnaires to respondents and observation of CWC cards. Parents/caregivers were contacted at CWCs or in their houses depending on where they were available to respond to the questionnaire. Questions centered on socio-demographic factors and other independents variables known to affect vaccine uptake. Each questionnaire administration and observation lasted about 20 minutes.

Covid-19 protocols of social distancing, hand hygiene, and wearing of facemask were strictly adhered to during the entire data collection stage. This was done so as not to put either the interviewer or the respondent at risk of the disease.

Data collection was done by the principal administrator and 5 research assistants.

3.7.1 Data collection instruments

Data collection instruments employed were questionnaire and an observation checklist. The questionnaire focused on the factors associated with uptake of malaria vaccine. Questions were based on socio-demographic characteristics, knowledge about malaria vaccine, previous experience with vaccines and vaccination, affordability, and accessibility of vaccines in Sunyani Municipal.

The observation checklist centred on the uptake of malaria vaccine and the timelines of uptake. The CWC card of the children provided this information.

3.8 Quality control

Training was done for data collectors to minimize errors during data collection. The principal researcher was also involved in the data collection. Training centered on the ethics of data collection, what to expect during the data collection, and how to conduct themselves on the field.

Pre-testing of the questionnaires was done in Fiapre, a town in Sunyani West district (a district also on the MVIP) that shares borders with Sunyani. Adjustments were made to the questionnaire and the observation checklist based on the outcome of the pre-testing. Questions were translated to the local language where applicable to ensure that participants understood the questions well in order to give appropriate responses.

The principal investigator was in constant communication with the research assistants to ensure that all problems encountered on the field were quickly resolved. All research assistants were given call credit to facilitate this. The principal investigator also met the research assistants at the end of every day to take delivery of data collected and to double-check the accuracy of data recorded.

All this was to ensure quality data leading to valid conclusions.

3.9 Data processing and analysis

The data was cleaned and entered into Microsoft excel. Entries were double-checked for errors and corrections made. It was then imported to STATA version 15 and analyzed. Frequencies and

percentages were generated for sociodemographic characteristics such as age, occupation, marital status, religion, and sex. Median, quartiles, and ranges were generated for the continuous variables. This was because the data was not normally distributed.

Ordinal logistic regression analysis was done to determine the association between the independent variables and the level of malaria vaccine uptake. The regression was done first at the univariate level. Independent variables with significant p-values at the univariate level were used in a multivariate analysis and the model with the best Akaike's Information Criterion (AIC) and Bayesian's Information Criterion (BIC) was selected. For all associations, significance level was set at 5%.

Results were presented in tables and charts indicating percentages, odds ratio (crude or adjusted), p-values, and confidence intervals. They were then discussed with the relevant literature.

The entire process of data entry, processing, and analysis was done by the principal investigator.

3.10 Ethical consideration

Ethical approval was sought from the Ghana Health Service ethical review board. Approval was given on 28th January 2020 with reference number: GHS-ERC029/12/19.

Approval was also sought from the Sunyani Municipal Health directorate before commencement of the study.

To ensure voluntary participation in the study, informed consent was obtained from each parent/caregiver before data collection. The purpose, risks, and benefits of the study were well explained to each participant. Their right to withdraw from the study at any point during the study

was also explained to them. Participants who agreed to be part of the study were made to sign or thumbprint the informed consent form. They were each given a participant's information sheet detailing what they needed to know about the study before they were asked to sign the informed consent.

Names of participants were not taken to ensure confidentiality. Each interview was also conducted at a location devoid of interference from other people to ensure privacy and confidentiality. Filled questionnaires and checklists were placed under lock and key and were not be given to any third party to handle. Participants were not compensated for participating in the study.

The contact numbers of the principal investigator, supervisor, and administrator at the ethics review committee were provided to participants to call if they had any queries.

3.11 Sponsorship

The study was supported by WHO's programme on Tropical Diseases Research (TDR). WHO/TDR provided funding for the study. All other works related to the study were done by the principal researcher with support from the University of Ghana School of Public Health.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic characteristic of study participants

The calculated sample size was 424. A total of 424 parents/caregivers participated in the study giving a response rate of 100%. They were drawn from 6 sub-Municipals in the Sunyani Municipality. The study lasted approximately 10 months.

The median age of parents/caregivers was 29 years [1st quartile: 27, 3rd quartile: 32]. It ranged from 17 years to 45 years. Majority of them (99.3%) were parents with almost all being females (99.5%). Most respondents (60.9%) were married with the rest being either single or cohabiting. Up to 43.2% of respondents had up to secondary education, whiles up to 41.5% of their partners, mostly males had up to tertiary education. Most of the respondents were christians (75%). Up to 55.2% of respondents were self-employed, whiles 20.5% of respondents were unemployed. However, only 2.6% of their partners were unemployed.

Details of the distribution of the socio-demographic characteristics of respondents are shown in the Table 4.

Table 4: Distribution of Socio-demographic characteristics of study participants, Sunyani Municipal, 2020

Characteristic (n = 424)	Frequency	Percentage (%)
Sub-Municipal		
Abesim	68	16.0
Antwikrom	45	10.6
Newtown/Baakoniaba	78	18.4
New Dormaa	102	24.1
Sunyani central	66	15.6
Penkwase	65	15.3
Age (years)		
15-19	11	2.6
20-24	46	10.9
25-29	171	40.3
30-34	151	35.6
35 and above	45	10.6
Parent or caregiver		
Parent	421	99.3
Caregiver	3	0.7
Sex		
Male	2	0.5
Female	422	99.5
Marital status		
Single	99	23.4
Married	258	60.9
Cohabiting	67	15.8
Number of children alive		
1 – 3	378	89.2
More than 3	46	10.8
Educational status		
No formal education	28	6.6
Primary education	141	33.3
Secondary education	183	43.2
Tertiary education	72	17.0
Educational status of partner		
No formal education	14	3.3
Primary education	72	17.1
Secondary education	161	38.2
Tertiary education	175	41.5
Religion		
Christianity	318	75.0
Islam	103	24.3
Traditionalist	3	0.7

Characteristic (n = 424)	Frequency	Percentage (%)
Occupation		
Unemployed	87	20.5
Self-employed	234	55.2
Farming	32	7.6
Civil servant	71	16.8
Religion of partner (n=421)		
Christianity	317	75.3
Islam	100	23.8
Traditionalist	4	1
Occupation of partner		
Unemployed	11	2.6
Self-employed	220	52.3
Farming	40	9.5
Civil servant	150	35.6

4.2 Characteristics of children studied, Sunyani Municipal, 2020

Out of the 424 children who were part of the study, 66.3% were aged 15 to 16 months. Their ages ranged from 13 months to 18 months. The median age was 15 months [1st quartile: 15, 3rd quartile: 16].

Up to 55.4% of them were males. Almost all of them were delivered at a health facility (94.6%).

Details of the characteristics of children studied are shown in Table 5.

Table 5: Distribution of characteristics of children, Sunyani Municipal, 2020

Characteristic (n = 424)	Frequency	Percentage (%)
Age (months)		
13 - 14	79	18.6
15 - 16	281	66.3
17 - 18	64	15.1
Sex		
Male	235	55.4
Female	189	44.6
Place of delivery		
Home	21	5.0
Health facility	401	94.6
Unknown	2	0.4

4.3 Uptake of RTS,S

Whiles 94.1% [95%CI: 91.4% - 96.0%] of the children had been administered the first dose of the malaria vaccine, 90.6% [95%CI: 87.4% - 93.0%] had been administered both the first and the second dose with a reduced percentage of 78.1 [95%CI: 73.9% - 83.8%] having been administered all the 3 doses.

The reasons given for receiving some but not all the doses of the vaccine were: "*did not know when the next one was due*" – 45.6%, "*was not around*", - 23.5%, and "*not comfortable with issues surrounding vaccine*" -13.2%.

For those who had received no dose of the vaccine, 60% said it was their partner's (husband) decision not to allow their children to be administered the vaccine whiles the rest said it was their own decision to refuse the vaccine.

Distribution of uptake of malaria vaccine in Sunyani Muncipal is shown in Table 6.

Table 6: Distribution of uptake of malaria vaccine in Sunyani Municipal, 2020

Characteristic	Frequency	Percentage (%)
Level of uptake (n=424)		
No uptake	25	5.9
Partial uptake	68	16.0
Full uptake	331	78.1
RTS,S 1 uptake (n=424)		
Yes	399	94.1
No	25	5.9
RTS,S 2 uptake (n=424)		
Yes	384	90.6
No	40	9.4
RTS,S 3 uptake (n=424)		
Yes	331	78.1
No	93	21.9

Characteristic	Frequency	Percentage (%)
Reason for child receiving some but not all doses of RTS,S (n=68)		
Did not know when next one was due	31	45.6
Did not take previous one on time	4	5.9
Not comfortable with side effects	8	11.8
Not comfortable with issues surrounding vaccine	9	13.2
Was not around	16	23.5
Reason for child receiving none of the doses of RTS,S (n=25)		
Personal decision to refuse vaccine	7	28.0
Partner's (husband) decision to refuse vaccine	15	60.0
Did not know child is eligible	3	12

4.3.1 Trend of uptake of malaria vaccine in Sunyani Municipal

The uptake of malaria vaccine in Sunyani Municipality shows a declining uptake for the subsequent doses of the vaccine. Whiles uptake for the first dose was 94.1%, it reduced to 90.6% for the second dose and to 78.1% for the third dose. RTS,S 1 and RTS,S 2 uptake met the WHO target of 90% but uptake of RTS,S 3 did not.

A chart of the uptake of the first three doses of malaria vaccine in Sunyani Municipality is shown in Figure 3.

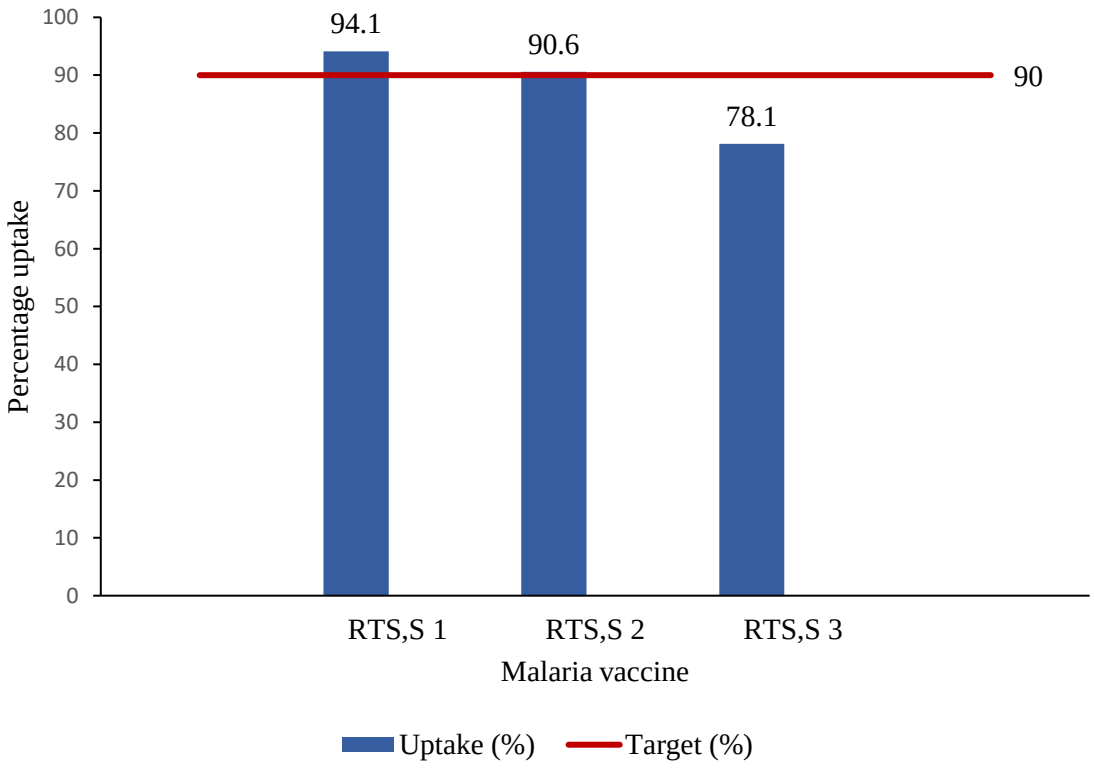

Figure 3: Uptake of Malaria vaccine in Sunyani Municipality

4.3.2 Level of uptake of malaria vaccine

The level of uptake of malaria vaccine in Sunyani Municipality as recorded from this study are: No uptake (no dose received) – 5.9%, partial uptake (either first or second dose received) – 16%, and full uptake (all three doses received) – 78.1%. This implies that majority of the children had received all three doses of the vaccine.

The level of uptake of malaria vaccine in Sunyani Municipality is depicted in Figure 4.

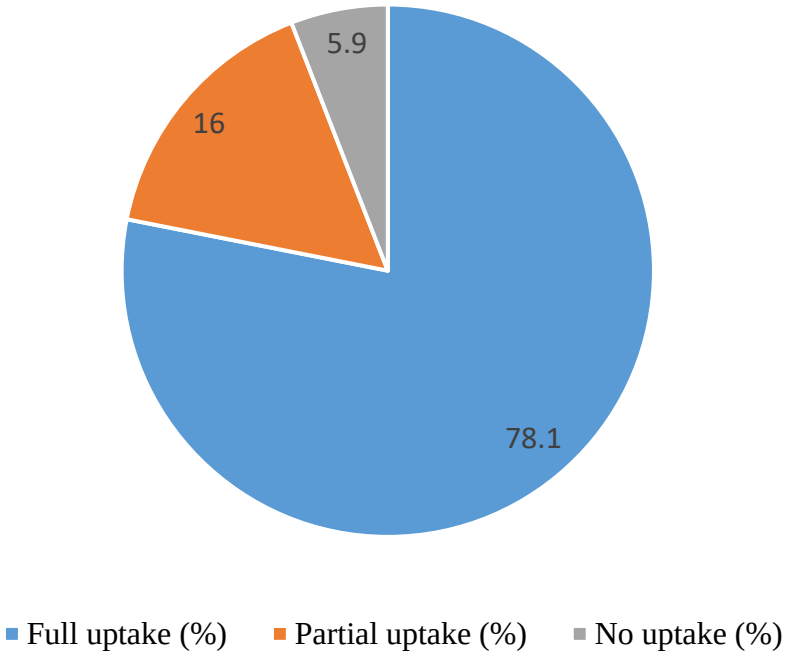

Figure 4: Level of uptake of Malaria vaccine in Sunyani Municipality

4.4 Timeliness of uptake

Timeliness of uptake of RTS,S 1 was 67.7%. The median age at taking RTS,S 1 was 6 months [1st quartile: 6, 3rd quartile: 7]. Most of those who did not receive it on time were administered the vaccine at 7 months (21.3%) . The minimum age at receiving RTS,S 1 was 5 months whiles the maximum age at being administered RTS,S 1 was 9 months.

RTS,S 2 had a timeliness of uptake of 51.8%. Time of uptake ranged from 6 months to 11 months. The median age at uptake was 7 months [1st quartile: 7, 3rd quartile: 8].

Timeliness of uptake of RTS,S 3 was 54.4%. The minimum age at receiving RTS,S 3 was 7 months whiles the maximum age was at 12 months. The median age at uptake was 9 months [1st quartile: 9, 3rd quartile:10].

Details of timeliness of uptake are shown in Figure 5.

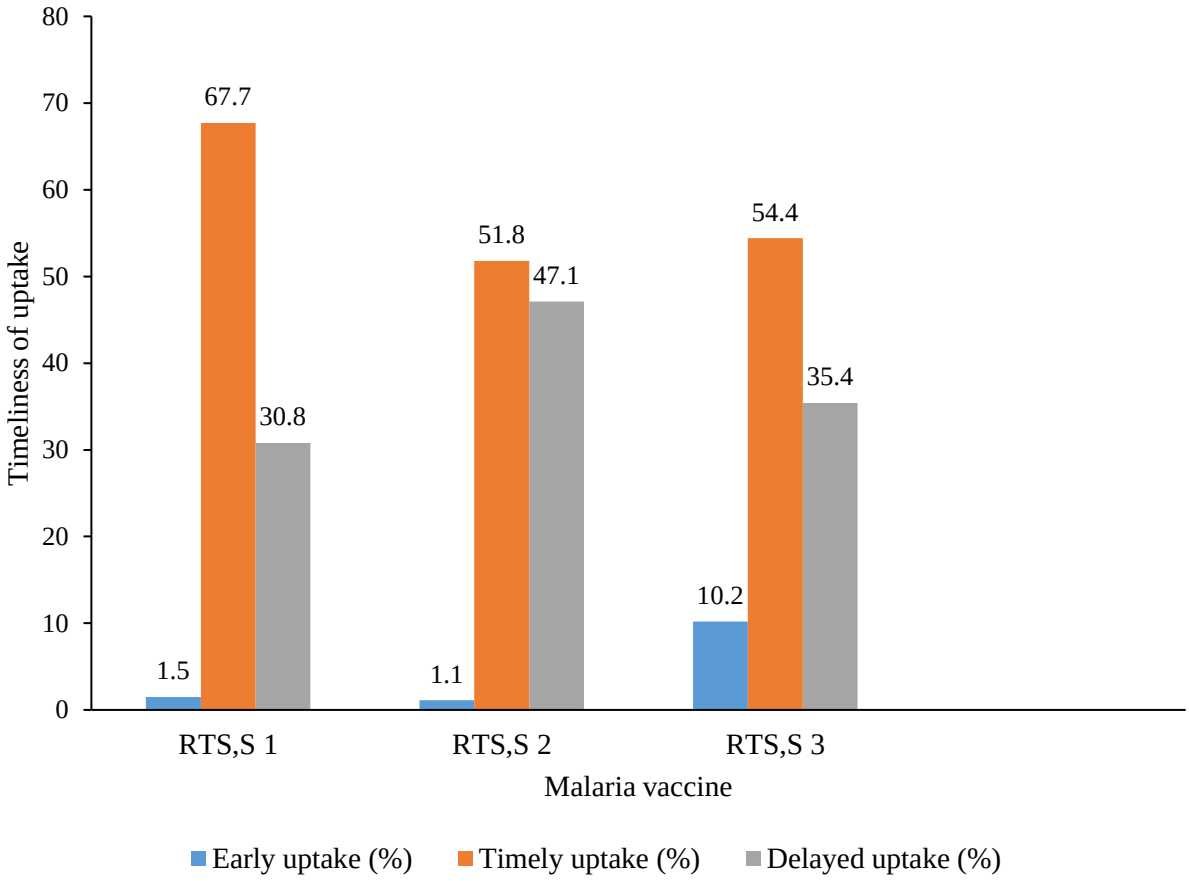

Figure 5: Timeliness of uptake of RTS,S in Sunyani Municipality

4.5 Knowledge and awareness about Malaria vaccine

Out of the 424 parents/caregivers, 50.7% correctly mentioned up to 3 childhood vaccine-preventable diseases, 9.7% could not mention any correct disease but 29% included malaria in their list of childhood vaccine-preventable diseases.

Majority of them (87%) said they had heard about the malaria vaccine with 87.3% saying they first heard about it at the child welfare clinic. The others first heard about it from health facility announcements and the radio.

Only 18.8% were able to state the correct number of times a child is supposed to take the malaria vaccine, with only 9.5% being able to tell the correct order of months a child is supposed to be administered the vaccine.

Out of the 61% who said they had heard about something negative regarding the malaria vaccine, 74.7% said they heard this negative information from either friends or relatives. Some (5.8%) also said they heard this negative information from health workers. Most of the negative reports they had heard centered on 'children being used for experiment' (62.2%) or that the vaccine was not safe (34.2%). However, only 20.4% said the negative report prevented or delayed their decision to take the malaria vaccine for their children.

Up to 67.7% of the respondents did not see the introduction of the malaria vaccine as making the childhood vaccines too many.

Majority (84.2%) also said they will recommend the vaccine to other parents/caregivers. They cited "*vaccine is safe"* and being able to "*protect children against malaria"* as their reasons for recommending the vaccine to others.

Those who said they will not recommend the vaccine to others cited the vaccine not considered safe as their reason (32.8%). However, many of them (52.2%) had no specific reason why they will not recommend the vaccine to others.

Details of the results on knowledge and awareness about the malaria vaccine are shown in Table 7.

Table 7: Knowledge and awareness about malaria vaccine among parents/caregivers in Sunyani Municipal, 2020

Characteristic	Frequency	Percentage (%)
Known vaccine-preventable diseases (n=424)		
No correct disease mentioned	41	9.7
Up to 3 correct diseases mentioned	215	50.7
4 – 8 correct diseases mentioned	45	10.6
Any correct disease mentioned BUT including Malaria	123	29.0
Heard about malaria vaccine (n=424)		
Yes	369	87.0
No	55	13.0
Where first heard about malaria vaccine (n=369)		
CWC	322	87.3
Health facility announcement	28	7.6
Radio	16	4.3
Friend/relative	3	0.8
Number of times a child is supposed to receive the malaria vaccine (n=369)		
Correct number	73	18.8
Incorrect number	296	80.2
Age order of receiving vaccines (n=369)		
Correct order	35	9.5
Incorrect order	334	90.5
Heard about any negative report or issue concerning the malaria vaccine (n=369)		
Yes	225	61.0
No	144	39.0
Where negative issue or report was heard (n=225)		
Radio	41	18.2
Friends/relatives	168	74.7
Health workers	13	5.8
Other	3	1.3

Characteristic	Frequency	Percentage (%)
Negative issue/report heard (n=225)		
Vaccine is not safe	77	34.2
Children are being used for experiment	140	62.2
Vaccine will affect children's development	8	3.6
Issue/report prevented or delayed vaccine acceptance (n=225)		
Yes	46	20.4
No	179	79.6
Given the option of accepting malaria vaccine at CWC (n=369)		
Yes	247	66.9
No	122	33.1
Vaccines becoming many for children with the introduction of the malaria vaccine (n=424)		
Yes	137	32.3
No	287	67.7
Recommend malaria vaccine to others		
Yes	357	84.2
No	67	15.8
Reason for recommending vaccine (n=357)		
It is safe	145	40.6
It protects children against malaria	212	59.4
Reason for not recommending vaccine (n=67)		
Vaccine does not make any difference	1	1.5
No specific reason	35	52.2
Too many issues surrounding vaccine	2	3.0
Do not have much information on the vaccine	7	10.5
It is not safe	22	32.8

4.5.1 Rating of knowledge level of respondents on malaria vaccine

The knowledge level of respondents on malaria vaccine was rated per the responses provided. Correct responses were scored "1" whiles incorrect responses were scored "0". The rating was based on the following questions: whether they had heard about the malaria vaccine, number of times a child is supposed to be administered the vaccine, age order of being administered the vaccine, whether vaccines were becoming too many for children with introduction of the malaria vaccine, and whether they will recommend the vaccine to others. The scores were summed up for each respondent to give a composite score, the highest being "5" and the least being "0".

Majority (73.6%) scored between 2 and 3 representing moderate knowledge with 16.3% having scores representing low knowledge whiles 10.1% scored between 4 and 5 representing high knowledge (Table 8)

Table 8: Rating of knowledge of respondents about malaria vaccine in Sunyani Municipal, 2020

Characteristic (knowledge) n=424	Scale	Frequency	Percentage (%)
Low knowledge	0-1	69	16.3
Moderate knowledge	2-3	312	73.6
High knowledge	4-5	43	10.1

4.6 Previous experience with childhood vaccines

Up to 52.6% of respondents said their child had ever suffered from an adverse reaction following the administration of a vaccine. The adverse reactions were fever (66.4%), abscess (28.7%), and diarrhoea/vomiting (4.9%). Details of distribution of respondents' previous experience with childhood vaccines is shown in Table 9.

Table 9: Previous experience with childhood vaccines among parents/caregivers in Sunyani Municipal, 2020

Characteristic (n = 424)	Frequency	Percentage (%)
Child ever suffered an adverse reaction following the administration (n=424)		
Yes	223	52.6
No	201	47.4
Reaction child suffered (n=223)		
Fever	148	66.4
Diarrhoea/Vomiting	11	4.9
Abscess	64	28.7
Did reaction influence acceptance of other vaccines (n=223)		
Yes	12	94.6
No	211	5.4

4.7 Experience with vaccination activities

Only 1.7% of respondents spent more than an hour in getting to the nearest vaccination centre with 67.2% spending less than 30 minutes. Most of them (67.9%) walked to the vaccination centre.

Majority of them (88.2%) were not required to pay any money at the vaccination centre. The CWC cards (51.4%) gave most of them information about when their child's vaccination was due. The rest got the information from their friends or nurses or visited the clinic monthly.

The attitude of nurses at CWCs was described as very good (45.1%) and good (41.3%). Only 4% of respondents thought vaccines had long term side effects.

Respondents' experience with vaccination activities are shown in Table 10.

Table 10: Experience with vaccination activities among parents/caregivers in Sunyani Municipal, 2020

Characteristic (n = 424)	Frequency	Percentage (%)
Time taken to reach vaccination centre		
Less than 30 minutes	285	67.2
30 minutes – 59 minutes	132	31.1
1 hour – 2 hours	7	1.7
Means of getting to vaccination centre		
Walking	288	67.9
Commercial vehicle	131	30.9
Personal vehicle	5	1.2
Required to pay any money at vaccination centre		
Yes	50	11.8
No	374	88.2
How to tell when child's vaccination is due		
Ask friends	12	2.8
Check child's CWC card	218	51.4
Visist clinic monthly	158	37.3
Told by nurses	36	8.5

Characteristic (n = 424)	Frequency	Percentage (%)
Description of CWC nurses' attitude		
Excellent	54	12.7
Very good	191	45.1
Good	175	41.3
Bad	4	0.9
Vaccines have long term side effects		
Yes	17	4.0
No	407	96.0

4.8 Association between socio-demographic characteristics of parents/caregivers and malaria vaccine uptake

Being a resident of Abesim sub-Municipal was associated 2.91 increased odds of full uptake of the malaria vaccine as compared to being a resident of Penkwase sub-Municipal. This association had a significant p-value of 0.01. Similarly, being a resident of Antwikrom, Newtown/Baakoniaba, and Sunyani central were significantly associated with full uptake when compared to being a resident of Penkwase. New Dormaa residents had increased odds of 1.41 of full uptake as compared to residents of Penkwase, however, this association was not significant.

Having a parent/caregiver aged 15 - 19 years, 25 – 29 years, 30 – 34 years, and 35+ years were associated with increased odds of full uptake as compared to having a parent/caregiver aged 20 - 24 years. Notably, having a parent aged 15 – 19 years was associated with an increased odds of full uptake of 3.41. However, none of these odds had a significant p-value.

Children with parents/caregivers who have up to tertiary education had an increased odds of 2.37 of full uptake as compared to those with primary education. This association had a significant p-value of 0.026. Those with parents with no formal education had an increased odds of 1.52 of full

uptake as compared to those with primary education. Those with parents who had up to secondary education also had an increased odds of full uptake of 1.36. This was, however, not significant.

Having a parent who was single or married was associated with increased odds of full uptake for the child as compared to having cohabiting parents. However, this association was not significant.

Religious affiliation of both parent/caregivers and their partners were not associated with a significant odds of full uptake by their children.

Having a parent/caregiver who is a civil servant was associated with 2.21 increased odds of full uptake as compared to having a parent/caregiver who is unemployed. This association had a significant p-value of 0.049. Additionally, having a farmer as the partner of your parent/caregiver was associated with a significantly increased odds of 3.07 of full uptake as compared to him/her having a self-employed partner.

Details of the association between socio-demographic characteristics of parents/caregivers and uptake of vaccine are displayed in Table 11.

Table 11: Association between socio-demographic characteristics of parents/caregivers and uptake of malaria vaccine

Characteristic (n = 424)	**Odds ratio**	**95% Confidence interval**	**P-value**
Sub-Municipal	**0.79**	**0.69 – 0.92**	**0.002**
Penkwase (base)	1		
Abesim	2.91	1.29 – 6.57	0.010
Antwikrom	5.36	1.71 – 16.79	0.004
Newtown/Baakoniaba	2.28	1.08 – 4.83	0.031
New Dormaa	1.41	0.73 – 2.73	0.303
Sunyani central	2.28	1.03 – 5.08	0.043
Age of parent (years)	**1.06**	**0.82 – 1.37**	**0.616**
20 – 24 (base)	1		
15 – 19	3.41	0.39 – 29.59	0.266
25 – 29	1.03	0.48 – 2.20	0.945
30 – 34	1.34	0.61 – 2.94	0.463
35 and above	1.38	0.51 – 3.73	0.522

Characteristic (n = 424)	Odds ratio	95% Confidence interval	P-value
Education level of parent/caregiver	**1.29**	**0.97 – 1.71**	**0.075**
Primary education (base)	1	1	
No formal education	1.52	0.54 – 4.30	0.432
Secondary education	1.36	0.82 – 2.26	0.234
Tertiary education	2.37	1.11 – 5.08	0.026
Education level of partner	**1.02**	**0.78 – 1.35**	**0.866**
Secondary education (base)	1	1	
No formal education	2.56	0.55 – 11.89	0.230
Primary education	2.46	1.19 – 5.07	0.015
Tertiary education	2.08	1.25 – 3.45	0.005
Number of children alive	**0.97**	**0.46 – 2.04**	**0.940**
1 – 3 (base)	1	1	
More than 3	0.97	0.46 – 2.04	0.940
Marital status	**0.80**	**0.55 – 1.17**	**0.254**
Cohabiting (base)	1	1	
Single	1.60	0.78 – 3.27	0.199
Married	1.68	0.91 – 3.08	0.097
Religion of parent/caregiver	**0.73**	**0.44 – 1.18**	**0.205**
Traditionalist (base)	1	1	
Christian	2.89	0.23 – 35.94	0.409
Islam	2.17	0.17 – 27.63	0.551
Religion of partner	**0.73**	**0.45 – 1.19**	**0.204**
Traditionalist (base)	1	1	
Christian	1.68	0.16 – 17.29	0.664
Islam	1.21	0.12 – 12.85	0.872
Occupation of parent/caregiver	**1.34**	**1.03 – 1.74**	**0.027**
Unemployed (base)	1	1	
Self employed	1.33	0.76 – 2.32	0.319
Farmer	2.66	0.85 – 8.39	0.094
Civil servant	2.21	1.00 – 4.90	0.049
Occupation of partner	**1.13**	**0.89 – 1.43**	**0.305**
Self-employed (base)	1	1	
Unemployed	3.24	0.40 – 26.06	0.268
Farmer	3.07	1.05 – 9.01	0.041
Civil servant	1.365	0.84 – 2.23	0.214

4.9 Association between knowledge and awareness of malaria vaccine and uptake

Parent/caregiver being unable to mention any correct vaccine-preventable disease (vpd) was associated with their child's increased odds of full uptake of 3.27 as compared to mentioning up to 3 vpds. This had a significant p-value of 0.031. A parent/caregiver mentioning malaria as a vpd

was associated with increased odds of uptake of 1.47 as compared to mentioning up to 3 vpds which did not include malaria. This association was however not significant.

Having heard about the malaria vaccine was not associated with a statistically significant increased odds of full uptake of child.

Those whose parent first heard about the malaria vaccine from the CWC, health facility announcement, and radio all had a statistically significant increased odds of full uptake as compared to those who first heard about the vaccine from friends/relatives.

Those who were able to mention the correct number of times a child is supposed to be administered the malaria vaccine had an increased odds of their child's uptake of 1.26. This association was however not significant. Likewise, knowing the correct order of months of taking the vaccines was positively associated with full uptake. This association, however, was also not statistically significant.

Those whose parents/caregivers had not heard of anything negative about the malaria vaccine had increased odds of full uptake of 1.72. This association was statistically significant. Those whose parents/caregivers heard the negative report from friends/relatives had a statistically significant increased odds of full uptake of 2.75 as compared to those who heard this negative issue/report on radio. Even though those whose parents/caregivers heard this negative issue/report from health workers and other sources had increased odds of full uptake when compared to having heard it from the radio, they were not statistically significant.

Those who said the negative issue/report prevented/delayed their acceptance of the vaccine had an increased odds of over 8 of their child's full uptake. This association had a significant p-value of less than 0.001.

Those who said vaccines for children are becoming many with the introduction of the malaria vaccine had 40% reduced odds of their child's full uptake as compared to those who said otherwise.

Those who said they will recommend the malaria vaccines to others had 12.61 increased odds of their child's full uptake as compared to those who said they will not recommend the vaccine.

Details of the association between knowledge and vaccine uptake are shown in Table 12.

Table 12: Association between knowledge and awareness of malaria vaccine and uptake

Characteristic (n = 424)	Odds ratio	95% Confidence interval	P-value
Known vaccine preventable diseases	**1.01**	**0.81 – 1.27**	**0.899**
Up to 3 vpds mentioned (base)	1	1	
No correct vpd mentioned	3.27	1.12 – 9.56	0.031
4 – 8 correct vpds mentioned	1.06	0.51 – 2.23	0.870
Any correct disease but including malaria	1.47	0.86 – 2.51	0.164
Heard about malaria vaccine	**0.64**	**0.30 – 1.36**	**0.249**
No (base)	1	1	
Yes	0.64	0.30 – 1.36	0.249
Where first heard about malaria vaccine	**0.86**	**0.55 – 1.35**	**0.510**
Friends/relatives (base)	1	1	
CWC	20.22	1.61 – 253.71	0.020
Health facility announcement	16.78	1.18 – 239.11	0.037
Radio	39.68	2.14 – 737.14	0.014
Number of times a child is expected to take the malaria vaccine	**1.26**	**0.67 – 2.34**	**0.472**
Incorrect number (base)	1	1	
Correct number	1.26	0.67 – 2.34	0.472
Schedule of malaria vaccine	**1.26**	**0.55 – 3.04**	**0.560**
Incorrect order (base)	1	1	
Correct order	1.29	0.55 – 3.04	0.560
Heard about any negative report or issue concerning the malaria vaccine	**1.72**	**1.03 – 2.88**	**0.040**
Yes (base)	1	1	
No	1.72	1.03 – 2.88	0.040

Characteristic (n = 424)	Odds ratio	95% Confidence interval	P-value
Where issue or report was heard	**1.38**	**0.81 – 2.34**	**0.232**
Radio (base)	1	1	
Friends/relatives	2.75	1.37 – 5.51	0.004
Health worker	2.28	0.55 – 9.44	0.255
Other	1.08	0.85 – 13.60	0.954
Did issue/report prevent or delay vaccine acceptance	**8.74**	**4.32 – 17.70**	**<0.001**
Yes (base)	1	1	
No	8.74	4.32 – 17.70	<0.001
Given the option of accepting malaria vaccine at CWC	**1.15**	**0.69 – 1.93**	**0.591**
Yes (base)	1	1	
No	1.15	0.69 – 1.93	0.591
Are vaccines becoming many for children with the introduction of the malaria vaccine	**0.60**	**0.38 – 0.97**	**0.038**
No (base)	1	1	
Yes	0.60	0.38 – 0.97	0.038
Will you recommend malaria vaccine to others			
No (base)	1	1	
Yes	12.61	7.00 – 22.72	<0.001

4.10 Association between Previous experience with childhood vaccines and malaria vaccine uptake

Parent/caregivers who had children who had ever suffered an adverse reaction following the administration of a vaccine had an increased odds of uptake of their children of 1.14. This increased odds was however, not statistically significant.

Those with siblings who had suffered fever as an adverse reaction had an increased odds of uptake of 3.09 as compared to those whose siblings had an abscess as an adverse reaction. Similarly, those with siblings who suffered diarrhoea/vomiting had an increased odds of 5.56 of full uptake as compared to those who had an abscess. All these associations were statistically significant.

Details of association between previous experience with childhood vaccines and vaccine uptake are shown in Table 13.

Table 13: Association between Previous experience with childhood vaccines and malaria vaccine uptake

Characteristic	Odds ratio	95% Confidence interval	P-value
Child ever suffered an adverse reaction following the administration	**1.14**	**0.72 – 1.80**	**0.576**
No (base)	1	1	
Yes	1.14	0.72 – 1.80	0.576
Reaction child suffered	**0.57**	**0.41 – 0.81**	**0.001**
Abscess (base)	1	1	
Fever	3.09	1.56 – 6.09	0.001
Diarrhoea/vomiting	5.56	0.67 – 46.00	0.111
Did reaction influence acceptance of other vaccines	**1.87**	**0.56 – 6.27**	**0.311**
Yes (base)	1	1	
No	1.87	0.56 – 6.27	0.311

4.11 Association between Experience with vaccination activities and malaria vaccine uptake

Increase in time taken to reach vaccination centre was not found to be significantly associated with increased odds of uptake.

Similarly, means of getting to the vaccination centre was not found to be significantly associated with increased odds of uptake when the various means are compared.

Means of checking when child's vaccine is due, description of CWC nurses' attitude had some association with odds of uptake. However, they were all not statistically significant.

Details of the association between experience with vaccination activities and uptake are displayed in Table 14 below.

Table 14: Association between Experience with vaccination activities and malaria vaccine uptake

Characteristic	Odds ratio	95% Confidence interval	P-value
Time taken to reach vaccination centre	**1.09**	**0.69 – 1.71**	**0.724**
Less than 30 minutes (base)	1	1	
30 minutes – 59 minutes	1.06	0.65 – 1.74	0.820
1 hour – 2 hours	1.51	0.18 – 12.98	0.706
Means of getting to vaccination centre	**1.23**	**0.77 – 1.99**	**0.385**
Walking (base)	1	1	
Commercial vehicle	1.43	0.85 – 2.40	0.176
Personal vehicle	0.411	0.07 – 2.47	0.331
Required to pay any money at vaccination centre	**1.24**	**0.62 – 2.48**	**0.544**
Yes (base)	1	1	
No	1.24	0.62 – 2.48	0.544
How to tell when child's vaccination is due	**0.81**	**0.58 – 1.12**	**0.195**
Visit clinic monthly (base)	1	1	
Check child'd CWC card	1.57	0.97 – 2.54	0.064
Told by nurses	2.04	0.80 – 5.20	0.136
Description of CWC nurses' attitude	**0.95**	**0.69 – 1.32**	**0.779**
Excellent (base)	1	1	
Very good	0.50	0.22 – 1.12	0.092
Good	0.61	0.27 – 1.40	0.242
Do you think vaccines have long term side effects	**1.01**	**0.33 – 3.13**	**0.984**
Yes (base)	1	1	
No	1.01	0.33 – 3.13	0.984

4.12 Multivariate analysis showing association between level of malaria vaccine uptake and independent variables

Multiple ordered logistic regression analysis using variables that were significant at 5% in the univariate analysis demonstrated that adjusted odds ratio for uptake per sub-Municipal was not significant.

As compared to secondary education, children with a parent who had been educated up to the tertiary level had an increased odds of 4.72 times of complete uptake. Those with parents who had

primary education also had an odds of 4.10 of complete uptake when compared to those with secondary education. All these odds ratios had a significant p-value.

Association between occupation of partner was no longer significant in the multivariate analysis.

Children with parents/caregivers who thought vaccines were becoming too many for them with the addition of the malaria vaccine had a 71% reduced odds of full uptake as compared to those who thought otherwise. This association was significant with a p-value of 0.001.

Additionally, children who had suffered fever as an adverse reaction had an increased odds of 2.27 of their children completing uptake as compared to those whose children suffered abscess.

Details of the multivariate analysis are depicted in Table 15.

Table 15: Multivariate analysis showing association between level of malaria vaccine uptake and independent variables

Characteristic	**Crude Odds ratio**	**95% Confidence interval**	**P-value**	**Adjusted Odds ratio**	**95% Confidence interval**	**P-value**
Sub-Municipal	**0.80**	**0.69 – 0.92**	**0.002**	**0.82**	**0.66 – 1.02**	**0.076**
Penkwase (base)	1	1				
Abesim	2.91	1.29 – 6.57	0.010	2.21	0.53 – 9.17	0.276
Antwikrom	5.36	1.71 – 16.79	0.004	2.01	0.16 – 26.03	0.593
Newtown/Baakoniaba	2.28	1.08 – 4.83	0.031	1.22	0.32 – 4.62	0.770
New Dormaa	1.41	0.73 – 2.73	0.303	0.36	0.10 – 1.29	0.117
Sunyani central	2.28	1.03 – 5.08	0.043	0.98	0.27 – 3.50	0.971
Education level of partner	**1.02**	**0.78 – 1.35**	**0.866**	**1.02**	**0.60 – 1.75**	**0.936**
Secondary education (base)	1	1				
No formal education	2.56	0.55 – 11.89	0.230	0.93	0.02 – 31.06	0.970
Primary education	2.46	1.19 – 5.07	0.015	4.10	1.02 – 16.47	0.047
Tertiary education	2.08	1.25– 3.45	0.005	4.72	1.27 – 17.55	0.020
Occupation of partner	**1.13**	**0.89 – 1.44**	**0.305**	**1.27**	**0.84 – 1.92**	**0.257**
Self employed (base)	1	1				
Unemployed	3.24	0.40 – 26.06	0.268	1.74	0.17 – 17.42	0.637
Farmer	3.07	1.05 – 9.01	0.041	0.97	0.08 – 11.06	0.980
Civil servant	1.365	0.84 – 2.23	0.214	0.61	0.16 – 2.31	0.464

Characteristic	Crude Odds ratio	95% Confidence interval	P-value	Adjusted Odds ratio	95% Confidence interval	P-value
Vaccines becoming many for children with the Introduction of the malaria vaccine	**0.60**	**0.38 – 0.97**	**0.038**	**0.29**	**0.14 – 0.61**	**0.004**
No (base)	1	1				
Yes	0.60	0.38 – 0.97	0.038	0.29	0.14 – 0.61	0.001
Experience with AEFI	**0.57**	**0.41 – 0.81**	**0.001**	**0.58**	**0.41 – 0.83**	**0.003**
Abscess (base)	1	1				
Fever	3.09	1.56 – 6.09	0.001	2.27	1.13 – 5.10	0.023
Diarrhoea/vomiting	5.56	0.67 – 46.00	0.111	6.95	0.69 – 69.77	0.099

CHAPTER FIVE

DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

5.1 Uptake of malaria vaccine

Findings from this study indicated an uptake of 94.1% for RTS,S 1; 90.6% for RTS,S 2; and 78.1% for RTS,S 3. Uptake of RTS,S 1 and RTS,S 2 thus met the target of 90% coverage for vaccines set by WHO (WHO, 2013). RTS,S 3 coverage, however, did not meet the set target.

There was a reduction in uptake of subsequent doses of the vaccine. This observed reduction is similar to that observed in Senegal in 2017 (Mbengue et al., 2017). In their study, uptake of Penta vaccine reduced from 95.6% to 93.5%, to 89.2% for Penta 1, Penta 2 and Penta 3 respectively. Similarly, uptake of OPV 1, OPV 2, and OPV 3 reduced across the doses from 95.8% to 92.9% to 83.7%.

Similar trends in uptake were observed by Russo et al. (2015) in Cameroun, Adedire et al. (2016) in Nigeria, , Ekouevi et al. (2018) in Togo, Acharya et al. (2018) in Congo, and Wemakor et al. (2018) in the Kwabre East district of Ghana.

The over 90% uptake recorded for the RTS,S 1 and RTS,S 2 indicates that the anti-vaccine campaigns that greeted the introduction of the malaria vaccine as reported by "Myjoyonline" (2019) did not impact heavily on the uptake of the vaccine in Sunyani Municipality. It may have been so because the messages were largely on social media and did not really seep down to negatively influence parents/caregivers. It may also have been due to effective public education and other community mobilization strategies employed by the Municipal health directorate to

create awareness about the vaccine when it was introduced. This is corroborated by the fact that 87.3% and 7.6% of respondents first heard about the vaccine from CWC and health facility announcement respectively (Table 7).

The trend of reduced coverages for subsequent doses of the malaria vaccine as recorded in this study which is similar to coverages of other vaccines reported in similar studies in different settings may be due to poor knowledge of parent/caregivers about the schedule of the vaccines. This could result in parents/caregivers not presenting their children for the subsequent doses on time or not presenting them at all as was the case of 45.6% of respondents (Table 6). The trend could also be because of poor knowledge about the need for their children to be administered all doses. Results from Table 6 also indicate that 23.5% of children had not been administered all three doses because their parents/caregivers had travelled when they were due. This is due to the fact that not all districts in the country are administering the vaccine (only districts on the MVIP). Therefore, when parents/caregivers travel to these non-implementing districts, their children may not be administered the vaccine at all or on time.

If children do not receive all the doses of the vaccine, they are not likely to get the full benefit of the vaccine as the full dose may provide, because their immune systems may not be stimulated enough by the partial doses received.

Out of the 5.9% of children who had not been administered any dose of the vaccine, most (88%) were attributed to a personal or partner's decision to refuse the vaccine (Table 6). Almost all the respondents were females indicating that it was the fathers who prevented their children from being administered the vaccine. Fathers play a major role in the family and are usually the decision-makers. The few who prevented their children from being given the vaccine may have been

influenced by the anti-vaccine campaigns. Fathers are usually not present at CWCs and so are not likely to benefit from education about vaccines which are usually delivered there.

Those who said it was their personal decision to refuse the vaccine for their children may have been influenced by the anti-vaccine campaigns and may feel the vaccines are not safe enough for their children.

5.2 Timeliness of malaria vaccine uptake

Timeliness of uptake of RTS,S 1 was 67.7%, that of RTS,S 2 was 51.8%, whiles that of RTS,S 3 was 54.4%. Whiles 1.5% of children received RTS,S 1 earlier than the recommended time, 30.8% received it later than the recommended time. Also, 1.1% of children were administered RTS,S 2 earlier than the recommended time whiles 47.1% received it later. Furthermore, 10.2% of children received RTS,S 3 earlier than the recommended schedule whiles there was a delayed uptake for 35.4% of children.

Timeliness of 89.6%, 86.5%, and 83.1% reported by Laryea et al. for OPV 1/Penta 1, OPV 2/Penta 2, and OPV 3/Penta 3 contrasts with the timeliness recorded for all doses of the malaria vaccine in this study. Similarly, the study recorded higher delays in timeliness than that reported by Mbengue et al. (2017).

The inability of parents/caregivers to go for the malaria vaccine for their children on time may be due to their poor knowledge about the schedule of the vaccine. It could also be that because it's a newly introduced vaccine, some parents/caregivers adopted a 'wait and see' attitude where they wanted to be sure nothing bad happened to those who went for the vaccine before sending their wards for theirs.

Timeliness of RTS,S 1 was better than RTS,S 2 and RTS,S 3 and may have been due to the public announcements and other social mobilization done to draw parents/caregivers' attention to the vaccine prompting them to go in for the first dose on time. Timeliness of uptake for RTS,S 3 was better than RTS,S 2 probably because at 9 months, the children are scheduled to be given the measles-rubella and yellow fever vaccines and most parents/caregivers are already aware of this schedule and would have reported for those vaccines even in the absence of RTS,S.

Some of the children were dosed earlier than the recommended schedule (1.5% for RTS,S 1, 1.1% for RTS,S 2 , and 10.8% for RTS,S 3). This could be attributed to health workers who give the vaccines not knowing the exact schedule of the vaccines. The 10.8% early timeliness of RTS,S 3 may be due to the fact that RTS,S 2 is given a month after RTS,S 1 prompting some staff to think that RTS,S 3 is also given a month after RTS,S 2 when actually the interval between RTS,S 2 and RTS,S 3 is two months.

5.3 Factors associated with uptake of malaria vaccine

The study identified a number of factors associated with full uptake of the malaria vaccine (Table 15). Each of the factors identified falls into one of the five domains identified by Thomson et al. (2016) as domains into which all factors associated with vaccine uptake were observed.

5.3.1 Knowledge about vaccines and uptake

Results on knowledge about vaccines, in general, compares with that found by Febir et al. (2013). Whiles Febir et al. identified that mothers demonstrated widespread knowledge about vaccines, results from this study indicate that more than 50% of respondents were able to mention more than 3 correct vaccine-preventable diseases. However, only 29% included malaria in their list of

vaccine-preventable diseases even though 87% confirmed that they had heard about the malaria vaccine when they were directly asked (Table 7). Knowledge about vaccines in general and the malaria vaccine specifically was not significantly associated with full uptake of the vaccine.

This implies that Adedire et al.'s findings of knowledge being positively associated with complete uptake was not consistent with findings from this study (Adedire et al., 2016). Additionally, Vonasek et al.'s finding on knowledge of mothers being associated with higher odds of uptake was not similar to findings from this study (Vonasek et al., 2016). Conversely, the findings of this study are similar to those found by Wemakor et al. in the Kwabre East district of Ghana (Wemakor et al., 2018). Both studies did not find any association between knowledge of parents/caregivers and full uptake.

Results on knowledge about the malaria vaccine indicate that even though public education has gone on about about the vaccine, it has not come to be accepted as part of the mainstream childhood vaccines. This may be because some parents/caregivers see it as some sort of vaccine trial given the anti-vaccine campaigns that greeted its introduction.

5.3.2 Factors positively associated with uptake

Findings of high level of education being positively associated with complete uptake was consistent with findings from this study (Adu, 2017).

Whiles age, education, parity, occupation, knowledge, and income were identified by Mukthar et al. (2015) as factors associated with PVC uptake, only education and occupation were in line with the findings of this study. Similarly, whiles Ofosu (2017) identified age, occupation, knowledge, and education level as key determinants of vaccine uptake in Assin North Municipality of Ghana, only occupation and education level were identified as positive predictors in this study.

Having a mother with secondary education or better was associated with complete immunization coverage according to a study conducted by Ekouevi et al. in Togo (Ekouevi et al., 2018). This finding was similar to the findings made by this study. Similarly, Acharya et al.'s findings of higher education being associated with complete uptake was consistent with findings from this study (Acharya et al., 2018).

Having a higher educated parent was associated with higher odds of complete uptake both in the univariate analysis and the multivariate analysis (AOR: 4.72, 95%CI: 1.27 – 17.55). This could be because highly educated parents have access to more information about the vaccine and were better placed to understand the implementation program. Since most parents/caregivers who send their wards for vaccination services are women (99.5%), having a partner who has higher education could mean that as the decision-maker, he is more likely to accept the vaccine. This is buttressed by the fact that 60% of those whose children had not received a single dose of the vaccine attributed it to their partner's decision to refuse the vaccine. Having a higher education is associated with better occupation, the possible reason why civil servants had higher odds of their children completing uptake when compared.

5.3.3 Factors negatively associated with uptake

Whiles Russo et al. identified mother's young age and long distance to vaccination centres as factors associated with incomplete uptake of vaccines, this study did not make such findings (Russo et al., 2015). However, the findings by Mvula et al. that having a lower educated mother was associated with incomplete vaccination is consistent with findings from this study (Mvula et al., 2016).

In Magodi et al.'s study on the factors associated with non-uptake of the second dose of Measles-Rubella (MR) vaccine, they identified caretaker being unaware of the ages for MR 1 and MR 2 as one of those factors (Magodi et al., 2019). However, being unaware of the schedule of the malaria vaccine was not found to be associated with incomplete uptake in this study.

The findings of parents/caregivers having the perception that vaccines are becoming too many for their children is unique to this study per available literature reviewed. Those who thought vaccines for children are becoming many had lower odds of completing uptake (AOR: 0.29, 95%CI: 0.14 – 0.61). This could be that parents/caregivers do not see the benefits of the child being vaccinated overriding the potential adverse effect that could occur when the vaccine is given.

Additionally, parents/caregivers who have children who have ever had fever as an adverse reaction following immunization had a higher odds of completing uptake as compared to those who had abscess as an adverse reaction (AOR: 3.09, 95%CI: 1.56 - 6.09). This could be related to the fact that most parents/caregivers consider fever to be a minor immediate side effect of vaccines as compared to developing an abscess. They were therefore not likely to 'risk' going for a new vaccine the safety of which has been questioned.

5.4 Strengths of the study

Per available literature reviewed, the study is the first of its kind to be conducted on the uptake of the new malaria vaccine in the country since its introduction in 2019. The study will therefore set the platform on which similar studies can be based.

It affords the Sunyani Municipal health directorate the opportunity to adopt strategies to improve uptake of the malaria vaccine and other vaccines in the Municipality based on the factors

identified. Other districts on the MVIP can also use findings from this study to improve uptake in their districts.

The study further gives policy makers (GHS) the opportunity to address barriers to uptake of the vaccine before its scale-up to other districts in the country.

5.5 Limitation of the study

The study would have benefited from a qualitative aspect. This would have thrown more light on the health system factors affecting uptake. It would have also helped to capture well the perceptions, experiences and challenges parents/caregivers face in getting their children the malaria vaccine.

5.6 Conclusion

Uptake for the first dose of the malaria vaccine (RTS,S 1) in Sunyani Municipality is 94.1%, that of the second dose (RTS,S 2) is 90.6%, and the uptake for the third dose (RTS,S 3) is 78.1%. The uptake for both RTS,S 1 and RTS,S 2 reached WHO's target of 90% coverage for all vaccines, whilst RTS,S 3 uptake did not.

Up to 67.7% of children in Sunyani Municipality were administered RTS,S 1 at the scheduled 6 months, 51.8% were administered the second dose (RTS,S 2) at the scheduled 7 months. Also, 54.4% of children were administered RTS,S 3 at the scheduled 9 months.

Having a parent/caregiver who had up to tertiary education was significantly associated with 2.08 increased odds of full uptake of the malaria vaccine. Conversely, a child had a 71% reduced odds of full uptake if his/her parent/caregiver perceived vaccines as becoming too many for children. Additionally, having a parent whose child had ever suffered an Adverse Event Following Immunization (AEFI) was associated with 42% reduced odds of full uptake of the malaria vaccine.

5.7 Recommendations

The following recommendations are made based on the findings of the study.

The Sunyani Municipal Health Directorate (MHD) should:

1. conduct a qualitative research into the factors associated with malaria vaccine uptake in the municipality. This will help better understand other dimensions of the factors associated with uptake of the vaccine so that it can be improved.
2. provide education about the necessity of timely uptake of the malaria vaccine. This will help improve upon the timeliness of uptake of the vaccine.
3. conduct research into the rising issue of vaccine hesitancy in the Municipality so that strategies can be adopted to halt it.

The Ghana Health Service (GHS) should conduct sustained public education about the malaria vaccine before scaling it up to other districts.

The World Health Organization (WHO) should:

1. initiate and support several studies of this nature in different areas of countries on the Malaria Vaccine Implementation Programme (MVIP) in order to achieve the objectives of the programme.
2. consider and implement strategies aimed at reducing vaccine hesitancy among the populace. Vaccine hesitancy has the potential of eroding the gains made through vaccination efforts.

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APPENDIX 1: QUESTIONNAIRE

No.	Question	Response (write and/or tick as appropriate)	Code
Part A: Parent/caregiver characteristics			
1.	Age		
2.	Sex	Male [ ]	1
		Female [ ]	2
3.	Number of pregnancies carried to term		
4.	Number of children alive		
5.	Parent or caregiver?	Parent [ ]	1
		Caregiver [ ]	2
6.	If caregiver, what is the relationship with child?	Relative's child [ ]	1
		Friend's child [ ]	2
		NA [ ]	8
7.	If caregiver, for how long?	Less than 1 month [ ]	1
		1 – 6 months [ ]	2
		6 months – 1 year [ ]	3
		NA [ ]	8
8.	If caregiver, why?	Mother has travelled [ ]	1
		Mother is sick [ ]	2
		Mother not alive [ ]	3
		Mother unconcerned about vaccination [ ]	4
		Other [ ] **(specify)**	7
		NA [ ]	8
9.	Highest education level (all respondents)	No formal education [ ]	0
		Primary education [ ]	1
		Secondary education [ ]	2
		Tertiary education [ ]	3
10.	Highest education level of partner (all respondents)	No formal education [ ]	0
		Primary education [ ]	1
		Secondary education [ ]	2
		Tertiary education [ ]	3
11.	Marital status (all respondents)	Single [ ]	1
		Married [ ]	2
		Cohabiting [ ]	3
12.	Religious affiliation (all respondents)	Christianity [ ]	1

		Islam [ ]	2
		Traditionalist [ ]	3
		Other [ ] **(specify)**	7
13.	Religious affiliation of partner (all respondents)	Christianity [ ]	1
		Islam [ ]	2
		Traditionalist [ ]	3
		Other [ ] **(specify)**	7
14.	Occupation (all respondents)	Unemployed [ ]	0
		Self-employed [ ]	1
		Farmer [ ]	2
		Civil servant [ ]	3
15.	Occupation of partner (all respondents)	Unemployed [ ]	0
		Self-employed [ ]	1
		Farmer [ ]	2
		Civil servant [ ]	3
16.	Number of ANC visits (when pregnant with child under review)	Number:	
		Cannot recall [ ]	9
		NA [ ]	8
17.	Where was child delivered?	Home [ ]	1
		Health facility [ ]	2
		Don't know [ ]	9
Part B: Parent/Caregivers knowledge and experience with vaccines in general			
18.	What is the **main** reason why children are vaccinated?	Don't know [ ]	9
		Protect them against diseases [ ]	1
		Make them breastfeed well	2
		Other [ ] **(specify)**	7
19.	What are some of the diseases childhood vaccines prevent? (**mention as many as can remember) <u>Vaccine Preventable diseases</u> Tuberculosis [ ] Influenza [ ] Poliomyelitis [ ] Hepatitis B [ ] Tetanus [ ] Pertusis [ ]	Number mentioned	
		**No correct disease mentioned [ ]	0
		**Up to 3 correct diseases mentioned [ ]	1
		**4 to 8 correct diseases mentioned [ ]	2

	Pneumonia [ ] Measles [ ] Diarrhoea [ ] Yellow fever [ ] Diphtheria [ ] Malaria [ ]	**Any correct disease **but including** malaria [ ]	3
20.	Has any of your children suffered an adverse reaction following the administration of any vaccine?	Yes [ ]	1
		No [ ]	0
21.	If 'yes' to Q20, what was it?	Fever [ ]	1
		Diarrhoea/vomiting [ ]	2
		Abscess [ ]	3
		Other [ ] **(specify)**	7
		NA [ ]	8
22.	Has this influenced your decision to take other vaccines for your child?	Yes [ ]	1
		No [ ]	0
		NA [ ]	8
23.	How many minutes does it take you to get to the vaccination centre?	Less than 30 mins [ ]	1
		30 mins – 59 mins [ ]	2
		1 hour – 2 hours [ ]	3
		More than 2 hours [ ]	4
24.	How do you usually get to the vaccination centre?	Walking [ ]	1
		Commercial (taxi/trotro/motorbike) [ ]	2
		Personal vehicle (car/motorbike) [ ]	3
25.	Are you required to pay any money at the vaccination centre?	Yes [ ]	1
		No [ ]	0
26.	If 'Yes' to Q25, how much?	Less than 50p [ ]	1
		50p – less than Gh₵2 [ ]	2
		Gh₵ 2 – < Gh₵ 5 [ ]	3
		Gh₵5 or more [ ]	4
		NA [ ]	8
27.	How do you know when your child's vaccination is due?	Ask friends [ ]	1
		Check child's CWC card [ ]	2
		I go there every month [ ]	3
		The nurses tell us [ ]	4
		Other [ ] **(specify)**	7

28.	How will you describe the attitude of nurses who attend to you during CWC for child under review?	Excellent [ ]	1
		Very good [ ]	2
		Good [ ]	3
		Bad [ ]	4
		Very bad [ ]	5
		NA [ ]	8
29.	Do you think vaccines have long term side effects?	Yes [ ]	1
		No [ ]	0
30.	If 'Yes' to Q29, what are some of the side effects?	Infertility [ ]	1
		Mental retardation [ ]	2
		Stroke [ ]	3
		Other [ ] **(specify)**	7
		NA [ ]	8
Part C: Patients/caregivers knowledge and experience with Malaria vaccine			
31.	Have you heard about the malaria vaccine?	Yes [ ]	1
		No [ ]	0
32.	If 'Yes' to Q31, where did you first hear about the malaria vaccine?	CWC [ ]	1
		Health facility announcement [ ]	2
		Radio [ ]	3
		Friend/Relative [ ]	4
		Community announcement [ ]	5
		Other [ ] **(specify)**	7
		NA [ ]	8
33.	How many times is a child supposed to take the malaria vaccine? **(correct number is 4 times)**	Number mentioned	
		**Correct number [ ]	1
		**Incorrect number [ ]	0
		Don't know [ ]	9
		NA [ ]	8
34.	What specific ages (in months) is child supposed to take the malaria vaccine? **(correct order is 6, 7, 9 and 24 months)**	**Correct order [ ]	1
		**Incorrect order [ ]	0
		NA [ ]	8
35.	Have you heard about any negative report/issue concerning the malaria vaccine?	Yes [ ]	1
		No [ ]	0
		NA [ ]	8
36.	If 'Yes' for Q35, from where?	Radio [ ]	1
		Friends/relatives [ ]	2

		Nurses/health workers [ ]	3
		Religious leader [ ]	4
		Other [ ] **(specify)**	7
		NA [ ]	8
37.	What issue/report was it?	The malaria vaccine is not safe [ ]	1
		Children are being used for experiment (trials) [ ]	2
		The malaria vaccine will affect children's development [ ]	3
		Other [ ] **(specify)**	7
		NA [ ]	8
38.	Did it prevent/delay your decision to get the malaria vaccine for your child?	Yes [ ]	1
		No [ ]	0
		NA [ ]	8
39.	Are you given the option of deciding to let your child be given the malaria vaccine at CWC	Yes [ ]	1
		No [ ]	0
		NA [ ]	8
40.	With this malaria vaccine, do you think vaccines are becoming too many for children?	Yes [ ]	1
		No [ ]	0

Part D: Checklist to check RTS,S uptake from child's CWC card

41.	Child's Date of birth		……../……../……		
42.	Age of child (in months)				
43.	Sex		Male [ ]		1
			Female [ ]		2
44.	Doses of RTS,S child has received		None [ ]		0
			RTS,S 1 only [ ]		1
			RTS,S 1 and 2 [ ]		2
			RTS, 1, 2 and 3 [ ]		3
45.	Dates child took RTS,S		**Age(months), write 'NA' if child has not taken vaccine**	**Recommended month?**	
	Dose	**Date received**			
	RTS,S 1	……/…./……		Yes [ ]	1
				No [ ]	0
	RTS,S 2	……/…./……		Yes [ ]	1
				No [ ]	0

	RTS,S 3	……/…./……		Yes [ ]	1
				No [ ]	0
46.	What is the reason why your child has not taken **ANY** of the three doses of the malaria vaccine?		Personal decision to refuse vaccine [ ]		1
			Partner's decision to refuse vaccine [ ]		2
			Did not know child is eligible		3
			Other [ ] **(specify)**		7
			NA [ ]		8
47.	What is the reason why your child has not taken **ALL** the three doses of the malaria vaccine		Did not know when next one was due [ ]		1
			Did not take previous dose on time [ ]		2
			Not comfortable with side effects [ ]		3
			Not comfortable with issues surrounding the vaccine [ ]		4
			Money charged for previous dose [ ]		5
			I was not around [ ]		6
			Other [ ]**(specify)**		7
			NA [ ]		8
48.	Will you recommend the malaria vaccine to other parents?		Yes [ ]		1
			No [ ]		0
			NA [ ]		8
49.	If 'Yes' to Q48, why?				
50.	If 'No' to Q48, why?				

THANK YOU!!!

APPENDIX 2: PARTICIPANT'S INFORMATION SHEET

Project Title: Factors associated with Malaria vaccine uptake in Sunyani Municipality

Introduction: Dennis Tabiri (0202865337, dennistbr@gmail.com)

Address: Department of Epidemiology and Disease Control, School of Public Health, College Of Health Sciences, University Of Ghana, Legon

I am a MASTER OF PUBLIC HEALTH student from the University of Ghana, Legon. I am conducting a study on the factors associated with malaria vaccine uptake in Sunyani Municipality.

Background and purpose of research: The aim of the study is to improve uptake of the vaccine in Sunyani Municipal and other parts of the country in order to reduce deaths and sickness associated with malaria among children.

The study will help improve uptake of the malaria vaccine which will lead to reduction in deaths and sickness associated with malaria in children.

Nature of research: This study is about what promotes or prevents parents/caregivers from getting their children getting the malaria vaccine. It is being conducted in the Sunyani Municipality and will involve about four hundred and twenty (420) parents/caregivers.

Confidentiality: Any information you provide will be treated confidentially and will be used solely for the purpose for which it is being collected – academic work. Thus, your responses will not be shared with anyone who is not part of the team involved in the study. Data will be analyzed at the aggregate level and your responses will not be traced to you.

Findings will be shared with relevant institutions concerned with childhood vaccine uptake.

Participant involvement: Participants will be required to provide answers to questions related to their children's malaria vaccine uptake. This is due to the fact that these children are less than a year old and it is parents/caregivers who decide/act for/on behalf of their children in such matters. It will take between 20 – 30 minutes to respond to the questionnaire.

Potential risks: Questions will centre mainly on you and your child and may evoke some emotional reactions.

Benefits: Even though the study may not directly benefit participant and his/her dependent, the benefit will be for the general and future population. The study will help the Sunyani Municipal Health Directorate and other directorates put in measures to promote uptake of the vaccine to reduce childhood illness and deaths associated with malaria.

Costs: The study is being sponsored by the World Health Organization's special programme for Tropical Diseases Research (WHO/TDR). There will be no costs for participating in the research. You will not be compensated for participating in this study.

Voluntary participation and withdrawal: You may withdraw from the study at any point without any consequences.

Outcome and Feedback: The outcome of this study will be shared with the Sunyani Municipal Health Directorate and will be shared with you during child welfare clinics

Sharing of participants information/data: The data generated from this study will be solely for the principal investigator and will only be shared with other individuals or organizations for studies concerning malaria or vaccine uptake after expressly written request.

Further clarifications/questions: Any questions concerning the research project should be directed to Dr. Priscilla Nortey, School of Public Health (0208181120), Dennis Tabiri (0249610235) and Ms. Abena Addai-Donkor, Administrator, Ghana Health Service Review Committee (0244712919).

A copy of this Information Sheet and Consent form will be given to you after it has been signed or thumb-printed to keep

APPENDIX 3: CONSENT FORM

Study title**: Factors associated with malaria vaccine uptake in Sunyani Municipality**

PARTICIPANTS' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the Participants' Information Sheet read and satisfactorily explained to me in a language I understand (English, Twi, other(specify) ……..). 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 ……...OR Thumb Print……

Date:…….

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 the (English, Twi, other(specify) ……..) 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……

Signature of Interpreter…….. Date:……

Contact Details

STATEMENT OF WITNESS

I was present when the purpose and contents of the Participant Information Sheet was read and explained satisfactorily to the participant in the language he/she understood (English, Twi, other(specify) ……..)
I confirm that he/she was given the opportunity to ask questions/seek clarifications and same were duly answered to his/her satisfaction before voluntarily agreeing to be part of the research.

Name:……

Signature…….... OR Thumb Print …….....

Date:……

INVESTIGATOR'S STATEMENT AND SIGNATURE
I declare that I have given enough information to the participant to make informed decision about participating in the study.

I certify that the participant has been given ample time to read and learn about the study. All questions and clarifications raised by the participant have been addressed.

Researcher's name: Dennis Tabiri

Signature …….

Date…….

APPENDIX 4: ETHICAL CLEARANCE

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: +233-0302-960628
Fax + 233-0302-685424
Mob + 233-050-3539896
Email: ethics.research@ghsmail.org

MyRef. GHS/RDD/ERC/Admin/App 1205
Your Ref. No.

28th January, 2020

Dennis Tabiri
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-ERC029/12/19**
Project Title	Factors Associated with Malaria Vaccine Uptake in Sunyani Municipality
Approval Date	28th January, 2020
Expiry Date	27th January, 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.

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. Cynthia Bannerman
(GHS-ERC Chairperson)

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

APPENDIX 5: APPROVAL TO CARRY OUT STUDY

OUR CORE VALUES

1. PEOPLE CENTEREDNESS
2. PROFESSIONALISM
3. TEAM WORK
4. INNOVATION & EXCELLENCE
5. DISCIPLINE
6. INTEGRITY

My Ref No: GHS/BA/MHD/
Your Ref. No.....

GHANA HEALTH SERVICES
MUNICIPAL HEALTH
DIRECTORATE
P. O. BOX 311
SUNYANI

25TH FEBRUARY, 2020

ALL SUB-MUNICIPAL IN-CHARGES

APPROVAL TO CARRY OUT RESEARCH

Approval has been given to **Mr. Dennis Tabiri** of the **University of Ghana School of Public Health** to carry out a research on **"Factors associated with malaria vaccine uptake in Sunyani Municipality".**

He will be collecting data from parents/caregivers in the Municipality. Kindly assist him with any information he may need and any help that you can. Do not hesitate to contact the directorate for any clarification.

Thank you

MUNICIPAL DIRECTOR OF HEALTH SERVICE
MUNICIPAL HEALTH DIRECTORATE
SUNYANI

DR. MRS. PAULINA CLARA APPIAH
MUNICIPAL DIRECTOR OF HEALTH SERVICES
SUNYANI

APPENDIX 6: TABLES

Table 16: EPI Schedule In Ghana (Without RTS,S)

Age of administration	Vaccine(s)	Mode of administration
At birth	BCG, OPV 0	Intradermal, oral
6 weeks	Penta 1, PCV 1, OPV 1, Rota 1,	Intramuscular, oral
10 weeks	Penta 2, PCV 2, OPV2, Rota 2	Intramuscular, oral
14 weeks	Penta 3, IPV, PCV 3, OPV 3	Intramuscular, oral
6 months	Vitamin A	Oral
9 months	Measles-Rubella (MR) 1, Yellow fever	Sub-cutaneous
12 months	Vitamin A	Oral
18 months	MR 2, Meningococcal 'A', Vitamin A	Subcutaneous, Intramuscular, oral

Source: GHS, 2019

Table 17: EPI Schedule with RTS,S for areas on MVIP in Ghana

Age of administration	Vaccine	Mode of administration
At birth	BCG, OPV 0	Intradermal, oral
6 weeks	Penta 1, PCV 1, OPV 1, Rota 1,	Intramuscular, oral
10 weeks	Penta 2, PCV 2, OPV 2, Rota 2	Intramuscular, oral
14 weeks	Penta 3, IPV, PCV 3, OPV 3	Intramuscular, oral
6 months	Vitamin A, **RTS,S 1**	Oral, **Intramuscular**
7 months	**RTS,S 2**	**Intramuscular**
9 months	Measles-Rubella (MR) 1, Yellow fever, **RTS,S 3**	Subcutaneous, **Intramuscular**
12 months	Vitamin A	Oral
18 months	MR 2, Meningococcal 'A', Vitamin A	Subcutaneous, Intramuscular, Oral
24 months	**RTS,S 4**	**Intramuscular**

Source: GHS, 2019