EXPLORING FACTORS INFLUENCING MALARIA VACCINE UPTAKE IN CHILDREN AGED 24-36 MONTHS IN NSANJE DISTRICT, MALAWI

ATUSAYE JOAQUIM SIMBEYE

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER IN EPIDEMIOLOGY AND BIOSTATISTICS JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

AUGUST 2023

DECLARATION

This thesis is my original work and has not been presented for an award of diploma or conferment of degree in any other university or institution.

Signature: Date: 21st August, 2023

Atusaye Joaquim Simbeye

Registration Number: H153/P/2508/21

This thesis has been submitted with our approval as the university supervisors

Signature: ………………………………….. Date: 31st August, 2023

Dr. Shehu Shagari Awandu

Department of Biomedical Sciences, School of Health Sciences,

Jaramogi Oginga Odinga University of Science and Technology

Signature: Date: 26th August, 2023

Associate Professor Save Kumwenda

Department of Public and Environmental Health Sciences, School of Science and Technology,

Malawi University of Business and Applied Sciences

Signature: Date: 28th August, 2023

Assistant Professor Lauren Cohee

Department of Pediatrics, Division of Infectious Disease and Tropical Pediatrics, Center for Vaccine Development and Global Health, University of Maryland School of Medicine

DEDICATION

I dedicate this thesis to my beloved wife Charlotte who tirelessly supported me throughout my masters academic journey. I left her in Malawi when we were two months into our marriage after a colourful wedding and came Kenya to do my studies. She has always been there for me encouraging me to work hard and assuring me that she was okay back in Malawi. She has contributed so much to my studies and I appreciate her for her unwavering support may God keep on blessing her.

ACKNOWLEDGEMENT

I thank God for helping me to reach this milestone in my life. I would like to express my sincere gratitude to my supervisors, Dr. Shehu Shagari Awandu, Associate Professor Save Kumwenda and Assistant Professor Lauren Cohee for their professional and technical guidance during the thesis development.

I would also like to thank African Population and Health Research Centre (APHRC) who supported this project through the Capacity Development of Applied Epidemiologists in Eastern African Region (CDAE) project, which is part of European and Developing Countries Clinical Trials Partnership II (EDCPT2) Programme supported by the European Union.

I acknowledge the National Health Sciences Research Committee in Malawi and Jaramogi Oginga Odinga University of Science and Technology Ethics Review Committee for reviewing and approving the research.

Further, acknowledgement goes to Nsanje Directorate of Health and Social Services for giving me clearance to conduct the study in their Health Catchment areas.

I would also like to thank the data collection team and data clerks for a job well done.

Lastly, I would like to acknowledge my classmates for their constructive criticism and contributions through all stages of this thesis development.

ABSTRACT

Malaria remains a significant global health burden affecting millions of people, with children under 5 years and pregnant women most vulnerable. Recently, World Health Organization (WHO) introduced, the RTS,S/AS01 malaria vaccine as an intervention strategy with implementation in three countries of Malawi, Kenya and Ghana. The factors influencing the uptake of malaria vaccine is relatively unknown in implementing areas. In Malawi, Nsanje District reported low coverage (60%) of fully immunized children with malaria vaccine in 2021, way below the recommended WHO target coverage of 80%. This study therefore explored the factors influencing the uptake of malaria vaccine among children aged 24-36 months in Nsanje District. The study investigated; how mother/caregiver factors, health care system factors, child factors and community factors influence the uptake of the malaria vaccine. A cross section study design was used and interviews conducted on 410 participants using a questionnaire. Data analyses included descriptive statistics and logistic regression to determine the factors that influence malaria vaccine uptake. Uptake of malaria vaccine was 90.5% for dose one, but reduced to 87.6%, 69.5% and 41.2% for dose two, three, and the booster, respectively. Timeliness of RTS,S one was 69.7%, 64.6% for RTSS two, 56.7% for RTS,S three and 48.3% for RTS,S four. Highest delay timeliness on uptake was noted on RTS,S dose four (51.7%). The dropout rate for malaria vaccine was 23.2%. Children of caregivers with secondary or upper education and who attended ANC four times or more had increased odds of full uptake of malaria vaccine [OR:2.43, 95%CI:1.08-6.51, p-value=0.033, and OR: 1.89, 95%CI 1.18 - 3.02, p-value=0.008, respectively]. Children who ever suffered adverse effects following immunization and those who traveled long distances to reach the vaccination centre had reduced odds of full uptake of malaria vaccine [OR: 0.35, 95%CI: 0.06-0.25, p-value<0.001 and OR:0.30, 95%CI:0.03-0.39, p-value <0.001, respectively]. Only 18% (n=65) knew the correct schedule for vaccination and 45.8% (n=158) knew the correct number of doses a child was to receive. Only RTS,S dose one uptake met the WHO targets and the mothers/caregivers have low level of information regarding malaria vaccine, especially on the dosing schedule. Further, the mothers/caregivers had low level of information regarding malaria vaccine, especially on the dosages and the scheduled months. Recommendation is that Nsanje District Health Directorate should strengthen communities education about malaria vaccine to increase its uptake.

TABLE OF CONTENTS

DECLARATION ii

DEDICATION iii

ACKNOWLEDGEMENT iv

ABSTRACT v

LIST OF TABLES xi

LIST OF FIGURES xiii

LIST OF ACRONYMS AND ABBREVIATIONS xiv

CHAPTER ONE: INTRODUCTION 1

1.0 Background information 1

1.2 Malawi contribution to global burden of malaria 2

1.3 Introduction of malaria vaccine 2

1.4 About RTS,S/AS01 3

1.5 Malaria control interventions in Malawi 3

1.6 How the RTS,S/AS01 vaccine is administered (Malaria vaccine in Malawi) 3

1.7 Child global vaccination situation 4

1.8 Child global vaccination situation in Africa 5

1.9 Child global vaccination situation Malawi 5

1.10 Statement of the problem 6

1.11 Objectives 7

1.11.1 Main objective 7

1.11.2 Specific objectives 8

1.11.3 Research questions 8

1.11.4 Justification of the study 8

1.12 Malaria vaccine uptake conceptual framework 8

CHAPTER TWO: LITERATURE REVIEW 11
2.0 Malaria 11
2.1 Malaria life cycle 11
2.3 Malaria Vaccine Implementation Program (MVIP) 12
2.4 Uptake of vaccines 13
2.5 Taking vaccines on scheduled time 13
2.6 Factors associated with vaccine uptake 14
2.6.1 Knowledge about vaccines 15
2.6.2 Knowledge about malaria vaccine and uptake 15
2.6.3 Vaccine side effects 16
2.6.4 Health service factors 16
2.6.5 Socio-demographic characteristics 16
CHAPTER THREE: RESEARCH METHODS 18
3.1 Study design 18
3.2 Study area 18
3.3 Malaria in Nsanje District 19
3.4 Variables (measurements) 20
3.5 Independent variable 20
3.6 Dependent variable 23
3.7 Study population and sampling (population) 23
3.7.1 Inclusion criteria 23
3.7.2 Exclusion criteria 24
3.8 Sample size and sampling procedure 24
3.8.1 Calculation of sample size 24
3.8.2 Sampling techniques 25

3.8.3 Sampling of individual participants ... 26
3.9 Data collection ... 26
3.10 Quality Control ... 27
3.10.1 Reliability ... 27
3.10.2 Validity ... 27
3.10.3 Training of the data collectors ... 27
3.10.4 Pre-testing ... 28
3.10.5 Supervision ... 28
3.11 Data management and analysis plan ... 28
3.12 Ethical consideration ... 29
3.13 Sponsorship ... 29
CHAPTER FOUR: RESULTS ... 31
4.1 Socio-demographic characteristics of the participants ... 31
4.2 Characteristics of study participants ... 32
4.3 Uptake of malaria vaccine ... 33
4.3.1 Assessment of uptake of malaria vaccine in Nsanje District ... 34
4.3.2 Uptake levels of malaria vaccine ... 34
4.3. 3 Malaria vaccine dropout rate ... 35
4.3.4 Uptake reasons ... 35
4.4 Timeliness of the uptake of malaria vaccine ... 36
4.5 Knowledge and awareness about vaccine in general ... 37
4.5.1 Knowledge and awareness about malaria vaccine ... 38
4.6 Previous experience with childhood vaccines and vaccine activities ... 39
4.7 Negative issues about malaria vaccine ... 42
4.8 Decision maker on child vaccination ... 42

4.9 Community level support 43

4.10 Association between sociodemographic characteristics and malaria vaccine uptake 43

4.11 Association between characteristics of a child and full vaccine uptake 45

4.12 Association between timeliness of malaria vaccine and full uptake of malaria vaccine .. 46

4.13 Association between knowledge, awareness of vaccines in general and malaria vaccine uptake 47

4.14 Association between knowledge, awareness and malaria vaccine uptake 48

4.15 Association between previous experience with childhood vaccines and malaria vaccine uptake 49

4.16 Association of issues about malaria vaccine and full malaria vaccine uptake 52

4.17 Association of community level support and full malaria vaccine uptake 52

4.18 Association between level of uptake and independent variables 53

CHAPTER FIVE: DISCUSSIONS 55

5.1 Malaria vaccine uptake 55

5.1.1 High coverage of RTS,S 1 55

5.1.2 Reduction in coverage of subsequent doses 56

5.1.3 No uptake 56

5.2 Timeliness of malaria vaccine uptake 57

5.3 Factors associated with malaria vaccine uptake 57

5.3.1 Knowledge about vaccine 57

5.3.2 Knowledge about malaria vaccine 58

5.3.3 Previous experience with vaccines 58

5.3.4 Accessibility to the vaccination site 59

5.3.5 Socio-demographic characteristics 59

5.3.6 Community level support 60

5.4 Strength of this study 61

5.5 Limitation of the study 61

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS 62

6.1 Conclusions 62

6.2 Recommendations 62

REFERENCES 64

APPENDICES 72

Appendix 1: Informed Consent Form in English 72

Appendix 2: Informed Consent Form in Chichewa (Local language) 76

Appendix 3: Data collection tool 80

Appendix 4: Malawi Ministry of Health Ethical Review Committee Approval 97

Appendix 5: Malawi Ministry of Health Ethical Review Committee Certificate 98

Appendix 6: JOOUST Ethical Review Committee Approval 99

Appendix 7: Clearance to conduct this study in Nsanje District 100

LIST OF TABLES

Table 1.1: Number of vaccines that has been introduced to Malawi EPI over the years 5
Table 1.2: Vaccination Schedule in Malawi EPI (with malaria vaccine added)........................... 7
Table 3.1: Operational definition and scale of measurement for socio-demographic variables.. 21
Table 3.2: Operational definition and scale of measurement for other independent variables.... 22
Table 3.3: Operational definition and scale of measurements for depended variables............... 23
Table 3.4: Shows the target population of the 4 clusters in Nsanje District that administer malaria vaccine. 25
Table 3.5: Sample size determination by cluster (proportionate to size)................................... 26
Table 4.1: Socio-demographic characteristics of respondents in Nsanje District........................ 32
Table 4.2: Distribution of characteristics of children who participated in the study.................. 33
Table 4.3: Distribution of malaria vaccine uptake in Nsanje District... 33
Table 4.3.4: Showing the details of reasons of partial or no uptakes in Nsanje District 36
Table 4.5: Showing details of knowledge and awareness about vaccines in general in Nsanje District.. 38
Table 4.5.1: Showing details of knowledge and awareness of malaria vaccine in Nsanje District 39
Table 4.6: Details of participant experiences on childhood vaccines in general in Nsanje District 41
Table 4.7: The details of the negative issues surrounding malaria vaccine in Nsanje District.... 42
Table 4.8: Showing the details on who decides the uptake of malaria vaccine in Nsanje District 43
Table 4.9: Showing details of community level support in Nsanje District 43
Table 4.10: Association between socio-demographic characteristics of parents/caregivers and full uptake of malaria vaccine in Nsanje District 45
Table 4.11: Showing details of children characteristics and full malaria vaccine uptake in Nsanje District.. 46
Table 4.12: Showing the association between timeliness and full malaria vaccine uptake in Nsanje District.. 47
Table 4.13: Showing details of association between knowledge of vaccines and full uptake of malaria vaccine in Nsanje District 48

Table 4.14: Showing details of the association between knowledge and malaria vaccine uptake in Nsanje District 49
Table 4.15: Showing the details of the association between uptake of malaria vaccine and previous experience with vaccines in Nsanje District 51
Table 4.16: Showing the association between malaria vaccine uptake and negative issues about malaria vaccine in Nsanje District 52
Table 4.17: Showing the detail of the associations between malaria vaccine uptake and community level support in Nsanje District........ 53
Table 4.18: Multivariate analysis of association between level of uptake and independent variables in Nsanje District 54

LIST OF FIGURES

Figure 1.1: Malaria vaccine uptake conceptual framework depicting influencing factors........... 9

Figure 2.1: Showing malaria life cycle... 12

Figure 3a: Map of Malawi showing the location of Nsanje District **Figure 3b:** Showing map of Nsanje District showing population densities.. 19

Figure 4.3.1: A graph showing the uptake of malaria vaccine in Nsanje District....................... 34

Figure 4.3.2: Showing the level of RTS,S malaria vaccine uptake in Nsanje District................ 35

Figure 4.4: Showing details of timeliness of malaria vaccine uptake in Nsanje District 37

LIST OF ACRONYMS AND ABBREVIATIONS

ABBREVIATION	**DEFINITION**
AEFI	Adverse Event Following Immunization
ANC	Ante-Natal Care
BCG	Bacille-Calmette Guerin
CHAM	Christian Health Association of Malawi
DHIS	District Health Information System
EIR	Entomological Inoculation Rate
EPI	Expanded Programme on Immunization
GAVI	Global Alliance for Vaccines and Immunization
GSK	GlaxoSmithKline
GVAP	Global Vaccine Action Plan
IA2030	Immunization Agenda 2030
LLIN	Long Lasting Insecticidal Nets
MOH	Ministry of Health
MPAG	Malaria Policy Advisory Group
MVIP	Malaria Vaccine Implementation Program
NMCP	National Malaria Control Program
OPV	Oral Polio Vaccine
PATH	Program for Appropriate Technology in Health
PBO	Piperonyl Butoxide
PCV	Pneumococcal Conjugate Vaccine
PNC	Post-Natal Care
RTS,S	Malaria vaccine
SAGE	Strategic Advisory Group of Experts
UNICEF	United Nations Children's Fund
VDP	Vaccine Preventable Diseases
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.0 Background information

Malaria remains a significant global health burden affecting millions of people. According to the World Health Organization (WHO) Malaria Report, 2021, over 241 million cases were registered in the year 2020 worldwide (WHO Malaria Report, 2021). The report indicated that the Sub-Saharan Africa countries was hardest hit. The sub-Saharan region contributed 95% (228 million) of total malaria cases but also contributed 96% (602,000) of total malaria death globally. Malaria killed about 481,600 children under five years amounting to 80% of the total malaria deaths (WHO Malaria Report, 2021).

The main approaches for malaria control are long lasting insecticidal-treated nets (LLINs), prompt diagnosis with effective treatment with artemisinin-based combination therapies (ACTs) and indoor residual spraying (IRS)(WHO, 2021). These control interventions have helped reduce the disease burden and malaria mortality over the years. However lately, the progress has stalled. For example, in the year 2016 more than five million more cases were reported globally and the greatest increase occurred in countries like Malawi (WHO Malaria Report, 2017). This increase occurred despite the continued use of the malaria control interventions. The rise in malaria cases despite the use of the control interventions raised question marks on the effectiveness of these interventions. This increase highlighted the urgent need of the new innovative malaria control interventions to control malaria. From 2017 to 2018 malaria morbidity and mortality declined until 2020 where the cases increased (WHO Malaria Report, 2021). However, in the year 2020, due to COVID-19 pandemic the mortality due to malaria went up by 12% from 2019. Global Strategy for Malaria 2016-2030 has a target to reduce global malaria deaths by 90% by year 2030 but also to decrease malaria incidence globally by 90% in the year 2030. To achieve these targets, the increase in malaria cases has to be tackled urgently (WHO Global strategy for malaria, 2021). In Malawi, two new interventions were introduced to control malaria, the use of piperonyl butoxide (PBO) nets in year 2018 after it was recommended by WHO in 2017(WHO, 2017) and the introduction of RTS,S/AS01 vaccine in year 2019 (MVIP-WHO, 2020).

1.2 Malawi contribution to global burden of malaria

Malawi is one of the countries with highest malaria prevalence and death rates. In the year 2020, Malawi contributed about 2% of the total global malaria cases and mortalities (WHO Malaria Report, 2021). In Malawi, the burden is highest in children aged under 5 years just like it is in other sub-Saharan countries. To control the morbidity and mortality of malaria, the World Health Organization (WHO) advocated the use of malaria vaccine in children to avert this childhood illness and mortality. Malaria vaccine acts on *Plasmodium falciparum.* It has been developed to reduce clinical and severe malaria in children. Currently this vaccine is being piloted in Africa in three countries namely; Malawi, Kenya and Ghana. This vaccination program has been embedded in routine Expanded Programme on Immunization (EPI) (MVIP-WHO, 2020). In Malawi everyone is at a risk of developing malaria. For all residents, the risk of malaria infection is high, with more than one case per 1000 residents per year (Mathanga *et al*., 2016). Over 4 million estimated malaria cases were reported in Malawi in year 2020. Malaria is endemic in Malawi although high transmission rates are reported in areas of high temperatures, low attitude and in the valley of lower Shire (Mathanga *et al.,* 2012). A study done by Mathanga *et al.,* 2012 found that Chikwawa District has the estimated entomological inoculation rate (EIR) for *Plasmodium falciparum* of 172 infective bites. Chikwawa and Nsanje Districts are neighboring districts and have a similar environment for mosquito breeding. According to Bennett *et al*., 2013; 75% of the population in about 13 districts out of 28 districts in Malawi live in areas with greater than 40% predicted malaria prevalence with the highest predicted malaria prevalence of about 42% recorded in Nsanje District. This means that Nsanje District is one of the districts in the country with very high malaria transition (Mathanga *et al.,* 2016).

1.3 Introduction of malaria vaccine

The development of malaria vaccine has taken more than 30 years. The first malaria vaccine that reached phase IV assessment is RTS,S/AS01. The World Health Organization selected three countries, namely Malawi, Kenya and Ghana, in Sub-Saharan Africa to pilot the malaria vaccine. The delivery of RTS,S/AS01 malaria vaccine is being coordinated by Malaria Vaccine Implementation Programme (MVIP) through EPI which is the routine national immunization programme. The implementation was launched in 2019 with the first dose given in late April in Malawi and Ghana and in early September in Kenya.

1.4 About RTS,S/AS01

RTS,S/AS01 was developed by GlaxoSmithKline (GSK), Belgium. This vaccine is based on the circumsporozoite protein (CSP), a protein on the sporozoite of *Plasmodium falciparum.* It targets on triggering an immunity defense mechanism that obstructs the *Plasmodium* infecting the liver and the red blood cells. The vaccine is developed for young children who reside in countries where malaria is endemic. A phase three clinical trial conducted in year 2015 reported that four doses of RTS,S/AS01 given to children aged five months or older decreased clinical malaria by 39% and malaria severity by 29% over four years of follow up (Greenwood, 2015). Additionally, another study reported that RTS,S/AS01 decreased probability for children to be hospitalized or to need blood transfusion due to severe anemia after suffering from malaria (Otieno *et al.,* 2020). RTS,S/AS01 usage will have a great impact in reducing childhood malaria morbidity and mortality (Otieno *et al.,* 2020). Despite these success stories, the acceptability and the coverage of the number of children vaccinated in an area have a great role in achieving the intended purpose of the vaccine. Therefore, it is important to look at the factors that influence the uptake of the vaccine (Greenwood, 2015).

1.5 Malaria control interventions in Malawi

The Malawi Ministry of Health (MOH) through its department of National Malaria Control Program (NMCP) is currently using the following interventions to control malaria; long lasting insecticidal-treated nets (LLINs), prompt diagnosis with effective treatment with artemisinin-based combination therapies (ACTs) and indoor residual spraying (IRS). More recently, novel interventions have been introduced by the MOH to control malaria in Malawi including introduction of the use of piperonyl butoxide (PBO nets) and the malaria vaccine (RTS,S/AS01). PBO nets is new formulation of insecticide-treated bed nets with a chemical synergist designed to enhance the insecticidal effect of pyrethroids.

1.6 How the RTS,S/AS01 vaccine is administered (Malaria vaccine in Malawi)

Malawi is piloting the malaria vaccine, RTS,S/AS01. The Malawi MOH through the National Malaria Control Program together with the MVIP are implementing this vaccine program. Malaria vaccine is not being implemented separately but it has been embedded in routine EPI program

together with all other childhood immunization antigens. Out of the 28 districts in Malawi, the vaccine program is being implemented in 11 districts only. In the districts where the vaccine is being implemented it is not the entire district but selected clusters within the district with other clusters within each district serving as controls. The chosen districts were selected according to the disease burden these are Nsanje, Balaka, Mangochi, Machinga, Lilongwe, Chikwawa, Ntchisi, Mchinji, Karonga, Nkhata-Bay and Phalombe. The aim is to build immunity in the children to reduce the disease burden hence reducing mortality among children. A child requires four doses to be fully immunized. The first dose of the primary series is given when the child is five months, the second dose at 6 months, the third dose at seven months and a child receives the fourth and final dose at 22 months, also referred to as the booster dose. While the vaccine was introduced in Malawi on 23rd April 2019, in Nsanje District it was introduced in July 2019.

1.7 Child global vaccination situation

Expanded Program on Immunization (EPI) was launched by the World Health Organization (WHO) in 1974. Since its inception immunization has been one of the most successful and very cost-effective public health intervention. The launch of EPI was a strategy to facilitate and strengthen routine coverage in all member countries with the aim of decreasing vaccine preventable diseases (VPDs) in children (Okwo-Bele & Cherian, 2011). At its inception EPI vaccines were targeting 6 diseases: tuberculosis, polio, diphtheria, pertussis, tetanus, and measles (Duclos *et al.,* 2009). As the years passed more vaccines were developed which included yellow fever, hepatitis B, Haemophilus influenza type b (Hib), and pneumococcal conjugate (Wiysonge *et al.,* 2013). Vaccination over the decades has achieved remarkable success by reducing deaths and lifelong disabilities worldwide (Reid & Fleck, 2014). It has also contributed to the eradication of smallpox (WHO-GAVI, 2013). According to WHO, immunization prevents 4–5 million deaths annually from VPDs (WHO, 2019). According to United Nations Children's Fund (UNICEF), over the past decades vaccination has played a very important role in reduction of under-five deaths from 12.5 million in 1990 to 5.3 million in 2018 (United Nations Children's Fund, 2019). Even though vaccination is very important, the coverage has remained poor over the years. For instance, in 2020, 23 million children did not receive basic vaccines according to WHO (Immunization, 2021).

1.8 Child global vaccination situation in Africa

Vaccination has helped in reducing the disease morbidity and mortality of many infectious diseases in Africa. Some of the dangerous infectious diseases are at the brink of elimination and eradication. For instance, diseases like polio and maternal and neonatal tetanus (World Health Organization (WHO), 2018). The introduction of new vaccines in African region will help out in fighting more of these infectious diseases (Erin C. *et al.,* 2017). Even though there are a lot of success stories that Africa has benefited from vaccination, there are a lot of challenges that the region is facing. The vaccination coverages have remained low in many African countries but also the region is still behind in terms of vaccine access (World Health Organization (WHO), 2018). It is estimated that 1 out of every 5 children do not have access to necessary and basic vaccines. Consequently, more than 30 million children of under 5 years of age get VPDs each year (World Health Organization (WHO), 2018)

1.9 Child global vaccination situation Malawi

Malawi launched EPI in 1979. Its objective initially was targeting six diseases (diphtheria, whooping cough, tetanus, measles, poliomyelitis and tuberculosis) as such six vaccines were recommended for children 0–24 months of age through routine infant immunization. Due to advancement in technology and more studies over the years, new vaccines have been introduced and added into the EPI. Table 1.1 shows the new vaccines added to EPI in Malawi.

Table 1.1: Number of vaccines that has been introduced to Malawi EPI over the years

Vaccine	Description of the vaccine	Year it was introduced
PCV13	Pneumococcal conjugate vaccine	2011
Pentavalent	Diphtheria and tetanus and pertussis and *Haemophilus influenzae* and hepatitis B	2012
Rotavirus	Rotavirus vaccine	2012
Measles 2	Measles second dose	2015
bOPV	bivalent oral polio vaccine	2016
MR	Measles-Rubella vaccine	2016
MV	Malaria vaccine	2019

Source: (Malawi Demographic and Health Survey, 2017; Expanded Program for Immunization, 2016; Bell *et al.,* 2020)

The universal childhood immunization goal is over 80% coverage per district or administrative unit and over 90% for the country as a whole by 2020, according to Global Vaccine Action Plan (GVAP 2011-2020). Following the end GVAP 2011-2020 in the year 2020 another agenda has been formed by WHO which is called Immunization Agenda 2030 (IA2030). The vision for Immunization Agenda 2030 is to continue from GVAP 2011-2020 in terms of coverage and equity. The IA2030 aims at reducing the number of under immunized children in communities but also maintain high vaccination coverage at national level and in all the districts (IA2030, 2021).

1.10 Statement of the problem

Worldwide approximately 4-5 million mortalities are prevented annually from VPDs through vaccination (WHO, 2019). Even though vaccination is important, the coverage has remained poor over the years. About 20 million children do not receive vaccines yearly according to WHO (Immunization, 2021). In Malawi between 2010 and 2016, the was a decline in the proportion of children age between 12 to 23 months who received full immunization from 81% to 76% (Mmanga *et al*., 2022). According to Otieno *et al.,* 2020 clinical trials on malaria vaccine have reported that the vaccine has a great impact in decreasing childhood malaria burden and deaths. Acceptability and the coverage of the number of children vaccinated in an area has a great role in achieving the intended purpose of the vaccine. Unlike other malaria interventions, RTS,S/AS01 malaria vaccine is new therefore factors influencing its uptake has to be explored particularly in Malawi. The table 1.2 below shows the EPI schedule for childhood vaccination schedule in Malawi.

Table 1.2: Vaccination Schedule in Malawi EPI (with malaria vaccine added)

Vaccine	**Description**	**Schedule**
BCG	Bacillus Calmette–Guérin (dose)	At birth or first contact
OPV0	Oral polio vaccine 0 (dose)	At birth to 2 weeks
Rotavirus	Rotavirus vaccine (two doses	6 and 10 weeks
Pentavalent	Diphtheria and tetanus and pertussis and *Haemophilus influenzae* and hepatitis B (three doses)	6, 10 and 14 weeks
OPV	Oral Polio Vaccine (three doses)	6, 10 and 14 weeks
Pneumo_conj	Pneumococcal conjugate vaccine (three doses)	6, 10 and 14 weeks
MV	Malaria vaccine/RTS,S/AS01 (four doses)	5, 6, 7 and 22 months
MR	Measles and rubella vaccine (Two doses)	9 and 15 months

Source: Malawi Demographic and Health Survey, 2017

In Malawi, Nsanje district has reported low coverage (60%) of fully immunized children with malaria vaccine in year 2021. This means that's only 60% of the target population received four doses of the malaria vaccine. The coverage is way below the recommended target acknowledged by WHO. The Global Vaccine Action Plan (GVAP) recommends that all childhood vaccines must have a coverage of 90% at national level and at least 80% coverage at district level (IA2030, 2021). Since malaria vaccine is a childhood vaccine it is expected to reach a target of 90% of the targeted children nationally and 80% in a district (GVAP). Among all the childhood vaccines that are offered in Nsanje Distict, malaria vaccine has the lowest for dose four. Since malaria vaccine has the potential of reducing malaria morbidity and mortality it is important that the uptake of the malaria vaccine should be high. High uptake of malaria vaccine is essential to achieve the intended goals of the vaccine. Therefore, this study will explore the factors influencing the uptake of malaria vaccine among children aged 24-36 months in Nsanje District.

1.11 Objectives

1.11.1 Main objective

Exploring factors influencing RTS,S/AS01 malaria vaccine uptake for children aged 24-36 months in Nsanje District, Malawi

1.11.2 Specific objectives

1. To assess the uptake levels of malaria vaccine in Nsanje District
2. To assess the timeliness of malaria vaccine uptake in Nsanje District
3. To determine the factors associated with fully malaria vaccine uptake in Nsanje District

1.11.3 Research questions

1. What are the uptake levels of malaria vaccine in Nsanje District?
2. What is timeliness of malaria vaccine uptake in Nsanje District?
3. What are the factors associated malaria vaccine uptake in Nsanje District?

1.11.4 Justification of the study

Malaria vaccine intervention primary outcome is aimed at averting the disease in the youngest children. This cannot be achieved if the malaria vaccine uptake is low. This study will bring to light, factors that affect the uptake of malaria vaccine. The finding from this study will inform policy on how to increase malaria vaccine uptake in Nsanje District, in other districts in Malawi as well as beyond Malawi where malaria vaccine is being offered. Understanding why people may not use the vaccine is very important because it may help in trying to improve uptake. Nsanje District Health Directorate, MVIP, MOH and stakeholders will be informed by this study to come up with robust ways of increasing the uptake of malaria vaccine.

1.12 Malaria vaccine uptake conceptual framework

Below is a figure showing a conceptual framework of malaria vaccine uptake. Malaria vaccine uptake was categorized into three; name full uptake (all four doses have been received by a child), partial uptake/incomplete uptake (child has received 1st, 2nd or 3rd dose) and no uptake (child has not received any dose). The figure also shows the relationship between potential factors that may affect malaria vaccine uptake. These are mother/caregiver factors, health care system factors, community factors and child characteristics.

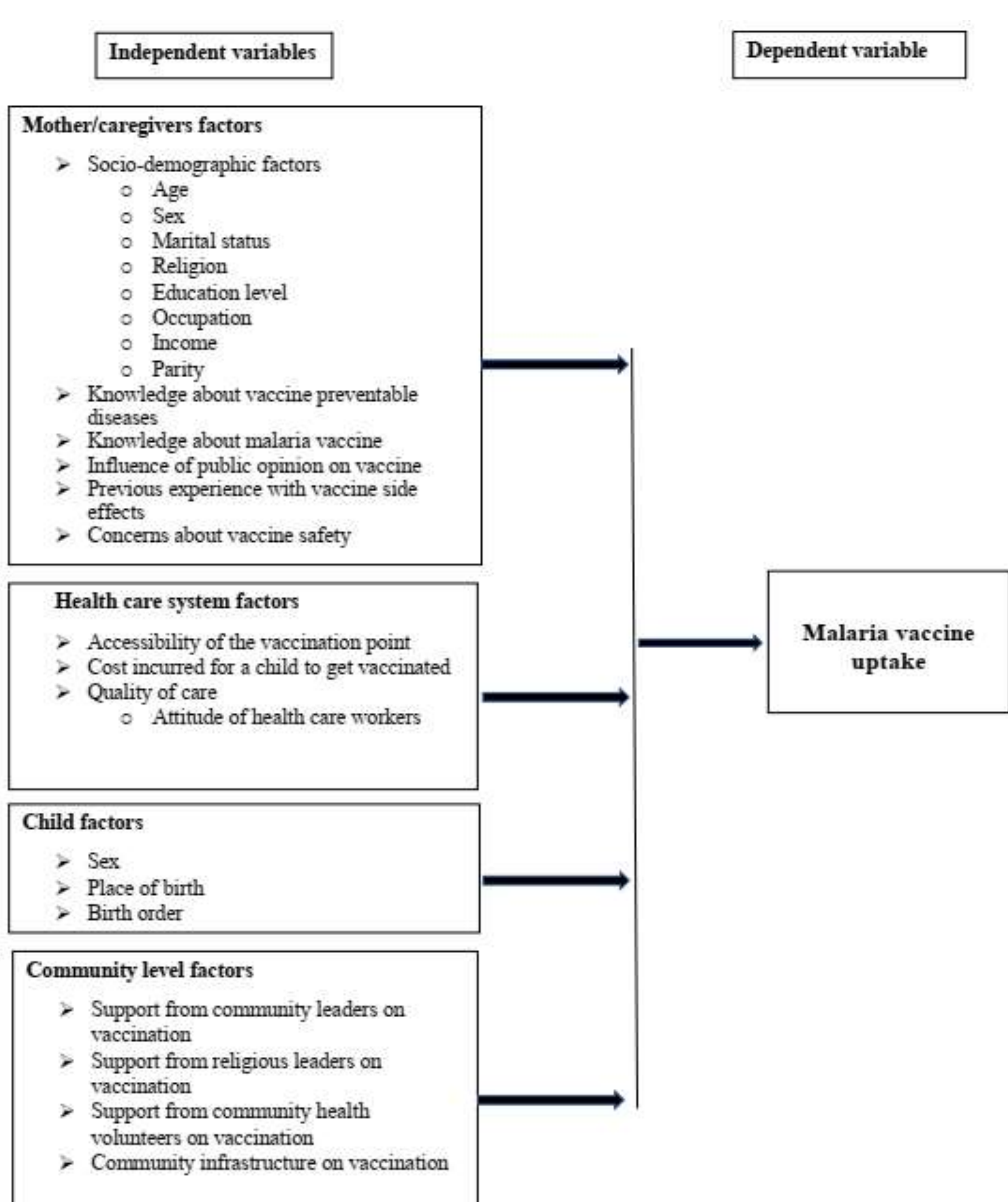


Figure 1.1: Malaria vaccine uptake conceptual framework depicting influencing factors

Previous models have been developed to explain the factors that influence that uptake of vaccines. The conceptual framework above is based on the model that was made on health care utilization made by Andersen and Newman 1973 (Andersen, 1973). The Andersen and Newman model explains three factors namely need factors, enabling factors, and predisposing factors influence utilization of health services. Examples of predisposing factors include socio-cultural and demographic factors. These predisposing factors enhance the possibility of an individual using health services. Family support, physical access and affordability are some of the enabling factors that influence positively towards access to health services. The model further explains that self-perceived health needs but also potential needs for health service use forms need factors (Li *et al.,* 2016). According to Thomson *et al.,* 2016 the vaccine uptake is influenced by various individual, community, and health care system factors that may enhance or obstruct the uptake of vaccines (Thomson *et al.,* 2016)

The characteristics of mother/caregiver, their behaviors or attitudes makes up the mother/caregiver factors that affect the uptake of the vaccine uptake. In the conceptual framework above mother/caregiver factors such as sociodemographic characteristics, for example, usually affect uptake of the vaccine either positively or negatively. Knowledge of the mother/caregiver about the vaccine and schedule, safety concerns and health seeking behavior may also influence the uptake of malaria vaccine. Antenatal clinic (ANC), Postnatal clinic (PNC) visits and place of delivery can be used to measure health-seeking behavior of the mother/caregiver. Attitude of the health care worker towards the mother/caregiver during the delivery the vaccine to the individual forms health care system factors. Accessibility, and/or affordability and also the quality of service may also influence uptake of the vaccine. Child factors are also important. The characteristics of the child either the child being male or female, the place where the child was born and birth order can also influence uptake of the vaccine. Perceived long-term effects of the vaccine, number of children a mother/caregiver has may also influence uptake. For given child to receive no vaccine, partial or complete uptake all these factors will influence the uptake of the vaccine.

CHAPTER TWO: LITERATURE REVIEW

2.0 Malaria

Malaria is caused by parasite called *Plasmodium* species. Five *Plasmodium* species are known to cause malaria namely *P. falciparum, P. vivax, P. malariae, P. ovale* and *P. knowlesi* (Centers for Disease Control and Prevention, 2020). Of these five species, two of them (*P. falciparum* and *P. vivax*) cause the most burden. Malaria is an acute illness but can become fatal when left untreated mostly in children, pregnant women and those with compromised immunity (WHO, 2022). In sub–Saharan Africa about 99.7% malaria cases are caused by *P. falciparum.* Malaria is transmitted from one person to the other through a bite of the infected vector, female *anopheles* mosquito (WHO, 2022).

2.1 Malaria life cycle

The life cycle of malaria involves two hosts namely; female *Anopheles* mosquito and human being. A malaria-infected female *Anopheles* mosquito transmits sporozoites into human host during the process of blood feeding. These sporozoites infect the liver and then later mature into schizonts. These schizonts rupture and release merozoites. The merozoites infect the red blood cells. After this rupture the parasite invade the bloodstream. Some parasites undergo asexual multiplication in the erythrocytes and a process of erythrocytic schizogony while some parasites differentiate into sexual stages called gametocytes. It is the blood stage parasites that are responsible for the clinical manifestation of the malaria disease. When female *Anopheles* is blood feeding it ingest gametocytes. The male gametocytes are called microgametocytes while the females are called macrogametocytes. Zygotes are generated in the mosquito stomach after microgametes penetrates into macrogametes. The zygotes turn into motile and elongated called ookinetes. The ookinetes invade the midgut wall of the mosquito and develop into oocysts. These oocysts grow and the rupture while releasing sporozoites. The sporozoites make their way into the salivary glands of the female *Anopheles* mosquitoes. The penetration of these sporozoites into a new human host sustains the malaria life cycle (Centers for Disease Control and Prevention, 2020). The figure 2.1 below shows the malaria life cycle according to CDC, 2020.

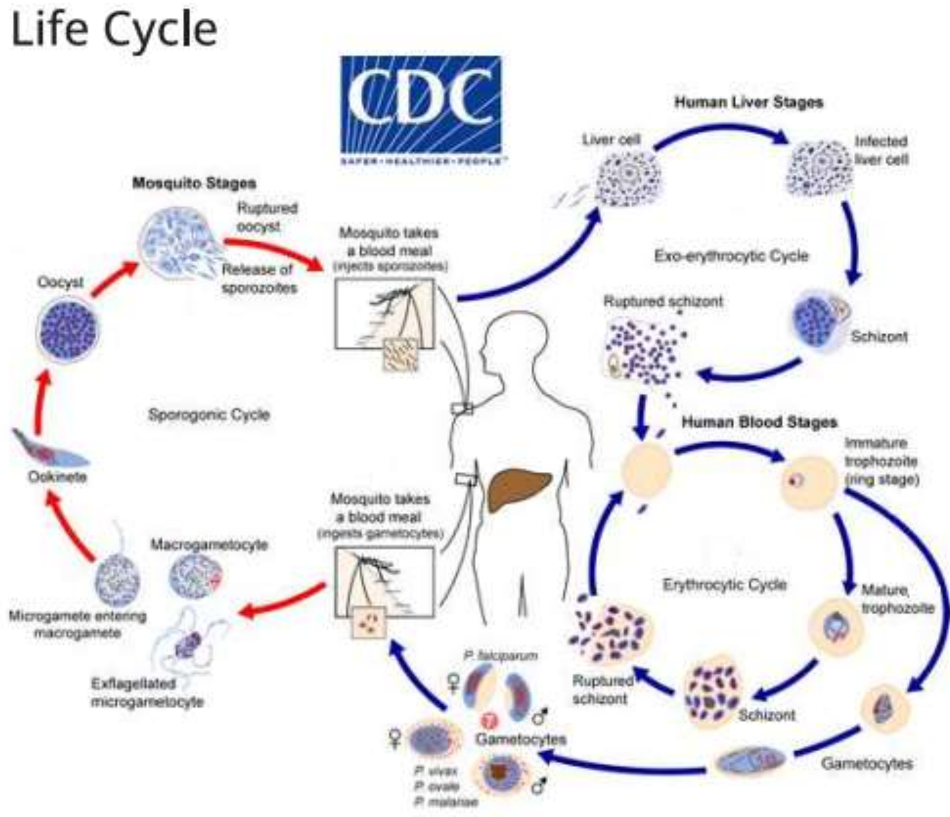


Figure 2.1: Showing malaria life cycle. Source: CDC, 2020

2.3 Malaria Vaccine Implementation Program (MVIP)

A thorough review of the third phase trial of malaria vaccine which was conducted in 2015 by two independent WHO advisory groups on immunization, the Strategic Advisory Group Experts (SAGE) and Malaria Policy Advisory Group (MPAG) advised for a pilot implementation of malaria vaccine in sub-Saharan setting (MVIP-WHO, 2020). Following this recommendation, MVIP was formed by WHO to evaluate the feasibility of embedding malaria vaccine into routine EPI programs but also the administration all the four doses of malaria vaccine. Three countries of Malawi, Ghana and Kenya were selected to be the first countries to implement malaria vaccine. There were a lot of factors why these countries were selected but most notably were well functioning EPI program but also the ministry of health in these countries showing great interest to be part of the program. Additionally malaria is endemic in these three countries and also the

presence of strong research background and the ability to evaluate safety outcomes of the vaccine (MVIP-WHO, 2020).

2.4 Uptake of vaccines

The uptake of vaccines is not uniform. It varies from one country to another but also within the country it varies from district to district. The uptake of childhood vaccines also varies across the various vaccines. According to Mmanga *et al* 2022, there was a coverage of 98% for Bacille Calmette Guerin (BCG), 93% for Pentavalent three, 83% for Oral Polio Vaccine (OPV), 90% for Pneunicoccal Conjugate Vaccine (PCV3) and 92% for Rotavirus Vaccine (RV2) in Malawi in 2015 (Mmanga *et al.,* 2022). The same study also reported that there were significantly differences in the vaccine among the regions. There were also variations in the OPV coverage with OPV zero having a lower uptake (70.7%), as compared to the uptake of OPV one (95.8%), OPV two (92.9%), and OPV three (83.7%) (Mbengue *et al*., 2017). Adedire *et al.,* 2016 found out that there were variations in the uptake of vaccines in Nigeria. The coverage for BCG was 85.5%, for OPV zero was 83.2% and 81.3% coverage of OPV one. The report showed that coverage declined from OPV zero to OPV three. For Diphtheria (DPT) one, uptake was 84.2% but decreased figures were reported for DPT two and DPT three at 77.9% and 74.1% respectively. The uptake of Measles and Yellow fever vaccines offered at nine months was 66.7% and 65.5% respectively (Adedire *et al.,* 2016). Ikilezi *et al.,* 2020 conducted a systematic review which reported that different geographical areas had inequalities for DTP three vaccine coverage in sub-Saharan Africa. The lowest coverage was observed in Somalia at 13.9%. In contrast other countries recorded high coverage of over 90%. These included Burkina Faso, Rwanda, Cape Verde, and Eritrea (Ikilezi *et al.*, 2020). Uptake of the childhood vaccines decreases with increasing age of the child. A study done by Huang *et al.,* 2023 found that children were more likely to be vaccinated when they were younger (Huang *et al.,* 2023)

2.5 Taking vaccines on scheduled time

Vaccines are timed. They are put in a schedule that must be followed. Though there is need for children to receive the vaccines on scheduled time this is not always the case as reported by Mvula *et al.,* 2016. Not receiving vaccines on scheduled time delays vaccine uptake for some vaccines. (Mvula *et al.,* 2016). In Gambia, a study done by Scott *et al.,*2014 found that 63.3% of the children

delayed in receiving at least one types of vaccine on scheduled time (Scott *et al.,* 2014). It is recommended by CDC that all childhood vaccines must be received following immunization schedule to provide children with maximum protection (Centers for Disease Control and Prevention, 2023). Those children that delay in receiving the immunization are at risk of developing disease (Centers for Disease Control and Prevention, 2023).

2.6 Factors associated with vaccine uptake

There have been previous studies conducted to explore the factors associated with vaccine uptake. A recent systematic review reported that immunization uptake in Africa is influenced by factors grouped into mother/caregiver socio-demographic factors, child sociodemographic factors, cultural beliefs, parity history, health care system, availability of vaccines and mother/caregiver knowledge on vaccines (Geladima *et al*., 2021). It further reported that obstetric factors, mother/caregivers knowledge, mother/caregiver attitude, self-efficacy and mother/caregiver outcome expectation, sociodemographic factors of mother/caregiver, factors of child, logistic factors and administration factors were significantly associated with vaccine update (Galadima *et al.,* 2021).

Thomson *et al.,* 2016 grouped vaccine uptake into five categories. These categories are accessibility, acceptability, affordability, awareness and activation. Physical access to the vaccination centre means accessibility. The ability of the client to afford the cost of the service and the benefits that comes with it means affordability. Awareness means having knowledge about the existence of the service. Acceptability means willingness of the mother/caregiver to go and get the vaccines and their perception that it is safe and other benefits it brings. Activation means that there are reminders about taking the vaccines (Thomson *et al.,* 2016)

A study conducted in Nigeria on the assessment of factors associated with immunization coverage observed that socio-demographic factors such as age of the mother, education, religion, marital status, and occupation, availability of a child health card, residential place, child birth order, child delivery place and number of children were significantly associated with immunization coverage. Additionally, another study done by Oleribe *et al.,* 2017 in Myanmar, Southeast Asia reported that mother/caregiver level of education, type of occupation, and their age were also significantly associated with coverage (Oleribe *et al.,* 2017). Further, another study conducted in Nigeria found

that the community plays a big role in vaccination uptake coverage. The study revealed that community links to immunization and decision-making patterns at household level. It further found that health service factors like unavailability of delivery services, inadequate health workers, vaccines unavailability at scheduled times, and indirect costs of immunization influenced immunization utilization (Adeloye *et al.,* 2017).

In Ethiopian, full vaccination was associated with health facility delivery, distance to the vaccination centre, number of ANC visit, maternal knowledge of immunization, being informed on immunization schedule, living in urban areas and a household being visited by health worker during postnatal period (Biset *et al.,* 2021).

A study conducted by Smith *et al.,* 2017 reported that if mothers/caregivers have knowledge about vaccines, if they trust the health system and if there is social influence as well the perception that vaccines do not have adverse health effects it is associated with high vaccine uptake (Smith *et al.,* 2017).

2.6.1 Knowledge about vaccines

Knowledge is power as the saying goes. Previous studies show that knowledge about vaccines influence the uptake of vaccines. Bangura *et al.,*2020 conducted a systematic review that found that the vaccine uptake was influenced by mothers/caregivers' knowledge on immunization among other factors (Bangura *et al.,* 2020). Another systematic review conducted in South West Ethiopia also found that among other factors, mothers/caregivers knowledge about vaccines was associated with vaccine uptake (Meleko *et al.,* 2017). Similar findings echoing the lack of knowledge about vaccines influence vaccine uptake were also reported in another study conducted in Nigeria (Adedire *et al.,* 2016)

2.6.2 Knowledge about malaria vaccine and uptake

A study in Eastern Nigeria 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, a majority of the study participants (95.6%) were willing to go for such a vaccine if it existed (Chukwuocha *et al.,* 2018).

2.6.3 Vaccine side effects

Fear of side effects of vaccine may prevent other mothers/caregivers from vaccinating their children hence affecting the vaccine uptake. A study done by Obasohan *et al,* 2018 found that mothers/caregivers afraid of side effects of vaccine were not likely to vaccinate their children (Obasohan *et al.,* 2018). Similar study outcomes were found in a study done in Ethiopia looking at predicators and barriers of full vaccination among children(Tefera *et al.,* 2018). Another study conducted in Burkina Faso reported that potential adverse effects was a barrier affecting vaccine coverage (Kagoné *et al.,* 2017).

2.6.4 Health service factors

Health care service factors may also influence that uptake of vaccine. A recent study in sub-Saharan Africa reported that health services factors like cold chain, disrupted supplies and distribution of vaccines; inadequate human resource and infrastructures, long distances separating vaccination points from families were barriers to childhood immunization (Bangura *et al.,* 2020). A study conducted in Malawi reported that stock-outs of vaccines resulted delayed vaccine uptake and reduced chances of completing vaccines on schedule (Mvula *et al.,* 2016).

2.6.5 Socio-demographic characteristics

Education level was found to influence the vaccine uptake in Togo (Ekouevi *et al.,* 2018). Mothers/caregivers with secondary school education or above secondary had more possibility of having their children completing vaccination. These similar findings were also reported in a study done in Malawi where low education level and mothers who were farmers and residing far away from vaccination centres had an association with either late vaccination or incomplete vaccination (Mvula *et al.*, 2016). Economic status and distance walked to a clinic where the vaccination was being offered influenced the vaccine uptake in this study. Households with low income, Mother/caregiver who had to walk long distances to vaccination centre were associated with incomplete vaccination compared to mothers/caregivers who walked for few hours (Ekouevi *et al.,* 2018)

This study will investigate the uptake of malaria vaccine in Nsanje District to see if there are any variations on the uptake of the four doses of the vaccines as being reported by previous studies. Timeliness of malaria vaccine uptake in the district will also be assessed because studies conducted

of timeliness has shown that delaying in receiving the vaccines on the scheduled time affects the completion time and it is also highly associated with not completing the vaccine doses (Mvula *et al.*, 2016) . Various studies conducted in Africa have shown that mothers/caregivers factors, health care system factors, child factors and community level factors influence the uptake of vaccines in a given area (Mvula *et al.,* 2016, Ntenda, 2019) Therefore, this study will explore if these factors influence the uptake of malaria vaccines in Nsanje District.

CHAPTER THREE: RESEARCH METHODS

3.1 Study design

The study used a cross-sectional study design and data was analyzed using a quantitative approach. Structured questionnaires were used together with checklists to collect data on the uptake of malaria vaccine and factors that influence the uptake of the vaccine. Data was collected once. Mothers/caregivers were not only asked questions about themselves and their children but also about factors that were associated to the uptake of malaria vaccine.

3.2 Study area

Nsanje District is located in the southern region of Malawi. It is situated at the southern tip of the country along latitude 16°45'00"S and longitude 35°10'00"E within the lower Shire valley (Figure 3.1a). The district has an estimated population of 299,168 of which 143,578 are male and 155,590 are female (NSO, 2018). There are 127 Group Village headmen, 724 villages and 59,180 households. The district is bordered by Chikwawa district in the North East, Thyolo district in the North and the rest of the district is surrounded by the Republic of Mozambique (Figure 3.1b).

Nsanje has 23 health facilities in total of which two are hospitals, one community hospital, twelve health centres and eight health posts. Of the 23 health facilities, four are Christian Health Association of Malawi (CHAM) facilities while 19 are government owned. There are 146 village clinics in total of which 108 are currently functional.

Geographically, Nsanje is divided into two regions of Eastern and Western banks with Shire river as the dividing line. It is a flatland including Ndindi and Elephant marshes. The district has 9 traditional authorities namely Chimombo, Mbenje, Makoko, Malemia, Mlolo, Ndamera, Ngabu, Nyachikadza and Tengani.

Nsanje District is divided into five clusters for health administration purposes. It is in four of these clusters where malaria vaccine was first implemented. These four clusters are Mlolo, Kalemba, Tengani and Boma. This study was conducted in the catchment areas of the following health facilities; Mlolo cluster (Mlolo, Trinity, Masenjere, Makhanga, Sankhulani and Mchacha), Kalemba cluster (Kalemba, Phokera, Sorgin, Misamvu, Kanyimbi), Tengani cluster (Tengani, Nyamithuthu and Mkango), Boma cluster (Nsanje District Hospital and Chididi). Sampling was done at cluster level and not on health facility level.

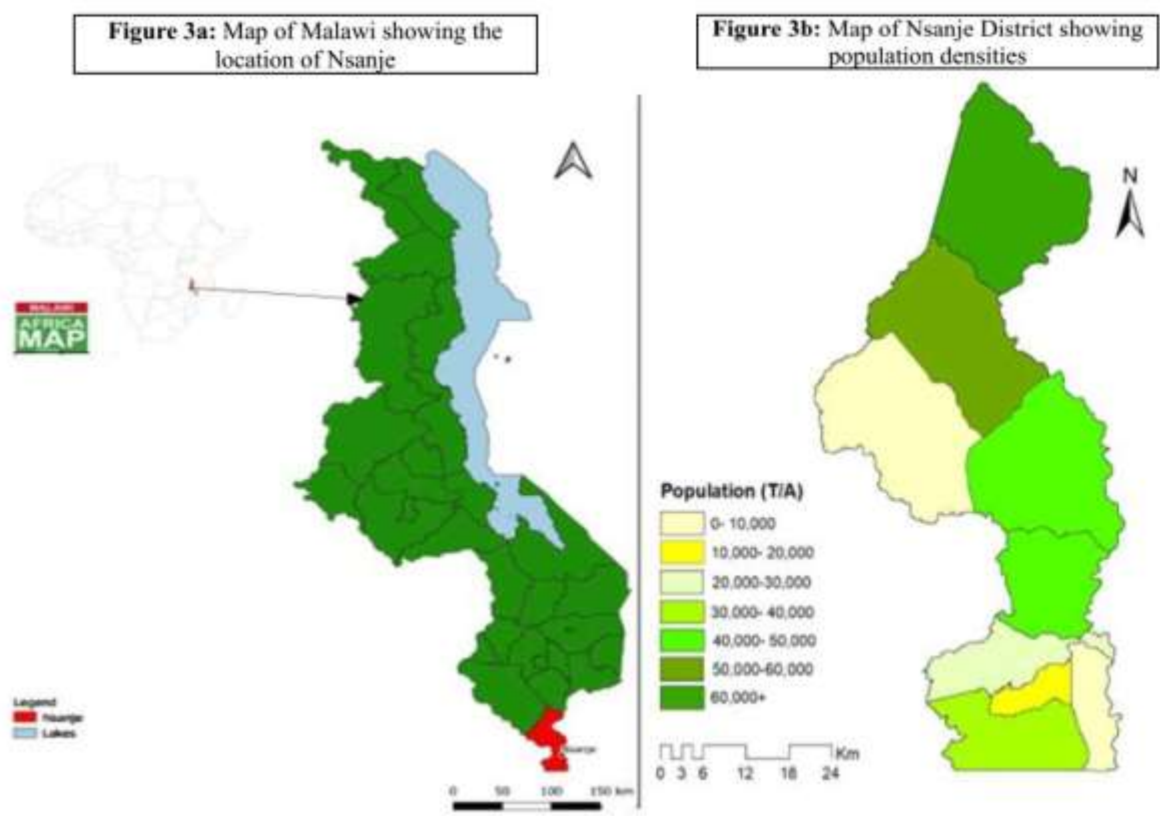


Figure 3a: Map of Malawi showing the location of Nsanje District (Source; Map drawn using GIS software). **Figure3b:** Showing map of Nsanje District showing population densities, Source; adopted from (Gondwe *et al*., 2021)

3.3 Malaria in Nsanje District

Nsanje District is found in the valley of lower Shire river. The area is characterized with high temperatures and is in the low attitude. Areas with such characteristics have a high transmission rate of malaria (Mathanga *et al.,* 2012). Since Nsanje District is part of the lower Shire it can be concluded that it has higher malaria transmission. A study conducted by Bennett *et al.,* 2013 reported Nsanje District with high transmission intensity and predicted prevalence of 42% (Bennett *et al.,* 2013).

3.4 Variables (measurements)

3.5 Independent variable

The independent variables that were considered for this study were; mother/caregiver factors, health care system factors, child factors and community level factors. For mothers/caregivers factors: socio-demographic characteristics of mother/caregiver such as their age, sex, level of education, marital status, number of children, occupation type and religion were considered. Additionally, mothers/caregiver's knowledge about vaccines, awareness of the schedule and benefits of malaria vaccine, knowledge about the malaria vaccine, safety concerns and previous side effects following vaccination were also be looked at. Furthermore, the following health care system factors were investigated: accessibility (near child residence), affordability (cost of transport or other payments involved in accessing vaccine), and quality of care perception (attitude of the staff who administer vaccine). On child factors: sex and place of birth were investigated. Lastly, community level factors such as support from community leaders on vaccination, support from religious leaders on vaccination, support from community health volunteers on vaccination and community infrastructure on vaccination were considered. Whether the vaccine was received at the recommended time for example five, six, seven and 22 months was also assessed. Table 3.1 shows the operation definition and scale of measurement for socio-demographic variables and table 3.2 below shows operational definition and scale of measurement for independent variables.

Table 2.1: Operational definition and scale of measurement for socio-demographic variables

Variable	Operational definition	Scale of measurement	Source of data
Age	Age in years	Ratio	Interview
Sex	Being male or female	Nominal	Observation
Marital status	Legal relationship with partner	Nominal • Married • Divorced • Separated • Single • Widowed	Interview
Religion	Religious denomination	Nominal • Christianity • Islam • Traditional • Other	Interview
Religion of the partner	Religious denomination	Nominal • Christianity • Islam • Traditional • Other	Interview
Education level	Highest formal education level attained	Ordinal • None formal • Primary • Secondary • Tertiary	Interview
Education level partner	Highest formal education level attained by partner	Ordinal • None formal • Primary • Secondary • Tertiary	Interview
Occupation	What the individual does for a living (brings him/her regular income)	Nominal • Unemployed • Self-employed • Farming • Civil service	Interview
Occupation of partner	What the partner does for a living (brings him/her regular income)	Nominal • Unemployed • Self-employed • Farming • Civil service	Interview
Parity	Number of children alive	Ratio	Interview

Table 3.2: Operational definition and scale of measurement for other independent variables

Variable	Operational definition	Scale of measurement	Source of data
Knowledge about RTS,S/AS01	Whether mother/caregiver has ever heard about the malaria vaccine	Binary • Yes • No	Interview
	Where mother/caregiver first heard about malaria vaccine	Nominal • Health facility • Radio • Friend/relative • Television • Newspaper • Village criers	Interview
	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 number • Incorrect number	Interview
Perception of malaria vaccines becoming too many doses	Parent/caregiver thinks malaria vaccines has too many doses to attain fully vaccination	Binary • Yes • No	Interview
Concern about vaccine safety	Heard about any negative issue/report concerning malaria vaccine	Binary • Correct number • Incorrect number	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 vaccination point	Ratio	Interview
Affordability	Cost incurred for vaccination services	Ratio	Interview
Perception of quality of vaccination service	Description of health workers 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 the child was born	Nominal • Home delivery • Health facility	Interview
Time of uptake	Age (in months) at which child was administered any dose of malaria vaccine	Ratio	Health passport of the child
Distance to the vaccination centre	Perceived distance to the vaccination centre	Binary • No big problem • Big problem	Interview
Community level factors	Support from community leaders for vaccination	Binary • Yes • No	Interview
	Support from religious leaders for vaccination	Binary • Yes • No	Interview
	Support and reminder from community health workers on vaccination	Binary • Yes • No	Interview
	Presence of community health infrastructure	Binary • Yes • No	Interview

3.6 Dependent variable

For this study malaria vaccine uptake was the dependent variable. Uptake was measured as whether or not the child received no dose (RTS,S 0), dose one (RTS,S 1), dose two (RTS,S 2), dose three (RTS,S 3), and dose four (RTS,S 4) which means fully vaccinated. Uptake was measured in three levels which are full uptake, partial uptake and no uptake. Table 3.3 below show details of operational definition and scale of measurements for dependent variables.

Table 3.3: Operational definition and scale of measurements for depended variables

Variable	Operational definition	Scale of measurement	Source of data
Uptake of RTS,S/AS01 malaria vaccine	Number of doses of malaria vaccine a child has received	Ordinal • Full uptake/Fully vaccinated (All four doses have been received by a child) • Partial uptake/incomplete uptake (Child has received 1st, 2nd or 3rd dose) • No uptake (child has not received any dose)	Child health passport

Note: Malaria vaccine doses are given 4 times for child to be fully vaccinated. In Malawi the schedule is at months 5 (first dose), 6 months (second dose), 7 months (third dose) and 22 months (4th dose)

3.7 Study population and sampling (population)

In this study the population was mothers/caregivers with children aged 24-36 months by the time of data collection and who were permanent residents of Nsanje District. The information about mothers/caregiver was gathered using the following process. Firstly, I extracted the information of children who are aged 24-36 months using village registers with the help of Health Surveillance Assistants. After they were selected from the village register, then mothers/caregivers of the selected children were contacted. Children are eligible of receiving the first dose of RTS,S at the age of five months and the fourth dose at 22 months. It expected that at age 24 months the children could have received all the four doses of RTS,S vaccine (fully vaccine).

3.7.1 Inclusion criteria

- All mothers/caregivers with children aged 24-36 months by the time of data collection

- Mothers/caregiver with children aged 24-36 months who are permanent residents of Nsanje District

3.7.2 Exclusion criteria

- All mothers/caregivers of children who were less than 24 months
- All mothers/caregivers of children who were more than 36 months
- All mothers/caregivers who were not permanent residents of Nsanje District
- All mothers/caregivers who did not give consent

3.8 Sample size and sampling procedure

3.8.1 Calculation of sample size

Cochrane's formula was used in calculating the sample size of the participants

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

where n = Sample size

Z = Standard normal variate for the margin error

p = Proportion of children who take RTS,S/AS01

q = 1-p

d = margin of error

In this study the margin of error is set at 5%. The annual malaria vaccine coverage for 2021 in Nsanje Distict was 60% for dose four. Therefore, 60% is the proportion used in the Cochrane formula. As it states that for known proportions (p) has to be used in the formula so that the population estimates are closer to the study findings.

Z= 1.96
p = 0.6
q = 1-0.6 = 0.4
d = 0.05

$$n = \frac{(1.96)^2(0.6)(0.4)}{(0.05)^2}$$

n = 369

The minimum sample is calculated to be 369 using the Cochrane formula above.

The minimum sample size will be adjusted in order to take into account for non-response. In this study 10% will be used to adjust the minimum sample size generally due to questionnaires that are incomplete, refusals and unreturned questionnaires.

Adjustment for a non-response rate of 10%, n= 369 +(0.1*369)

n=406

Therefore, in this study the sample size was n=410

3.8.2 Sampling techniques

Nsanje District is divided into five clusters for health administration purposes. Malaria vaccine was administered in four clusters. The total population in these four clusters 245,620 and from this total population, the population of mothers/caregivers in the four clusters is 12,281. Therefore, stratified sampling technique proportionate to size of the cluster population was used in selecting participants for the study. This kind of sampling was to ensure that all the clusters were well represented in the total sample size. Table 3.4 below shows the target population of the four clusters in Nsanje District that administered malaria vaccine.

Table 3.4: Shows the target population of the 4 clusters in Nsanje District that administer malaria vaccine.

Cluster	Total Population	Target Population
Mlolo	74,606	3,894
Boma	47,085	2,336
Tengani	58,975	2,906
Kalemba	64,954	3,145
Total	**245,620**	**12,281**

Source: Nsanje District Health Office Data

Each cluster contributed a fraction to the total sample size based on its population. The proportion from each sub-cluster was determined by this formula K=n/N*100, where K was the sampling

fraction (proportion size), n was the target population and N was the total target population in all the 4 clusters then multiplied by 100. The determination of the sample size for each sub-cluster is shown in Table 3.5 below.

Table 3.5: Sample size determination by cluster (proportionate to size)

Cluster	Total Population	Target Population	Proportion	Sample
Mlolo	74,606	3,894	32	130
Boma	47,085	2,336	19	78
Tengani	58,975	2,906	24	97
Kalemba	64,954	3,145	26	105
Total	**245,620**	**12,281**	**100**	**410**

3.8.3 Sampling of individual participants

To sample individual respondents in this study, firstly, systematic sampling technique was used to selected respondents from each sub-cluster. The Village Health Registers were used as source of the names for mothers/caregivers. The names of all mothers/caregivers who met the eligibility criteria in each cluster was numbered and written down, thus forming the sampling frame. A formula was used to determine a sampling interval from each cluster. The formula that was used is i=N/n where I was the sampling interval, N was the total number of eligible mothers/caregivers in the sampling frame whereas n was sample size of the sub-cluster. The names and the villages of the mothers/caregivers counting from one to the sampling frame were written on a piece of paper, folded, mixed thoroughly and put in a box then a simple random sampling technique was used to select the first sample. After the first sample was drawn, we went back to the initial list that was written down in order to select the subsequent. The subsequent participants were selected by adding the sampling interval to the number of the initial sample until the required samples were drawn for that cluster.

3.9 Data collection

Questionnaire and observational checklist were used to collect data (refer to appendix 3). Questionnaires were administered to the study participants and it focused on factors associated

with the uptake of malaria vaccine. Questions based on mothers/caregiver socio-demographic characteristics, child factors, community level factors and health care system factors. On the other hand, the information on vaccine uptake and timeliness was extracted from the health passport of the child through observation. Mothers/caregivers who did not have health passports for the children, data was recorded using recall history. Mothers/caregivers were contacted in their homes depending on when they were available to respond to the questionnaire but not on health facilities or on the vaccination point. It was estimated that the administration of each questionnaire and observation took about 25 minutes. The research assistants and data clerks that were hired were properly trained on data collection and entry.

3.10 Quality Control

3.10.1 Reliability

The data collection tool was pretested in order to ensure the reliability of the research instruments. Reliability was determined by using the test-retest methods for computation of reliability coefficients. According to Haradhan, 2017 the minimum threshold for Pearson correlation is 0.70 (Haradhan, 2017). During the pilot a Pearson correlation that was established was 0.863 which was above the minimum threshold.

3.10.2 Validity

Content validity was established by including relevant variables in the questionnaire based on the literature reviewed. Additionally, during the pretest, content validity was achieved through piloting the questionnaire and made corrections with careful review of the questions for simplicity but also for easy comprehension to avoid ambiguity. Further the expert opinion of university supervisors was sought to assess the research tools to establish face validity.

3.10.3 Training of the data collectors

In order to minimize errors during data collection, protocol training was be done for data collectors. The main focus of the training was on data collection ethics, the expectations from data collection and how data research assistants should conduct themselves in the field. The principal investigator helped in collecting data and also was responsible for supervising the data collectors during the entire data collection period.

3.10.4 Pre-testing

Before the actual study, data collection tools were tested in Mbeta village and analyzed as planned in order to reduce the errors of the study. This helped to make sure that the questionnaire was clearly understood by the respondents but also that the checklist was capturing the intended variables. Mbeta village is also located n Nsanje District**.** In order to get the right responses from the participants the questions were translated into the local language to ensure that respondents understand questions very well. A total of 41 participants were piloted which represents 10% of the total sample size.

3.10.5 Supervision

The principal researcher was regularly communicating with research assistants throughout the whole data collection process. This was important because any problems that the research assistants faced in the field was resolved quickly. The research team was conducting meetings at the end of each day to discuss how the day went and to verify the accuracy of the data documented. These meeting was done to make sure that the data collected was of high quality thus leading to authentic conclusions.

3.11 Data management and analysis plan

Hard copies of questionnaires were kept in a safe drawer with a lock while the data that were entered in Microsoft Excel was kept in a safe folder with a protected password. This data will be kept for 5 years. After that duration it will be destroyed by incineration of the hard copies of the questionnaire and deleting the soft data from the computer. Single data entry was done. Data was entered in Microsoft Excel after being cleaned thoroughly. The data was double-checked by a different person by checking the questionnaire and the entered data in Microsoft Excel in order to check for errors and if found they were corrected. Then the data was imported to STATA version 16 for analysis. For objective one, graphs and tables were used to show the frequencies and percentages of different socio-demographic characteristics. For continuous variables; ranges, median and quartiles were used.

For objective number two descriptive statistics were used on details of uptake timeliness. Inferential analysis was used for objective three. For the third objective, logistic regression analysis

was done to determine the association between the independent variables and the level of malaria vaccine uptake. Regression analysis was conducted first at univariate level. After the univariate analysis, a multivariate analysis was done on those independent variables with significant p-values of 0.05 in the first stage. A model was selected based on having the lowest Akaike's Information Criteria (AIC). The principal researcher was responsible for data management and analysis.

3.12 Ethical consideration

Ethical approval was sought from Jaramogi Oginga Odinga University of Science and Technology ethical review board. Approval was also sought from Malawi National Health Sciences Research Committee. Clearance was obtained from Nsanje District Health Directorate before commencement of the study activities. Before data collection, informed consent was sought from each study participant (refer to appendix 2) to ensure voluntary participation in the study. All necessary information about the study was explained to the participants. The purpose, risks, and benefits of the study was explained to each study participant. Further, the study participants were told that they have right to withdraw from the study at any point during the study period. Those participants who agreed to be interviewed were requested to either sign or thumbprint the informed consent form.

A location that has no interference from other people was used for the interviews to safeguard privacy and confidentiality. Additionally, names of participants were not taken for confidentiality purposes. Clearance was sought from the village heads in the villages where study participants were drawn from. There was a provision of the contact phone numbers of the principal researcher, supervisors, and administrator at the ethics review committees to participants to call if they had any queries.

3.13 Sponsorship

This research was funded by Capacity Development of Applied Epidemiologists in Eastern African Region (CDAE), a project which is part of European and Developing Countries Clinical Trials Partnership II (EDCPT2) Programme supported by European Union. CDAE is jointly implemented by the African Population and Health Research Centre (APHRC). The principal investigator with support from the Jaramogi Oginga Odinga University of Science and

Technology, School of Health Sciences and Nsanje District Health Office did all other tasks related to this study.

CHAPTER FOUR: RESULTS

4.1 Socio-demographic characteristics of the participants

The study administered a total of 410 questionnaires to randomly selected parents/caregivers with children between age of 24 to 36 months in Nsanje District, Malawi. The calculated sample size was 410 and this study had a response rate of 100%. The study participants were drawn from 4 clusters in the district namely Boma, Kalemba, Mlolo and Tengani.

The minimum age of the parent/caregiver was 16 years and the maximum age was 56 years with the median age being 27 years. The first quartile was 23 and the third quartile was 33. Most of the of respondents were between 20 to 29 years of age (54.15%). Of the 410 participants the majority were parents (97.6%), while (2.7%) were caregivers. Majority of the respondents were married (79.8%), while a small fraction of them were widowed (3.2%). Up to 40.7% of the study participants had reached secondary education, 36.3% had gone up to primary level of education and only 1% had gone up to tertiary education. The majority of the study participants were Christians (95.1%). More than half (58.8%) of the respondents were self-employed whereas only 3.2 % were civil servants. Table 4.1 below shows the details of socio-demographic characteristics of the study participants.

Table 4.1: Socio-demographic characteristics of respondents in Nsanje District

Characteristic	Category	n	%
Age group (Years)	Less than 20	31	7.6
	20-29	222	54.2
	30-39	125	30.5
	40 and above	32	7.8
Sex	Female	374	91.2
	Male	36	8.8
Education Level	No education	90	22
	Primary	149	36.3
	Secondary	167	40.7
	Tertiary	4	1
Marital status	Single	44	10.7
	Married	327	79.8
	Divorced	26	6.3
	Widowed	13	3.2
Religion	Christianity	390	95.1
	Islam	19	4.6
	Traditionalist	1	0.2
Occupation	Unemployed	67	16.3
	Self-employed	241	58.8
	Farmer	89	21.7
	Civil servant	13	3.2
Parity	1 to 3	254	62
	4 and above	156	38
Anti Natal Care visit	1 to 3	131	43.8
	4 and above	168	56.2

4.2 Characteristics of study participants

The median age of the children in this study was 29(IQR 26-33). The minimum age of the children was 24 months and the maximum age was 36 months. Out of the 410 children that took part in the study 42.9% were aged between 24 to 27 months and 20.7% were aged between 28 to 31 months. Over half (51.5%) of the children were males while 48.5% were females. The majority of the

children were delivered at a health facility (98.8%). The table 4.2 below shows the details of the characteristics of the children that participated in this study. Not all the participants had their children's health passports, some lost them due to various reasons. Out of the 410 participants, 82.4% (338) had their children's health passports present whereas 17.6% (72) had no health passports for their children.

Table 4.2: Distribution of characteristics of children who participated in the study

Characteristic	Category	**n**	**%**
Age group (Months)	24-27	176	42.9
	28-31	85	20.7
	32-36	149	36.3
Sex	Female	199	48.5
	Male	211	51.5
Delivery place	Health facility	405	98.8
	Home	4	1
	Don't know	1	0.2

4.3 Uptake of malaria vaccine

Out of the 410 children that participated in this study the uptake of malaria vaccine dose 1 was 90.5%, 87.6% of the children had received both malaria vaccine dose one and dose two, while 69.5% of the children had received up to three doses of malaria vaccine. Those who were fully vaccinated and managed to get all the 4 doses of malaria vaccine were 41.2%. 9.5% of the children did not receive even a single dose of malaria vaccine. Table 4.3 below shows the detail of malaria vaccine uptake distribution.

Table 4.3: Distribution of malaria vaccine uptake in Nsanje District

Level of uptake		
	n	**%**
No uptake	39	9.5
Partial uptake	202	49.3
Full uptake	169	41.2

Out of 70 mothers/caregivers who had health passports of their children present 31.9% (23) had not taken any malaria vaccine at all (no uptake) whereas 25% (18) had taken all the doses of malaria vaccine (full uptake) and 43.1% had partial uptake of malaria vaccine.

4.3.1 Assessment of uptake of malaria vaccine in Nsanje District

Malaria vaccine uptake in Nsanje District shows that the level of uptake is different from one dose to another. The malaria vaccine uptake is declining with each subsequent dose of the vaccine. The first dose had the highest uptake reaching 90.5%, the second dose uptake declined to 87.6%, dose 3 declined in uptake levels to 69.5% whereas the uptake of the fourth dose was the lowest at 41.2%. According to WHO targets, childhood vaccines must reach at least 90% uptake at the district level. Therefore, it is only dose one that met the WHO target whereas uptake of dose two, dose three and dose 4 did not. The figure 4.3.1 below shows the uptake levels of malaria vaccine in Nsanje District

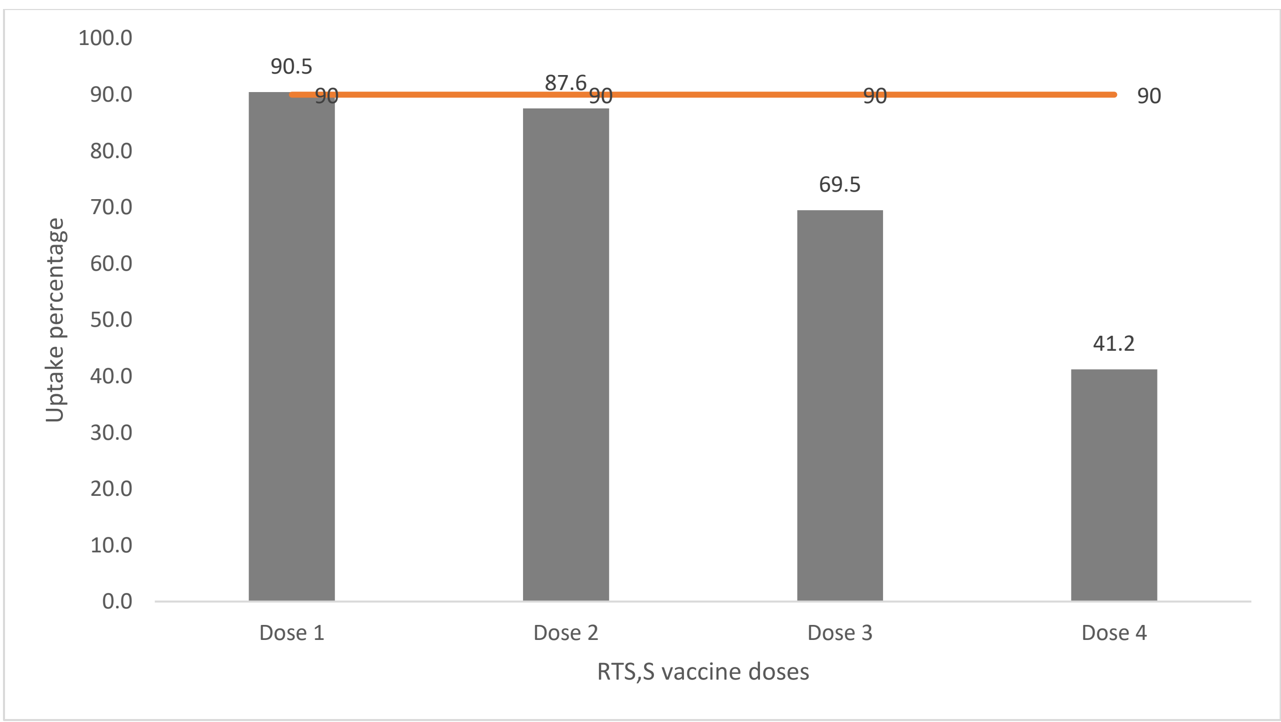


Figure 4.3.1: A graph showing the uptake of malaria vaccine in Nsanje District

4.3.2 Uptake levels of malaria vaccine

The uptake levels were divided into three, namely; no uptake (those children that did not receive any dose of malaria vaccine), partial uptake (for those children that received first, second or third dose) and full uptake (those children who received all the four doses of malaria vaccine). This

study found that the levels of malaria vaccine uptake were 9.5% for no uptake, 49.3% for partial uptake whereas for full uptake it was 41.2%. The results below half of the children received all the four doses of malaria vaccine. Figure 4.3.2 below show the level of malaria vaccine uptake in Nsanje district.

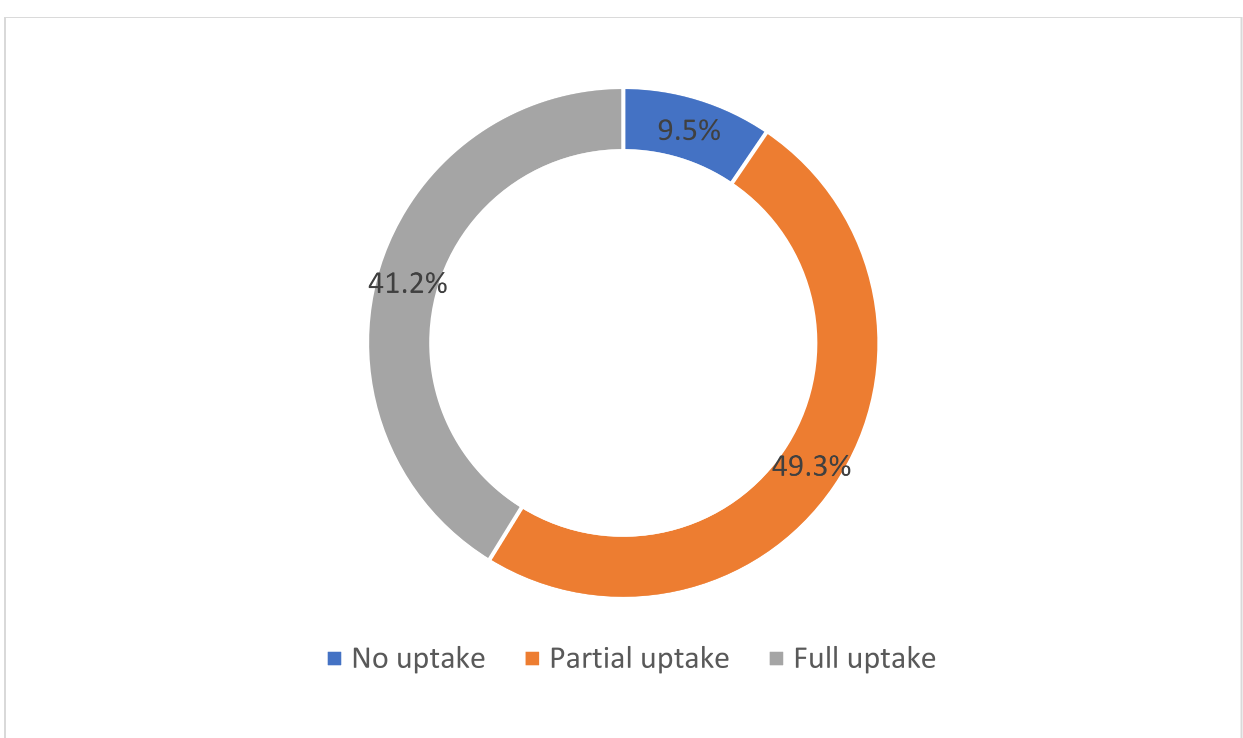


Figure 4.3.2: Showing the level of RTS,S malaria vaccine uptake in Nsanje District

4.3. 3 Malaria vaccine dropout rate

This study found that the malaria vaccine dropout rate was 23.2%. The dropout rate for malaria vaccine was calculated using the formula below;

$$\text{Malaria drop-out rate} = \frac{\text{Malaria vaccine dose 1 uptake} - \text{Malaria vaccine dose 3 uptake}}{\text{Malaria vaccine dose 1 uptake}}$$

4.3.4 Uptake reasons

Only 9.5% (39) of the total participants did not take any of the doses of malaria vaccine. When asked why they did not take any of the vaccine two thirds of them (26/39) said they did not know

that their child was eligible. Whereas 9 participants (23.8%) said it was due their to religious belief which prohibit them from using any health services.

Two hundred and two participants (49.3%) had partial uptake of the vaccine. When asked why they did not finish all the doses, the majority (70.4%) said they did not know the next date when the vaccination was due. Only 4% said they were not comfortable with issues surrounding vaccines. In total 28 participants (6.8% of total participant - 4 complete refusals, 9 with religious reasons, and 15 partially vaccinated), reported vaccine hesitancy leading to no or partial vaccine uptake. Table 4.3.4 below shows the details of the reasons why some participants did not take any vaccines and why some had partial uptake.

Table 4.3.4: Showing the details of reasons of partial or no uptakes in Nsanje District

Reasons for not taking any of the doses	n	%
Did not know the child was eligible	26	66.7
Religious beliefs	9	23
Personal decision to refuse vaccine	4	10.3
Reason for not taking all the doses		
Did not know when next one was due	261	70.4
Was not around	81	21.8
Child was sick	14	3.8
Not comfortable with issues surrounding vaccine	15	4

4.4 Timeliness of the uptake of malaria vaccine

This study found that the timeliness of different doses of malaria vaccine to be different. The timeliness of uptake of RTS,S 1 was at 69.7%. The median age of uptake timeliness of dose one of malaria vaccine was five months (IQR 5-6). The minimum age to take dose one was five months and the maximum age was 14 months. Timeliness of uptake of RTS,S dose two was 64.6 % with the median age of timeliness uptake being six months of age. The minimum age at taking RTS,S dose two was six months whereas 19 months was the maximum age. The first quartile for RTS,S dose two was six while the third quartile was seven. RTS,S dose three timeliness uptake was 56.7%. Time of uptake ranged from seven months to eight months. The median age at uptake was seven months with 1st quartile being seven and third quartile being eight.

The study also found that the timeliness of RTS,S dose four was 48.3%. The median age at RTS,S dose four uptake was 22 months with 1st quartile was 22 and the third quartile was 24. The minimum age of taking RTS,S dose four was 22 months and the maximum age was at 28 months. Figure 4.4 below shows the details of timeliness of malaria vaccine uptake.

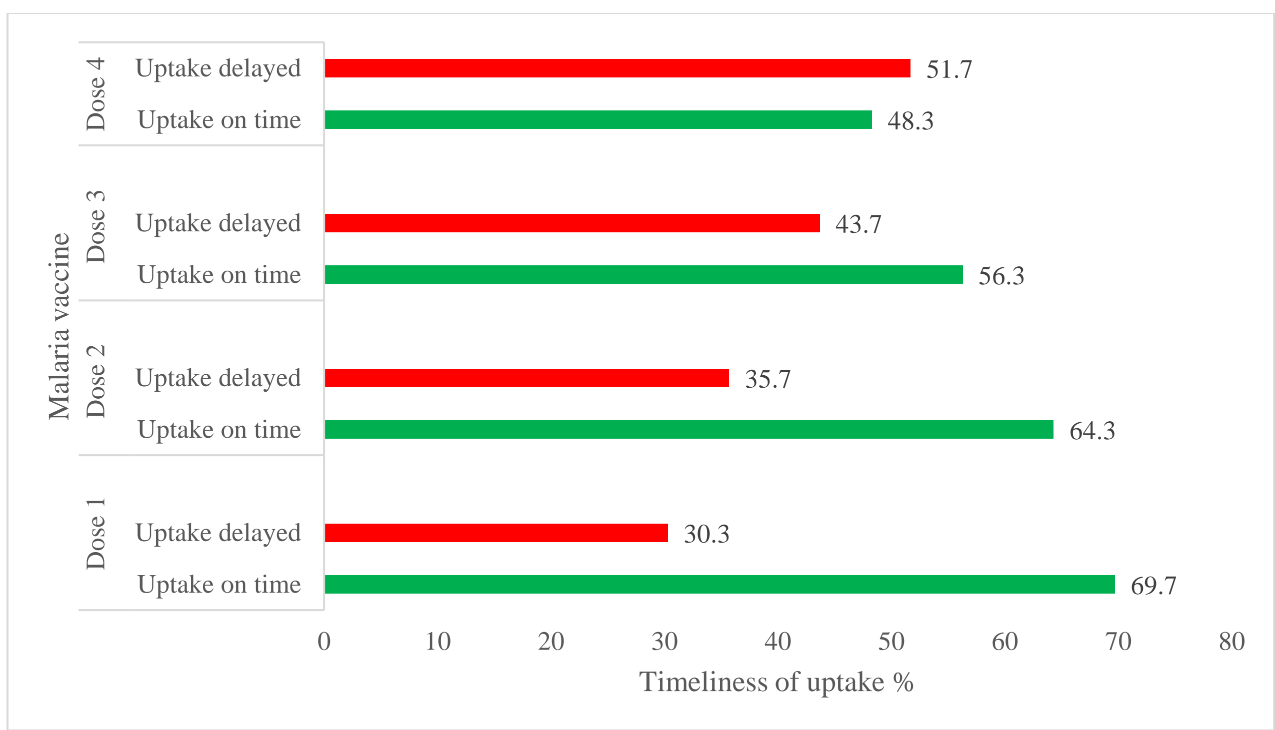


Figure 4.4: Showing details of timeliness of malaria vaccine uptake in Nsanje District

4.5 Knowledge and awareness about vaccine in general

The study participants were asked to mention childhood vaccine preventable diseases they know. Out of 410, 390 of them (95.1%) said that the main reason to vaccine their children was to protect them against diseases, 4.9% said that the reason to vaccine their children was to make the breastfed well and 2.9% said they don't know why children get the vaccination. Only 6.6% failed to mention any disease that is prevented by childhood vaccines, 35.1 % mentioned up to 3 diseases that can be prevented by childhood vaccines and only14.6% mentioned any disease including malaria as a disease that can be prevented by childhood vaccines. Table 4.5 below shows the details on knowledge and awareness of vaccines in general.

Table 4.5: Showing details of knowledge and awareness about vaccines in general in Nsanje District

Main reason for childhood vaccination		
	n	**%**
Protect them against diseases	390	95.1
Don't know	12	2.9
Make them breastfed well	8	2
Number of vaccine preventable diseases mentioned		
No correct disease mentioned	27	6.6
Up to 3 correct diseases mentioned	179	43.7
4 to 8 correct diseases mentioned	144	35.1
Any correct diseases but including malaria	60	14.6

4.5.1 Knowledge and awareness about malaria vaccine

In this study three questions were asked to assess the knowledge of mothers/caregivers on malaria vaccine. The questions assessed if the mother/caregiver has ever heard about malaria vaccine, if they knew the number of doses a child has to receive to be fully vaccinated, and if they know the specific ages at which a child is supposed to receive the vaccines. In this report the way the level of knowledge was assessed by looking at the correct responses by the mother/caregiver. Those who gave 0-1 out of the 3 correct responses were categorized as to have low knowledge, two correct responses were categorized as having moderate knowledge and those who gave three correct responses were categorized as to have high knowledge. The assessment of knowledge levels was adapted from a study done by Ramil *et al.,* 2018 (Ramli, 2018).

The majority 94.9% of the study participants said that they have ever heard about malaria vaccine and 62.0% of them said that they heard it first from under five clinic. Only 5.1% said that they heard it first from their friends/relatives. The respondents that were able to mention the correct number of doses a child is supposed to receive malaria vaccine was 38.5% while 45.5% mentioned incorrect number and 15.9% said they didn’t know. When the participants were asked the specific ages in months at which the children are supposed to receive malaria vaccine only 15.9% were able to mention the ages correctly whereas over half of the respondents 68.3% mentioned incorrect ages. Table 4.5.1 below show the details of the knowledge and awareness of malaria vaccine.

Table 4.5.1: Showing details of knowledge and awareness of malaria vaccine in Nsanje District

Knowledge and awareness about malaria		
	n	**%**
Ever heard of malaria vaccine		
No	21	5.1
Yes	389	94.9
First heard from where		
Under 5 clinic	241	62
Health facility announcement	88	22.6
Radio	26	6.7
Friends/Relatives	20	5.1
Community announcements	14	3.6
Number of times a child is supposed to receive malaria vaccine		
Incorrect number	187	45.6
Correct number	158	38.5
Don't know	65	15.9
Age of taking malaria vaccine		
Incorrect	280	68.3
Correct	65	15.9
Don't know	65	15.9

4.6 Previous experience with childhood vaccines and vaccine activities

Over half of the respondents 56.6% admitted that their children ever suffered from side effects following immunization and the majority 70.7% mentioned that the side effect their child suffered from was fever whereas few of the children 7.8%, suffered from diarrhea/vomiting as a side effect following vaccination. When the participants were asked where the adverse effects their children experienced affected their decision for subsequent vaccination for their children the majority 95.3% say that their decision was not affected at all.

This study found out that 13.7% of the respondents had to spent 1 to 2 hours travelling to reach the vaccination point whereas 44.3%, had to travel for less than 30 minutes to reach the vaccination point. The majority 87.5%, of these study participants went to the vaccination point walking and very few 0.5% use either personal vehicle/bike/motorbike.

When asked whether they have ever attended vaccination site and failed to vaccinate their children, 22.4% admitted that they ever attended under five clinic and failed to vaccinate their children.

However, most of them 77.6%, said they have always vaccinated their children once they got to under five clinic.

Over half of the parents/caregivers (54.2%) said that they knew the next due date for vaccination as told by the Health Surveillance Assistants whereas 34.6% said that they checked in the child's health passport. Other participants responded that they ask their friends/relatives but also some said that they are told by the community health volunteers from their villages.

A handful (0.5%) of the participants reported that the attitude of health workers was very bad but most the parents/caregivers either said the attitude of the health workers was ranging from good to excellent. The parents/caregiver who said the attitude of the health workers were excellent were 24.4% while 46.8% said the attitude was very good.

The parents/caregivers who reported that childhood vaccines have long-term effects were only 11.0% while the majority of the participants (89.0%) said that childhood vaccines had no long-term effects. The most mentioned long term side effect of childhood vaccines was infertility (62.2%) and stroke (37.8%). All the participants reported that they are not required to pay any money for them to get malaria vaccine. Further details on experiences on childhood vaccines that parents/caregivers experience are shown in Table 4.6 below

Table 4.6: Details of participant experiences on childhood vaccines in general in Nsanje District

Experiences on childhood vaccines	n	%
Any side effects following immunization		
No	178	43.4
Yes	232	56.6
The side effects experienced		
Fever	164	70.7
Abscess	50	21.5
Diarhoea/vomiting	18	7.8
Did the side effects influence decision on vaccine uptake		
No	221	95.3
Yes	11	4.7
Distance to the vaccination point		
Less than 30 minutes	182	44.3
30 minutes - 59 minutes	172	42
1hour - 2 hours	56	13.7
Mode of transport to vaccination point		
Walking	359	87.5
Commercial (motorbike/bike)	49	12
Personal vehicle(car/bike/motorbike)	2	0.5
Attended vaccination site and failed to vaccinate a child		
No	318	77.6
Yes	92	22.4
How do you know due date for vaccination		
The Health Surveillance Assistants tell us	218	53.2
Check in child's health passport	142	34.6
Ask friends/relatives	23	5.6
I go there every month	21	5.1
The volunteer from my village tells us	6	1.5
The attitude of health workers at vaccination centres		
Very good	192	46.8
Excellent	100	24.4
Good	113	27.6
Bad	3	0.7
Very bad	2	0.5
Long term side effects of childhood vaccines		
No	365	89
Yes	45	11
Long term side effects of childhood vaccines mentioned		
Infertility	28	62.2
Stroke	17	37.8
Required to pay at vaccination site		
No	410	100
Yes	0	0

4.7 Negative issues about malaria vaccine

The participants were asked if they have ever heard any negative issues about malaria vaccine and the majority 75.6% said they have never heard any negative issues. About 24.4% of the participants admitted that they have ever heard negative issues about malaria vaccine. Those who heard negatives issues of malaria vaccines above half of them (61.1%) said that the children were used for experiment whereas 13.7% said they heard that malaria vaccine was not safe. The source of these negative issues about malaria vaccines 78.9% came from friends/relatives while only 1.1% come from health workers. When asked their thoughts on the introduction of malaria vaccine, majority (83%) said they had no problem while 10.5%, said that vaccines were becoming too many for the children. Table 4.7 below shows the details of issues surrounding malaria vaccine.

Table 4.7: The details of the negative issues surrounding malaria vaccine in Nsanje District

Issues surrounding malaria vaccine		
Ever heard bad issues about malaria vaccine	**n**	**%**
No	294	75.6
Yes	95	24.4
Negative issues were from		
Friends/relatives	75	78.9
Religious leaders	12	12.6
Radio	7	7.4
Health worker	1	1.1
The negative issues		
Children are being used for experiments (trials)	58	61.1
Malaria vaccine is not safe	24	25.3
The malaria vaccine affects child development	13	13.7
Thoughts on introduction of malaria vaccine		
There is no problem with that	40	83
Don't know	27	6.6
Vaccines are becoming too many for our children	43	10.5

4.8 Decision maker on child vaccination

The study participants were asked about who made the decision for a child to take malaria vaccine. Whereby 45.8%, said that the decision was made by the mother while only 2% said that the decision was made by other. Table 4.8 below shows that details on who makes the decision for malaria vaccine uptake.

Table 4.8: Showing the details on who decides the uptake of malaria vaccine in Nsanje District

Who decides vaccine uptake	**n**	**%**
Mother	188	45.8
Both	184	44.9
Father	30	7.3
Other	8	2

4.9 Community level support

The majority of the participants receive support from community level. This study found out that the participants received support from traditional leaders, religious leaders, community health volunteers and household members respectively. Table 4.9 below show the details of the support the participants got from at community level.

Table 4.9: Showing details of community level support in Nsanje District

Community level support on malaria vaccine	**n**	**%**
Traditional leaders support		
I don't know	12	2.9
No	20	4.9
Yes	378	92.2
Religious leaders support		
I don't know	12	2.9
No	23	5.6
Yes	375	91.5
Community health volunteers support		
I don't know	6	1.5
No	17	4.1
Yes	387	94.4
Household members support		
I don't know	11	2.7
No	20	4.9
Yes	379	92.4

4.10 Association between sociodemographic characteristics and malaria vaccine uptake

Children who had parents/caregivers with the age range 30 to 39 years old had increased odds to get their children to have full uptake than those children whose parents were aged 40 years and above. The odds of parents/caregivers between 30 to 39 years to get their children have full uptake

malaria of malaria vaccine was 2.31 more than those who were 40 years and above. This result was statistically significant (p-value 0.047, 95%CI 1.01-5.27). Whether the parent/caregiver was male or female was not associated with the full malaria vaccine uptake. Parents/caregivers who had secondary or more education had 2.43 odds to make their children have full uptake than those who had no education and association was statistically significant (p-value 0.001 95%CI 1.43-4.12). This study found an association between full vaccine uptake and marital status. The parents/caregivers who were married had increased odds of 2.9 to get their children have full vaccine uptake compare to those that were divorce or widowed. This association was statistically significant (p-value 0.009). On religion, occupation and parity of the parent/caregiver and full malaria vaccine uptake this study found no statistically significant association. However, the study found an association between number of ANC visits and full malaria vaccine uptake. The study found that parents/caregivers who have attended four or more ANC visits had 1.89 odds to make their children have full malaria vaccine uptake than those parents/caregivers who had fewer ANC visits with a (p-value 0.008). Details of the association between socio-demographic characteristics of parents/caregivers and full uptake of malaria vaccine has been show in Table 4.10 below.

Table 4.10: Association between socio-demographic characteristics of parents/caregivers and full uptake of malaria vaccine in Nsanje District

Characteristics of parents/caregivers						
		n	**%**	**OR**	**95%CI**	**P value**
Age group	Less than 20	12	7.1	1.39	0.49-3.93	0.535
	20-29	83	49.1	1.31	0.59-2.91	0.501
	30-39	64	37.9	2.31	1.01-5.27	0.047
	40 and above	10	5.9	Ref		
Sex	Female	151	89.4	Ref		
	Male	18	10.6	1.48	0.74-2.93	0.265
Education Level	No education	32	18.9	Ref		
	Primary	39	23.1	0.64	0.37-1.13	0.125
	Secondary and above	98	58.0	2.43	1.43-4.12	0.001
Marital status	Once married	8	4.7	Ref		
	Single	20	11.9	3.23	1.21-8.59	0.019
	Married	144	83.4	2.9	1.31-6.59	0.009
Religion	Christianity	161	95.1	Ref		
	Islam	8	4.6	1.03	0.41-2.62	0.943
	Traditionist	0	0	N/A		
Occupation	Unemployed	32	18.9	Ref		
	Self-employed	34	20.1	0.75	0.44-1.29	0.299
	Farmer	98	58.0	0.68	0.36-1.29	0.232
	Civil servant	5	3.0	0.68	0.20-2.31	0.540
Parity	1 to 3	100	59.2	Ref		
	4 and above	69	40.8	1.22	0.82-1.83	0.332
ANC visit	1 to 3	44	34.9	Ref		
	4 and above	82	65.1	1.89	1.18-3.02	0.008

4.11 Association between characteristics of a child and full vaccine uptake

On characteristics of children, this study found that there was an association between age of children and full uptake of malaria vaccine. Children who were aged between 32 to 36 months had odds of 1.72 to uptake malaria vaccine fully than children who were between 24 to 27 months of

age. This finding was statistically significant (p-value 0.018 95%CI 1.11-2.69). The was no association between full uptake of malaria vaccine and delivery place of a child. Table 4.11 below show the detail of the association between children characteristics and full uptake of malaria vaccine.

Table 4.11: Showing details of children characteristics and full malaria vaccine uptake in Nsanje District

Characteristics of children		n	%	OR	95%CI	P value
Age group	24-27	61	36.1	Ref		
	28-31	37	21.9	1.45	0.86-2.47	0.166
	32-36	71	40.0	1.72	1.11-2.69	0.018
Sex	Female	89	52.7	Ref		
	Male	80	47.3	0.75	0.51-1.12	0.162
Delivery place	Home	1	99.4	Ref		
	Health facility	167	0.6	2.11	0.22-20.41	0.521

This study found that children who had their health passports present had increased odds of 2.4 to have receive all the doses of malaria vaccine compared to the children who had no health passport. This result was statistically significant with p-value of 0.003 (CI: 1.36-4.30).

4.12 Association between timeliness of malaria vaccine and full uptake of malaria vaccine

There was association between receiving doses 1, 2 and 3 on time and full uptake of malaria vaccine. The parents/caregivers who had their children receive dose 1 on time had odds of 2.18 to receive full uptake of malaria vaccine. This result was statistically significant with p-value of 0.002 (95% CI 1.33-3.58). Likewise, timely uptake of dose 2 had increased odds of 2.5 to having full uptake of malaria vaccine than those who did not receive dose 2 on time. This result was statistically significant (p-value <0.001 95%CI 1.54-4.04). This study also found out that receiving dose 3 on time had increased odds of 3.5 of having full uptake of malaria vaccine than those who did not receive dose 3 on time. This result was statistically significant (p-value <0.001 95%CI2.08-5.88). Table 4.12 below shows that details of the association between timeliness receiving of different doses and full uptake of malaria vaccine.

Table 4.12: Showing the association between timeliness and full malaria vaccine uptake in Nsanje District

Timeliness of malaria vaccine uptake		n	%	OR	95%CI	P value
Dose 1	Uptake delayed	33	21.9	Ref		
	Uptake on time	118	78.1	2.18	1.33-3.58	0.002
Dose 2	Uptake delayed	38	25.2	Ref		
	Uptake on time	113	74.8	2.5	1.54-4.04	<0.001
Dose 3	Uptake delayed	57	37.8	Ref		
	Uptake on time	94	62.2	3.5	2.08-5.88	<0.001

4.13 Association between knowledge, awareness of vaccines in general and malaria vaccine uptake

There was an increased odds of 1.09 in full malaria vaccine uptake to parents/caregiver who said that vaccine protect their children against diseases than those who said vaccine makes them breastfed well, however this association was not statistically significant. The study also found that there was an association between participants who included malaria as a disease that can be prevented by childhood vaccines and full uptake of malaria vaccine. This result was statistically significant (p-value 0.025 95%CI 0.13-0.87). Table 4.13 below shows the details of the association between knowledge of vaccines and full uptake of malaria vaccine.

Table 4.13: Showing details of association between knowledge of vaccines and full uptake of malaria vaccine in Nsanje District

Main reason for childhood vaccination	n	%	OR	95%CI	P value
Make them breastfed well	3	1.8	Ref		
Protect them against diseases	163	98.2	1.09	0.53-2.25	0.808
Number of vaccine preventable diseases mentioned					
No correct disease mentioned	17	10.1	Ref		
Up to 3 correct diseases mentioned	60	35.5	0.3	0.13-0.69	0.005
4 up to 8 correct diseases mentioned	70	41.4	0.56	0.24-1.3	0.175
Any correct diseases but including malaria	22	13.0	0.34	0.13-0.87	0.025

4.14 Association between knowledge, awareness and malaria vaccine uptake

Parents/caregivers who had previously heard about malaria vaccine had increased odds of full malaria vaccine uptake (OR: 4.47, 95%CI: 1.29-15.41) compared to parents/caregiver who had never heard of malaria vaccine. This increased odd was statistically significant with p-value of 0.018. The study found that those study participants who heard from under 5 clinic were 3.15 times more likely to have their children have full uptake of malaria vaccine than those who heard from the radio. This result was statistically significant with p-value of 0.018 (CI 1.22-8.11). However, the study found that there was no association between knowing number of malaria vaccine doses a child has to received but asl knowing the specific ages in months. Table 4.14 below shows the association between knowledge and full malaria vaccine uptake.

Table 4.14: Showing details of the association between knowledge and malaria vaccine uptake in Nsanje District

Knowledge and awareness about malaria	n	%	OR	95%CI	P value
Ever heard of malaria vaccine					
No	3	1.8	Ref		
Yes	166	98.2	4.47	1.29-15.41	0.018
First heard from where					
Radio	6	3.6	Ref		
Friends/Relatives	9	5.4	2.73	0.77-9.69	0.121
Community announcements	5	3.0	1.85	0.45-7.69	0.396
Health facility announcement	29	17.5	1.64	0.59-4.52	0.340
Under 5 clinic	117	70.5	3.15	1.22-8.11	0.018
Number of times a child is supposed to receive malaria vaccine					
Incorrect number	90	58.2	Ref		
Correct number	64	41.6	0.73	0.48-1.13	0.156
Age of taking malaria vaccine					
Incorrect	126	81.8	Ref		
Correct	28	18.2	0.92	0.54-1.60	0.779

4.15 Association between previous experience with childhood vaccines and malaria vaccine uptake

Having parents/caregivers who reported that they have never suffered side effects following immunization was associated with full vaccine uptake (p-value <0.001 95%CI 0.24-0.54). Whether the side effect was abscess or fever it was not statistically associated with full malaria vaccine uptake. This study also found out that there was no association between side effects and decision on vaccine uptake.

There was an association between mode of transport and full malaria vaccine uptake. The parents/caregivers who used commercial motorbikes/bikes had odds of 2.66 to have their children receive all doses of malaria vaccine than those who were walking. This result was statistically significant.

The study also found that parents/caregivers who have never failed to vaccine their children after reaching the vaccination point had 2.66 odds to have their children receive all the doses of malaria vaccine compared to those who ever failed vaccine their children after attending vaccination site.

This result was statistically significant with p-value <0.001. The method which they parents/caregiver use to know when the next vaccination date is, the attitude of health workers at vaccination site was not associated with full malaria vaccine uptake. However, the study found out that those parents/caregivers said vaccines will cause infertility in their children were associated with low uptake of malaria vaccine (p-value 0.033, 95% CI 0.14-0.09), this result was statistically significant. Table 4.15 below show the details of the association between previous experience with vaccines and uptake of malaria vaccine.

Table 4.15: Showing the details of the association between uptake of malaria vaccine and previous experience with vaccines in Nsanje District

Any side effects following immunization	n	%	OR	95%CI	P value
No	98	58.0	Ref		
Yes	71	42.0	0.36	0.24-0.54	<0.001
The side effects experienced					
Diarhoea/vomiting	3	4.2	Ref		
Abscess	11	15.5	2.66	0.74-9.59	0.134
Fever	57	80.3	1.41	0.34-5.77	0.632
Did the side effects influence decision on vaccine uptake					
No	66	93.0	Ref		
Yes	5	7.0	1.96	0.58-6.64	0.281
Distance to the vaccination point					
Less than 30 minutes	107	63.3	Ref		
30 minutes - 59 minutes	51	30.2	0.3	0.19-0.46	<0.001
1 hour - 2 hours	11	6.5	0.17	0.08-0.35	<0.001
Mode of transport to vaccination point					
Walking	359	87.5	Ref		
Personal vehicle(car/bike/motorbike)	2	0.5	1.62	0.10-26.12	0.734
Commercial (motorbike/bike)	49	12	2.79	1.50-5.18	0.001
Attended vaccination site and failed to vaccine a child					
No	114	67.5	Ref		
Yes	55	32.5	2.66	1.65-4.28	<0.001
How do you know due date for vaccination					
Ask friends/relatives	9	5.3	Ref		
Check child's health passport	54	32.0	0.32	0.03-3.12	0.321
I go there every month	6	3.5	0.62	0.18-2.20	0.462
The Health Surveillance Assistants tell us	99	58.6	0.94	0.39-2.36	0.920
The volunteer from my village tells us	1	0.6	1.29	0.54-3.12	0.565
The attitude of health workers at vaccination centres					
Very bad	0	0.0	N/A		
Bad	0	0.0	N/A		
Good	46	27.2	0.87	0.51-1.51	0.627
Very good	79	46.8	0.89	0.55-1.45	0.639
Excellent	44	26.0	Ref		
Long term side effects of childhood vaccines					
No	156	92.3	Ref		
Yes	13	7.7	0.54	0.28-1.07	0.078
Long term side effects of childhood vaccines mentioned					
No	156	92.3	Ref		
Infertility	6	3.6	0.37	0.14-0.92	0.033
Stroke	7	4.1	0.94	0.35-2.52	0.899

4.16 Association of issues about malaria vaccine and full malaria vaccine uptake

Those parents/caregivers who ever heard about negative issues about malaria vaccine had reduced odds by 25% to have their children take fully malaria vaccine. This result was statistically significant (p-value <0.001 95%CI 0.14-0.44). The study showed that it did not matter where the issues was heard from, there was no association between the source of the bad news and malaria vaccine uptake. There were increased odds of 3.37 to full uptake to those parents/caregivers who said they see no problem to the introduction of malaria vaccine. Table 4.16 below is showing the details of the association between malaria vaccine uptake and issues surrounding malaria vaccine.

Table 4.16: Showing the association between malaria vaccine uptake and negative issues about malaria vaccine in Nsanje District

Ever heard bad issues about malaria vaccine	**n**	**%**	**OR**	**95%CI**	**P value**
No	146	88.5	Ref		
Yes	19	11.5	0.25	0.14-0.44	<0.001
Negative issues were from					
Friends/relatives	18	94.7	Ref		
Health worker	0	0	N/A		
Radio	0	0	N/A		
Religious leaders	1	5.3	0.29	0.03-2.29	0.248
The negative issues					
Children are being used for experiments (trials)	15	79.0	Ref		
Malaria vaccine is not safe	2	10.5	0.26	0.55-1.24	0.092
The malaria vaccine affects child development	2	10.5	0.52	0.10-2.63	0.430
Thoughts on introduction of malaria vaccine					
Don't know	5	3.0	Ref		
There is no problem with that	150	88.7	3.47	1.29-9.39	0.014
vaccines are becoming too many for our children	14	8.3	2.12	0.66-6.79	0.204

4.17 Association of community level support and full malaria vaccine uptake

There was an association between parents/caregivers receiving support from either traditional leaders, religious leaders, community health volunteers and at household level and full malaria

vaccine uptake. All the associations were statistically significant. Table 4.17 shows the details of the association between malaria vaccine uptake and community level support.

Table 4.17: Showing the detail of the associations between malaria vaccine uptake and community level support in Nsanje District

Community level support on malaria vaccine	n	%	OR	95%CI	P value
Traditional leaders support					
No	2	1.2	Ref		
Yes	165	98.8	6.97	1.6-30.47	0.01
Religious leaders support					
No	2	1.2	Ref		
Yes	164	98.8	8.16	1.89-35.31	0.005
Community health volunteers support					
No	1	0.6	Ref		
Yes	167	99.4	12.15	1.59-92.50	0.016
Household members support					
No	2	1.2	Ref		
Yes	167	98.8	7.09	1.62-30.99	0.009

4.18 Association between level of uptake and independent variables

In the multivariate logistic regression analysis number of Antenatal Visit and timeliness of dose one showed that adjusted odds ratio for uptake was not statistically significant. On the other hand, factors like education level, occupation, distance to the vaccination point, whether the mother/caregiver child had ever suffered any adverse effects following immunization had association with malaria vaccine uptake that was statistically significant in the multivariate analysis. Details of the multivariate analysis are shown in the Table 4.18 below.

Table 4.18: Multivariate analysis of association between level of uptake and independent variables in Nsanje District

Characteristics	OR	95%CI	P value	aOR	95%CI	P value
Education Level	**1.8**	**1.35-2.32**	**<0.000**	**1.89**	**1.21-2.92**	**0.004**
No education	Ref					
Primary	0.64	0.37-1.13	0.125	0.57	0.22-1.46	0.24
Secondary and above	2.43	1.43-4.12	0.001	2.65	1.08-6.51	0.033
Occupation	**0.85**	**0.64-1.12**	**0.267**	**0.55**	**0.33-0.90**	**0.017**
Unemployed	Ref					
Self-employed	0.75	0.44-1.29	0.299	0.51	0.17-1.51	0.226
Farmer	0.68	0.36-1.29	0.232	0.26	0.08-0.87	0.029
Civil servant	0.68	0.20-2.31	0.54	0.19	0.02-1.51	0.115
Antenatal Clinic visit	**1.89**	**1.18-3.02**	**0.008**	**1.2**	**0.62-2.33**	**0.588**
1 to 3	Ref					
4 and above	1.89	1.18-3.02	0.008	1.1	0.54-2.23	0.795
Distance to the vaccination point	**0.36**	**0.26-0.50**	**<0.001**	**0.31**	**0.19-0.53**	**<0.001**
Less than 30 minutes	Ref					
30 minutes - 59 minutes	0.3	0.19-0.46	<0.001	0.28	0.14-0.58	0.001
1 hour - 2 hours	0.17	0.08-0.35	<0.001	0.16	0.03-0.39	<0.001
Timeliness of dose 1	**2.18**	**1.33-3.58**	**0.002**	**1.97**	**0.95-4.07**	**0.069**
Uptake delayed	Ref					
Uptake on time	2.18	1.33-3.58	0.002	2.08	0.99-4.37	0.053
Any adverse effects following immunization	**0.36**	**0.24-0.54**	**<0.001**	**0.12**	**0.06-0.25**	**<0.001**
No	Ref					
Yes	0.36	0.24-0.54	<0.001	0.12	0.06-0.25	<0.001
Attended vaccination site and failed to vaccine a child	**2.67**	**1.65-4.28**	**<0.001**	**3.47**	**1.52-7.89**	**0.003**
No	Ref					
Yes	2.67	1.65-4.28	<0.001	3.43	1.51-7.82	0.03

CHAPTER FIVE: DISCUSSIONS

This chapter covers the discussions of the results that were found by this study. The discussions presented are based on the specific objectives of this study. The discussions made in this chapter are purely based on the findings of this study.

5.1 Malaria vaccine uptake

This study found that only the uptake of RTS,S 1 met target of coverage of 90% for childhood vaccines set by WHO (WHO Immunization Agenda 2030) Coverage for the other 3 subsequent doses did meet the WHO target. This result means that the malaria vaccine cannot meet its intended purpose of averting childhood malaria morbidity and mortality unless if its uptake for full vaccination can be improved. Similarly, a study that was looking at factors associated with malaria vaccine uptake conducted in Ghana in 2021 by Tabiri *et al.,* 2021 found that the uptake of dose one was highest while the uptake of the subsequent doses reduced. (Tabiri *et al.,* 2021). The study that was conducted in Ghana looked at the uptake of three doses of malaria vaccine (RTS,S 1, RTS,S 2 and RTS,S 3) in a Municipality while my study was conducted in a district and it was looking at the uptake of four doses of malaria vaccine. Tabiri *et al.,* 2021 found that RTS,S 1 coverage was 94.1% but RTS,S 2 reduced to 90.6% and RTS,S 3 reduced further to 78.1%. Similar findings were also observed in a study conducted in Nigeria (Adedire *et al.,* 2016) with a reported coverage that declined from OPV 0 to OPV 3. Studies done in Senegal (Mbengue *et al.,* 2017) and Congo (Acharya *et al.,* 2018) found similar trends in uptake whereby polio 1 was at 91% and reduced to 65.1% for polio three.

5.1.1 High coverage of RTS,S 1

The high coverage of RTS,S 1 (90.5%) could have been achieved because the vaccine was just being introduced in the routine vaccination system in Nsanje District for the first time. This possibly and that they created a lot of demand to make the communities aware of the malaria vaccine and start accessing it. This was evidenced by the 94.9 %, ever heard about malaria vaccine in this study. Furthermore, high coverage could also have been achieved due to ongoing community campaigns that during the introduction of the vaccine.

5.1.2 Reduction in coverage of subsequent doses

Similar to other studies conducted in different settings on childhood vaccine uptake the subsequent doses of malaria vaccine reduced in this study (Adedire *et al.,* 2016) . This may be due poor knowledge and awareness of mothers/caregivers on malaria vaccine. Poor knowledge on vaccine schedule, number of doses a child must receive to be fully vaccinated but also ages at which those doses are received could possibly result into mothers/caregivers missing the subsequent doses. This was evidence where 70.4% of the respondents said that they did not take all the doses because they did not know the next due date. Only 38.5% knew that the child needed four doses to be fully vaccinated and only 15.9% knew the correct ages for all the four doses. Further, this study established that dropout rate was high (23.2%). The recommendation by WHO is that the dropout rates should be less 10% in order to achieve high immunization coverage and reduced mortality and morbidity in children under the age of five (Chinawa, 2014).

The vaccine has four doses and for the child to be fully protected, they have to receive all the doses. The dropout rate observed in this study reflected low uptake of malaria vaccine. This in turn may not achieve the intended purpose of the vaccine which is to avert the morbidity and mortality of malaria in children. Therefore, it is very important that children must receive all the doses to boost their immunity against malaria.

5.1.3 No uptake

The proportion children that did not take any malaria dose in this study was 9.5%. The main reason was their mother/caregiver not knowing that their children were eligible. The study also found that 23.0% refused to take any dose because of religious beliefs. In Nsanje District there are certain religions that prohibits its member to go to the hospital or access any other health services. Since mothers/caregivers from these religions are likely not be found at under 5 clinic to learn the importance of malaria vaccines, even if they are willing to be vaccinated their church leader will prevent them from accessing the health services. This was also evidenced in a study conducted by Adeyanju *et al.,* 2022 in Malawi (Adeyanju *et al.,* 2022). Adeyanju reported that some religious groupings, for example Zion and Apostolic faith were prohibiting their members from visiting the hospital and accessing vaccines.

5.2 Timeliness of malaria vaccine uptake

Most of the children did not take the vaccines on time. The highest delay timeliness on uptake was noted on RTS,S dose 4 (51.7%). Not taking vaccine on scheduled time affects who the vaccine functions in the body of the children. According to CDC, children taking vaccines on schedule time provide them with maximum protection (Centers for Disease Control and Prevention, 2023). In a study conducted (Tabiri *et al.,* 2021) in Ghana reported the timeliness of malaria vaccine to be 67.7% for RTS,S 1, 51.8% for RTS,S 2 and 54.4% for RTS,S 3 similar to this study. In a study done (Mvula *et al.*, 2016) in northern Malawi, found that they was delay in the timeliness of the uptake of newly introduced Pneumococcal and Rotavirus vaccines.

Mothers/caregivers could have delayed in making their children receive malaria vaccine due to poor knowledge about the vaccine schedule and number of doses to be received for a child to be fully vaccinated. Being a new vaccine, some mothers/caregivers could hesitate in making their children receive it as some reported that their children may have been used as experiment for the vaccine.

Over 50% of the mothers/caregivers received both RTS,S doses one, two and three on time. This maybe because children were still less than nine months and that their mothers/caregivers were to under five clinics for other vaccine and for growth monitoring services. More mothers/caregivers delayed to receive dose four probably because it is at 22 months and some of the had stopped going for under five clinics for growth monitoring and even some mothers/caregivers are pregnant expecting another child.

5.3 Factors associated with malaria vaccine uptake

This study identified a number of factors that are associated with full uptake of malaria vaccine.

5.3.1 Knowledge about vaccine

This study found that knowledge on vaccines in general was associated with full uptake of malaria vaccine. This result is similar with other studies that conducted on factors that influence the uptake of childhood vaccines (Bangura *et al.,* 2020) a systematic review in Sub-Saharan Africa, (Galadima et al., 2021), a systematic review done in Sub-Saharan Africa, a systematic review done in Nigeria and (Biset *et al.,* 2021) a systematic review done in Ethiopia. In this study mothers/caregivers who were able to mentioned at least three diseases that are prevented by

childhood vaccines were more had increased of making the children receive all the four doses of malaria vaccine.

5.3.2 Knowledge about malaria vaccine

Most mothers/caregivers admitted that they ever hear about malaria vaccine prior to this study 94.9%. However, a handful (14.6%) mentioned malaria as a childhood vaccine preventable disease this showed that there was poor knowledge of malaria vaccine as a disease that can be prevented by childhood vaccine. There was also lack of knowledge on the number doses a child has to receive to be fully vaccinated but also specific ages in months at which a child is supposed to receive malaria vaccine). This may have contributed to low vaccine uptake even those these results were not statistically significant.

5.3.3 Previous experience with vaccines

This study found that mothers/caregiver whose children had ever suffered from adverse reactions following immunization had decreased odds of completing all the four doses of malaria vaccine than those who reported that their children never suffered from adverse effects following immunization. Most of these mothers/caregivers could have been afraid of taking their children for vaccination in fear of the side effects. These findings are similar to studies conducted by (Kagoné *et al.,* 2017) in Burkina Faso, (Negussie *et al.,* 2016) in Ethiopia and (Obasohan *et al.,* 2018) in Nigeria. Since malaria vaccine was being newly introduced in Nsanje District mothers/caregivers could think that the vaccine may have worst adverse effects after immunization hence hesitating in the uptake. Further, the study revealed that some mothers/caregiver had the perception that vaccines have long term bad side effects that included infertility and stroke and those who said infertility were more likely not to get all the doses of malaria and this result was statistically significant. This could be so because in the rural set up where Nsanje District is more mothers/caregivers are concerned with the continuation of their clan and lineage thus if anything affects reproduction of children then cannot be part of it. Even though most mothers/caregivers said that they have ever experienced side effects after immunization but they said they still vaccinate their children because health workers encourage them to do so one respondent said.

Some of the concerns that mothers/caregivers mentioned were the misconception that malaria vaccine will make their children infertile but also complained that the doses were many and suggested if all doses should be combined into one dose.

5.3.4 Accessibility to the vaccination site

Uptake of the malaria vaccine in this study was affected negatively by distance covered to the vaccination point. Mothers/caregivers were living near the vaccination point had increased odds in getting their children receiving all the doses than those mothers who were living far. Similar results were observed in studies conducted by (Mvula *et al.,* 2016) in Northern Malawi, (Bangura *et al.,* 2020), Sub-Saharan African systematic review, (Biset *et al.,* 2021) a systematic review done in Ethiopia and (Obasohan *et al.,* 2018) in Nigeria. Similarly, mode of transport was found to be a significant factor associated with full uptake of malaria vaccine the same finding were reported in a study done by (Ekouevi *et al.,* 2018) and (Scott *et al.,* 2014). This study observed that those mothers/caregivers who used commercial motorbikes or bikes were finding it easy to reach the vaccination points hence most of the had their children received full malaria vaccine uptake.

5.3.5 Socio-demographic characteristics

(Mvula *et al.,* 2016) found that high education level of the mother/caregiver was associated with complete uptake of newly introduced childhood vaccines. This study showed that mothers/caregivers who had secondary and above education were associated with complete uptake of malaria vaccine. This finding was consistent with the findings from a study conducted (Ekouevi et al., 2018) in Togo. Similarly, a study by (Kagoné *et al.,* 2017) reported that level of education was a determinant in the uptake of childhood vaccines. A systematic review conducted in Sub-Saharan (Tekle *et al.,* 2022; Touray *et al.,* 2021) found that level of education of a mother/caregiver was associated with full uptake of childhood vaccine. High uptake of malaria vaccine by those mothers/caregiver that are more educated could be due to the knowledge they gained in school they can easily understand the importance of malaria vaccine to the children but also they can have more access of information regarding malaria vaccines and other vaccines in general.

Age of a mother/caregiver was found to be associated with full malaria vaccine uptake in this study. This result is consistent with the result of (Tesema *et al*., 2020) where age of a mother/caregiver was a significant factor. However other studies found that age the

mother/caregiver was not a significant factor, for example studies conducted by (Touray et al., 2021) and a systematic review on Sub-Saharan Africa conducted by (Galadima *et al.,* 2021)

Occupation was found to be a significant factor associated with malaria vaccine uptake. This finding is in agreement with a study that was conducted in Malawi by (Mvula *et al.,* 2016) but also a study that was conducted in Ghana (Anokye *et al.,* 2018) reported that employment status was associated with childhood vaccine uptake.

Marital status was reported to be a factor that was associated with uptake of childhood vaccine in a study conducted by (Anokye *et al.,* 2018). Similarly, another study that was conducted Nigeria by (Chris-Otubor, 2015) showed that marital status was associated with uptake of childhood vaccines. In this study just like those other two studies it was found that marital status was associated with full uptake of malaria vaccine. However, other studies found that marital status was not significantly associated with full uptake of childhood vaccines, for example in a study that was conducted in Gambia by (Touray *et al.,* 2021).

This study found that number of antenatal visits was a factor affected full uptake of malaria vaccine. The children whose mothers/caregivers went for greater 4 ANC visit had increased odds of getting fully vaccinated. This could be due to their health seeking behavior but also it could be because they could have probably heard about the introduction of malaria vaccine an ANC and being told the importance of making the children get the vaccines. Similar results were reported in a study conducted by (Ntenda, 2019) in Malawi. Other studies that found that ANC visit was associated with full uptake of childhood vaccines are a systematic review conducted in Ethiopia by (Biset *et al.,* 2021), (Adedokun *et al.,* 2017) done in Nigeria and (Abebe *et al.,* 2019)

5.3.6 Community level support

This study found that community level support was associated with full uptake of malaria vaccine. These community level supports included support from traditional leaders, religious leader, home members support and community health volunteers. People in the communities could listen more to their community leaders that a government official this could have been a reason that those mothers/caregiver that received support from their local community leaders had increased odds of getting their children receive all doses of malaria vaccine. In a study conducted in Nigeria by

(Akwataghibe *et al.*, 2019) found that community support was associated with full uptake of malaria vaccine.

5.4 Strength of this study

Malaria vaccine is a new vaccine in Malawi. The findings from this study will help Nsanje District Health Directorate to increase the malaria vaccine uptake and other vaccines in the district. This is so because the study will identify the factors that influence the uptake of malaria vaccine. The MVIP will also benefit from the findings of this study to boost the uptake of malaria vaccine in other districts. Additionally, this study will accord policy makers for example, MOH the opportunity to address the bottlenecks that affect the uptake of malaria vaccine prior nationwide scale-up of the implementation of malaria vaccine. Furthermore, this study will establish a benchmark on which other similar studies can base on.

5.5 Limitation of the study

Some of the mothers/caregiver had no health passports for their children and consequently the researcher only relied on the word of mouth to re-call some information. This study did not collect qualitative data using Focus Group Discussions (FGDs), this would have thrown more light on the health system factors affecting the uptake of malaria vaccine it could have also given more understanding on perceptions, experiences and challenges faced by mothers/caregivers getting their children to receive malaria vaccine.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The uptake of malaria vaccine was different for different doses. Only dose one coverage met the target set by WHO of the coverage of 90% while doses two, three and four were below the set target. There was poor coverage of children who were fully vaccinated against malaria. The dropout rate for malaria vaccine was very high compared to the recommended by WHO of less than 10%.

In Nsanje District 69.7% of the children received the first dose of malaria on scheduled 6 months, 64.6% received the second dose on scheduled 7 months, 56.7% received the third dose of malaria vaccine on scheduled eight months and 48.3% received dose four at the scheduled 22 months.

Mothers/caregivers with secondary or upper education increased the odds of full uptake of malaria vaccine. Mothers/caregivers whose children ever suffered adverse effects following immunization had reduced odds of full uptake of malaria vaccine. Shorter distances travelled to get to the vaccination showed increased odds in the full uptake of malaria vaccines. Mothers/caregivers who went for times or above ANC visits had increased odds in of making their children take full malaria vaccine uptake. Mothers/caregiver that had support from community level had increased odds of making their children receive all the malaria doses.

6.2 Recommendations

Based on the findings from this study the following recommendations are made at different levels

Nsanje Directorate of Health and Social Services

1. Increase community awareness of the malaria vaccine and vaccines in general. The emphasis should be on;
    I. how many doses a child is to receive to be fully vaccinated, age at which a child is supposed to receive those doses
    II. clear myths and negative issues surrounding malaria vaccine and all other vaccines in general through community engagement
    III. clear myths that childhood vaccines cause infertility and stroke when children grow
2. Sensitize the communities where malaria vaccine has not yet been rolled out so that high uptake can be achieve

3. Educate the communities on the importance of attending above four times Ante-natal visits during pregnancy
4. Encourage health workers who provide vaccines to sustain the good attitudes towards the mothers/caregivers who come for vaccination services
5. Conduct well-designed qualitative research on factors associated with malaria vaccine uptake in Nsanje District.
6. Engage the various religious groups that prevent their members to access vaccines

Malawi Ministry of Health

1. Do community engagement to educate those district that malaria vaccine has not be rolled out with emphasis on;
   I. how many doses a child is to receive to be fully vaccinated, age at which a child is supposed to receive those doses
   II. defusing anti-vaccine myths and rumors

World Health Organization

1. Support different studies on malaria vaccines in the countries where it is being rolled out so that more should be known about the vaccine
2. Formulate and implement strategies aimed at reducing vaccine hesitance so that high levels of vaccine uptake are achieved and sustained.

REFERENCES

Abebe, A. M., Mengistu, T., & Mekuria, A. D. (2019). Measles case , immunization coverage and its determinant factors among 12 – 23 month children , in Bassona Worena Woreda , Amhara. *BMC Research Notes*, 1–6. https://doi.org/10.1186/s13104-019-4104-8

Acharya, P., Kismul, H., Mapatano, M. A., & Hatl, A. (2018). *Individual- and community-level determinants of child immunization in the Democratic Republic of Congo : A multilevel analysis*. 1–17.

Adedire, E. B., Ajayi, I., Fawole, O. I., Ajumobi, O., Kasasa, S., Wasswa, P., & Nguku, P. (2016). Immunisation coverage and its determinants among children aged 12-23 months in Atakumosa-west district, Osun State Nigeria: A cross-sectional study. *BMC Public Health*, *16*(1), 1–8. https://doi.org/10.1186/s12889-016-3531-x

Adedokun, S. T., Uthman, O. A., Adekanmbi, V. T., & Wiysonge, C. S. (2017). *Incomplete childhood immunization in Nigeria : a multilevel analysis of individual and contextual factors*. 1–10. https://doi.org/10.1186/s12889-017-4137-7

Adeloye, D., Jacobs, W., Amuta, A. O., Ogundipe, O., Mosaku, O., Gadanya, M. A., & Oni, G. (2017). Coverage and determinants of childhood immunization in Nigeria: A systematic review and meta-analysis. *Vaccine*, *35*(22), 2871–2881. https://doi.org/10.1016/j.vaccine.2017.04.034

Adeyanju, G. C., Betsch, C., Adamu, A. A., Gumbi, K. S., Head, M. G., Aplogan, A., Tall, H., & Essoh, T. A. (2022). Examining enablers of vaccine hesitancy toward routine childhood and adolescent vaccination in Malawi. *Global Health Research and Policy*. https://doi.org/10.1186/s41256-022-00261-3

Akwataghibe, N. N., Ogunsola, E. A., Broerse, J. E. W., & Miller, E. R. (2019). *Exploring Factors Influencing Immunization Utilization in Nigeria — A Mixed Methods Study*. *7*(December). https://doi.org/10.3389/fpubh.2019.00392

Andersen, R. (1973). Societal and Individual Determinants of Medical Care Utilization in the United States. *29th Congress of the International Council of the Aeronautical Sciences, ICAS 2014*, *83*(4), 1–28.

Anokye, R., Acheampong, E., Ainooson, A. B., Edusei, A. K., Okyere, P., Dogbe, J., & Nadutey, A. (2018). Socio - demographic determinants of childhood immunization incompletion in Koforidua , Ghana. *BMC Research Notes*, 1–7. https://doi.org/10.1186/s13104-018-3767-x

Bangura, J. B., Xiao, S., Qiu, D., Ouyang, F., & Chen, L. (2020). Barriers to childhood immunization in sub-Saharan Africa: A systematic review. *BMC Public Health*, *20*(1). https://doi.org/10.1186/s12889-020-09169-4

Bennett, A., Kazembe, L., Mathanga, D. P., Kinyoki, D., Ali, D., Snow, R. W., & Noor, A. M. (2013). Mapping malaria transmission intensity in Malawi, 2000-2010. *American Journal of Tropical Medicine and Hygiene*, *89*(5), 840–849. https://doi.org/10.4269/ajtmh.13-0028

Biset, G., Woday, A., Mihret, S., & Tsihay, M. (2021). Full immunization coverage and associated factors among children age 12-23 months in Ethiopia: systematic review and meta-analysis of observational studies. *Human Vaccines and Immunotherapeutics*, *17*(7), 2326–2335. https://doi.org/10.1080/21645515.2020.1870392

Centers for Disease Control and Prevention, 2020. (2020). *CDC, 2020.pdf*.

Centers for Disease Control and Prevention, 2023. (2023). *CDC, 2023.pdf*.

Chinawa, J. (2014). *Immunization Dropout Rates in Ihe , Awgu Local Government Area , Enugu State , South East Nigeria : A 1 Year Review*. *4*(4), 3–7. https://doi.org/10.4103/2141-9248.139360

Chris-Otubor. (2015). *Assessment of Knowledge , Attitudes and Practices of Mothers in Jos North Assessment of Knowledge , Attitudes and Practices of Mothers in Jos North Regarding Immunization*. *November 2017*.

Chukwuocha, U. M., Okorie, P. C., Iwuoha, G. N., Ibe, S. N., Dozie, I. N., & Nwoke, B. E. (2018). Awareness, perceptions and intent to comply with the prospective malaria vaccine in parts of South Eastern Nigeria. *Malaria Journal*, *17*(1), 1–7. https://doi.org/10.1186/s12936-018-2335-0

Duclos, P., Okwo-Bele, J.-M., Gacic-Dobo, M., & Cherian, T. (2009). Global immunization: status, progress, challenges and future. *BMC International Health and Human Rights*, *9*(S1), 1–11. https://doi.org/10.1186/1472-698x-9-s1-s2

Ekouevi, D. K., Gbeasor-komlanvi, F. A., Yaya, I., Zida-compaore, W. I., Boko, A., Sewu, E., Lacle, A., Ndibu, N., Toke, Y., & Landoh, D. E. (2018). *Incomplete immunization among children aged 12 – 23 months in Togo : a multilevel analysis of individual and contextual factors*. 1–10.

Erin C. et al. (2017). Estimated reductions in hospitalizations and deaths from childhood diarrhea following implementation of rotavirus vaccination in Africa. *Physiology & Behavior*, *176*(3), 139–148. https://doi.org/10.1080/14760584.2017.1371595.Estimated

Galadima, A. N., Zulkefli, N. A. M., Said, S. M., & Ahmad, N. (2021). Factors influencing childhood immunisation uptake in Africa: a systematic review. *BMC Public Health*, *21*(1), 1–20. https://doi.org/10.1186/s12889-021-11466-5

Gondwe, T., Yang, Y., Yosefe, S., Kasanga, M., Mulula, G., Luwemba, M. P., Jere, A., Daka, V., & Mudenda, T. (2021). *Epidemiological Trends of Malaria in Five Years and under Children of Nsanje District in Malawi , 2015 – 2019*.

Greenwood, B. M. (2015). Efficacy and safety of RTS,S/AS01 malaria vaccine with or without a booster dose in infants and children in Africa: Final results of a phase 3, individually randomised, controlled trial. *The Lancet*, *386*(9988), 31–45. https://doi.org/10.1016/S0140-6736(15)60721-8

Haradhan, M. (2017). *Munich Personal RePEc Archive Two Criteria for Good Measurements in Research : Validity and Reliability Two Criteria for Good Measurements in Research : Validity and Reliability*. *83458*.

Huang, J., Cheung, C. K. M., Keung, V. M. W., Lo, A. S. C., Chan, S. C., Pang, W. S., Li, Q. H. Y., Mui, L. W. H., Lee, A., & Wong, M. C. S. (2023). *Factors Associated with Vaccination Uptake among Young Children : A Follow-Up Study of 1799 Toddlers*. 1–13.

IA2030. (2021). *Immunization Agenda 2030*. 1–24. https://www.who.int/immunization/ia2030_Draft_One_English.pdf?ua=1

Ikilezi, G., Augusto, O. J., Sbarra, A., Sherr, K., Dieleman, J. L., & Lim, S. S. (2020). Determinants of geographical inequalities for DTP3 vaccine coverage in sub-Saharan Africa. *Vaccine*, *38*(18), 3447–3454. https://doi.org/10.1016/j.vaccine.2020.03.005

Immunization. (2021). *Immunization coverage*. Immunization Coverage. https://www.who.int/news-room/fact-sheets/detail/immunization-coverage

Kagoné, M., Yé, M., Nébié, E., Sie, A., Schoeps, A., Becher, H., Muller, O., & Fisker, A. B. (2017). Vaccination coverage and factors associated with adherence to the vaccination schedule in young children of a rural area in Burkina Faso. *Global Health Action*, *10*(1). https://doi.org/10.1080/16549716.2017.1399749

Li, Y. N., Nong, D. X., Wei, B., Feng, Q. M., & Luo, H. Y. (2016). The impact of predisposing, enabling, and need factors in utilization of health services among rural residents in Guangxi, China. *BMC Health Services Research*, *16*(1), 1–9. https://doi.org/10.1186/s12913-016-1825-4

Mathanga, D. P., Tembo, A. K., Mzilahowa, T., Bauleni, A., Mtimaukenena, K., Taylor, T. E., Valim, C., Walker, E. D., & Wilson, M. L. (2016). Patterns and determinants of malaria risk in urban and peri-urban areas of Blantyre, Malawi. *Malaria Journal*, *15*(1), 1–9. https://doi.org/10.1186/s12936-016-1623-9

Mathanga, D. P., Walker, E. D., Wilson, M. L., Ali, D., Taylor, T. E., & Laufer, M. K. (2012). Malaria control in Malawi: Current status and directions for the future. *Acta Tropica*, *121*(3), 212–217. https://doi.org/10.1016/j.actatropica.2011.06.017

Mbengue, M. A. S., Bei, A. K., Mboup, A., Ahouidi, A., Sarr, M., Mboup, S., & Gaye, O. (2017). Factors influencing the use of malaria prevention strategies by women in Senegal: A cross-sectional study. *Malaria Journal*, *16*(1), 1–9. https://doi.org/10.1186/s12936-017-2095-2

Meleko, A., Geremew, M., & Birhanu, F. (2017). Assessment of Child Immunization Coverage and Associated Factors with Full Vaccination among Children Aged 12–23 Months at Mizan Aman Town, Bench Maji Zone, Southwest Ethiopia. *International Journal of Pediatrics*, *2017*, 1–11. https://doi.org/10.1155/2017/7976587

Mmanga, K., Mwenyenkulu, T. E., Nkoka, O., & Ntenda, P. A. M. (2022). Tracking immunization coverage, dropout and equity gaps among children ages 12–23 months in Malawi – bottleneck analysis of the Malawi Demographic and Health Survey. *International Health*, *14*(3), 250–259. https://doi.org/10.1093/inthealth/ihab038

MVIP-WHO. (2020). *Malaria: The malaria vaccine implementation programme (MVIP)*. https://www.who.int/news-room/questions-and-answers/item/malaria-vaccine-implementation-programme

Mvula, H., Heinsbroek, E., Chihana, M., Crampin, A. C., Kabuluzi, S., Chirwa, G., Mwansambo, C., Costello, A., Cunliffe, A., Heyderman, R. S., French, N., & Bar-zeev, N. (2016). *Predictors of Uptake and Timeliness of Newly Introduced Pneumococcal and Rotavirus Vaccines , and of Measles Vaccine in Rural Malawi : A Population Cohort Study*. 1–15. https://doi.org/10.1371/journal.pone.0154997

Negussie, A., Kassahun, W., Assegid, S., & Hagan, A. K. (2016). Factors associated with incomplete childhood immunization in Arbegona district , southern Ethiopia : a case – control study. *BMC Public Health*, 1–9. https://doi.org/10.1186/s12889-015-2678-1

NSO. (2018). *MALAWI POPULATION AND HOUSING CENSUS REPORT-2018 2018 Malawi Population and Housing Main Report*. *May*. http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_2018/2018 Malawi Population and Housing Census Main Report.pdf

Ntenda, P. A. M. (2019). Factors associated with non- and under-vaccination among children aged 12–23 months in Malawi. A multinomial analysis of the population-based sample. *Pediatrics and Neonatology*, *60*(6), 623–633. https://doi.org/10.1016/j.pedneo.2019.03.005

Obasohan, P. E., Mustapha, M. A., Makada, A., & Obasohan, D. N. (2018). Evaluating the reasons for partial and non-immunization of children in Wushishi local government area, Niger state, Nigeria: Methodological comparison. *African Journal of Reproductive Health*, *22*(4), 113–122. https://doi.org/10.29063/ajrh2018/v22i4.12

Okwo-Bele, J. M., & Cherian, T. (2011). The expanded programme on immunization: A lasting legacy of smallpox eradication. *Vaccine*, *29*(SUPPL. 4), D74–D79. https://doi.org/10.1016/j.vaccine.2012.01.080

Oleribe, O., Kumar, V., Awosika-Olumo, A., & Taylor-Robinson, S. D. (2017). Individual and socioeconomic factors associated with childhood immunization coverage in Nigeria. *Pan African Medical Journal*, *26*, 1–14. https://doi.org/10.11604/pamj.2017.26.220.11453

Otieno, L., Guerra Mendoza, Y., Adjei, S., Agbenyega, T., Agnandji, S. T., Aide, P., Akoo, P., Ansong, D., Asante, K. P., Berkley, J. A., Gesase, S., Hamel, M. J., Hoffman, I., Kaali, S., Kamthunzi, P., Kariuki, S., Kremsner, P., Lanaspa, M., Lell, B., … Oneko, M. (2020). Safety and immunogenicity of the RTS,S/AS01 malaria vaccine in infants and children identified as HIV-infected during a randomized trial in sub-Saharan Africa. *Vaccine*, *38*(4), 897–906. https://doi.org/10.1016/j.vaccine.2019.10.077

Ramli, N. (2018). *Knowledge , Attitude , and Practice Regarding Osteoporosis Among Allied Health Sciences Students in a Public University in Malaysia*. *40*(4), 210–217. https://doi.org/10.5152/etd.2018.18103

Reid, M., & Fleck, F. (2014). The immunization programme that saved millions of lives. *Bulletin of the World Health Organization*, *92*(5), 314–315. https://doi.org/10.2471/BLT.14.020514

Scott, S., Odutola, A., Mackenzie, G., Fulford, T., Afolabi, M. O., Jallow, Y. L., Jasseh, M., Jeffries, D., Dondeh, B. L., Howie, S. R. C., & D'Alessandro, U. (2014). Coverage and timing of children's vaccination: An evaluation of the expanded programme on immunisation in the Gambia. *PLoS ONE*, *9*(9), 1–9. https://doi.org/10.1371/journal.pone.0107280

Smith, L. E., Amlôt, R., Weinman, J., Yiend, J., & Rubin, G. J. (2017). A systematic review of factors affecting vaccine uptake in young children. *Vaccine*, *35*(45), 6059–6069. https://doi.org/10.1016/j.vaccine.2017.09.046

Tabiri, D., Claude, J., Pingdwindé, R., & Nortey, P. A. (2021). Factors associated with malaria vaccine uptake in Sunyani Municipality , Ghana. *Malaria Journal*, 1–18. https://doi.org/10.1186/s12936-021-03857-1

Tefera, Y. A., Wagner, A. L., Mekonen, E. B., Carlson, B. F., & Boulton, M. L. (2018). Predictors and barriers to full vaccination among children in Ethiopia. *Vaccines*, *6*(2), 1–11. https://doi.org/10.3390/vaccines6020022

Tekle, F., Asante, A., Woldie, M., Dawson, A., & Hayen, A. (2022). Child vaccination in sub-Saharan Africa : Increasing coverage addresses inequalities. *Vaccine*, *40*(1), 141–150. https://doi.org/10.1016/j.vaccine.2021.11.005

Tesema, G. A., Tessema, Z. T., Tamirat, K. S., & Teshale, A. B. (2020). *Complete basic childhood vaccination and associated factors among children aged 12 – 23 months in East Africa : a multilevel analysis of recent demographic and health surveys*. 1–14.

Thomson, A., Robinson, K., & Vallée-Tourangeau, G. (2016). The 5As: A practical taxonomy for the determinants of vaccine uptake. *Vaccine*, *34*(8), 1018–1024. https://doi.org/10.1016/j.vaccine.2015.11.065

Touray, E., Barrow, A., Kinteh, B., Badjie, M., Nget, M., Touray, J., Kinteh, S. L. S., Jatta, S. P. S., & Ceesay, L. (2021). *Childhood vaccination uptake and associated factors among children 12 – 23 months in rural settings of the Gambia : a community-based cross-sectional study*. 1–10.

United Nations Children's Fund. (2019). Levels and Trends of Child Mortality 2019. *United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME).*

WHO-GAVI. (2013). Global Vaccine Action Plan. *Vaccine*, *31*, B5–B31. https://doi.org/10.1016/j.vaccine.2013.02.015

WHO. (2019). *Immunization*. https://www.who.int/news-room/facts-in-pictures/detail/immunization

WHO. (2021). https://www.who.int/news-room/fact-sheets/detail/malaria

WHO. (2022). *Malaria*. https://www.who.int/news-room/fact-sheets/detail/malaria

WHO, 2017. (2017). *Conditions for deployment of mosquito nets treated with a pyrethroid and piperonyl butoxide*. *2017*(December).

WHO Global strategy for malaria. (2021). *Global Technical Strategy for Malaria 2016-2030.*

WHO Malaria Report. (2017). World malaria report 2017. In *World Health Organization*.

WHO Malaria Report. (2021). World Malaria Report 2021. In *Word Malaria report Geneva: World Health Organization. (2021). Licence: CC*.

Wiysonge, C. S., Uthman, O. A., Ndumbe, P. M., & Hussey, G. D. (2013). A bibliometric analysis of childhood immunization research productivity in Africa since the onset of the Expanded Program on Immunization in 1974. *BMC Medicine*, *11*(1).

https://doi.org/10.1186/1741-7015-11-66

World Health Organization (WHO). (2018). *Business case for WHO immunization activities on the African continent*.

APPENDICES

Appendix 1: Informed Consent Form in English

TITLE OF THE STUDY

Exploring factors influencing malaria vaccine uptake for children aged 24-36 months in Nsanje District, Malawi

INTRODUCTION

Atusaye Joaquim Simbeye (+265881950031, atusayesimbeye@gmail.com) Address: Jaramogi Oginga Odinga University of Science and Technology, School of Health Sciences, Department of Biomedical Sciences, P.O Box 210-4001, Bondo, Kenya or Nsanje District Health Office, P. O Box 30, Nsanje, Malawi. I am a MASTER OF SCIENCE IN EPIDEMIOLOGY AND BIOSTATISTICS student from Jaramogi Oginga Odinga University of Science and Technology. I am conducting a study on exploring factors influencing malaria vaccine uptake for children aged 22-36 months in Nsanje District, Malawi.

PURPOSE OF RESEARCH

The purpose of this study is to find out the factors that influence the uptake of malaria vaccine. The aim of the study is to improve uptake of the vaccine in Nsanje District and other parts of the country in order to reduce mortality and morbidity associated with malaria among children. The findings from this study will inform stakeholders on how to increase malaria vaccine uptake in Nsanje District and other districts

NATURE OF RESEARCH

This study is about what positively or negatively influence mothers/caregivers from getting their children receiving the malaria vaccine. It is being conducted in Nsanje District, Malawi and will involve about four hundred and ten (410) parents/caregivers.

STUDY PROCEDURES

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 five years old and it is parents/caregivers who decide/act for/on behalf of their children in such matters. We will also

require to check into the health passport of the child. It will take between 25-35 minutes to respond to the questionnaire.

POTENTIAL RISKS

There is no potential foreseen risk in participating in this study

BENEFITS

The study may not directly benefit participant and his/her dependent but the benefit will be for the general and future population. The study will help the Nsanje District Health Directorate and other directorates put in measures to increase uptake of the vaccine to reduce childhood morbidity and mortality associated with malaria.

PRIVACY AND 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.

COSTS FOR PARTICIPATION

There will be no costs for participating in the research. The participants will be found I their homes by research assistants. Therefore, participant will not be compensated for participating in this study as such participants will not receive any money for participating in this study.

RESEARCH FUNDING

This study will be supported by European Union (EU) on a project called European and Developing Countries Clinical Trials Partnership 2 (EDCPT2) through African Population and Health Research Centre (APHRC). APHRC will provide funding for the study.

OUTCOME AND FEEDBACK

The outcome of this study will be shared with the Nsanje District Health Directorate.

SHARING OF PARTICIPANTS INFORMATION/DATA

The data generated from this study will be solely for the principal researcher and will only be shared with other individuals or organizations for studies concerning malaria or vaccine uptake after expressly written request.

CONTACT INFORMATION FOR QUESTIONS AND CONCERNS

If you have any questions or has any problems from the study you can contact Mr. Atusaye Simbeye, the principal investigator on the following phone number, +265881950031.

If you want to talk about the study with someone who is not the principal investigator of this research study, please contact Mr. Sam Ohanga, Board of Postgraduate studies, Jaramogi Oginga Odinga University of Science and Technology (+254 720 863894) and Dr. Shehu Shagari Awandu, Head of Biomedical Sciences Department, Jaramogi Oginga Odinga University of Science and Technology (+254 741 911577) or contact contact the Executive Committee, National Health Sciences Research, Ministry of Health, P. O Box 30377, Lilongwe, Malawi or call Dr. Collins Mitambo, Phone number; +265 999 397 913, email address: research@mail.gov.mw

VOLUNTARY PARTICIPATION AND WITHDRAWAL

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed

CONSENT

I have understood the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Name of Participant:………………………………………………………………………………

Signature/thumb print:………………………………Date:………………………........................

Name of witness:…………………………………………………………………………………

Signature/thumb print………………………….............Date:………………………………………

Name of the person who explained about this research.......………………..…………………………

Signature………………………….................................Date:……………………………………...

Appendix 2: Informed Consent Form in Chichewa (Local language)

Mutu wakafukufuku

Kuwunika zomwe zikupangitsa kuti ana a miyezi yapati pa makumi awiniri ndi mphambu zinayi ndi miyezi makumi atatu ndi mphambu zisani ndi umodzi alandire katemera wa malungo m'boma la Nsanje, m'dziko la Malawi.

Maina ndi momwe mungalumikizirane ndi mkulu wakafukufukuyi

Dzina langa ndi Atusaye Joaquim Simbeye. Muntha kulankhulana nawe pa manambala alamya ya m'manja awa; +265 8819 50 031/+265 991 739 168 kapena imelo adiresi iyi: atusayesimbeye@gmail.com komanso mutha kundilembera kalata pama keyala awa: Jaramogi Oginga Odinga University of Science and Technology, School of Health Sciences, Department of Biomedical Sciences, P.O Box 210-4001, Bondo, Kenya kapena Nsanje District Health Office, P.O Box 30, Nsanje, Malawi.

Momwe mungalumikizirane ndi National Health Sciences Research Committee

National Health Sciences Research, Ministry of Health, P. O Box 30377, Lilongwe, Malawi kapena imbani lamya kwa Dr. Collins Mitambo, pa nambala iyi ya lamya; +265 999 397 913, kapena pa imelo adiresi iyi: research@mail.gov.mw.

Mawu oyamba

Ine ndi Atusaye Joaquim Simbeye, ndikuphunzira Master of science in Epidemiology and Biostatistics ku sukulu ya ukachenjede ya Jaramogi Oginga Odinga University of Science and Technology m'dziko la Kenya. Ndifuna kupanga kafukufuku ofuna kuwunika zomwe zikupangitsa kuti ana a miyezi yapati pa makumi awiniri ndi mphambu zinayi ndi miyezi makumi atatu ndi mphambu zisani ndi umodzi alandire katemera wa malungo m'boma la Nsanje, m'dziko la Malawi. Kafukufukuyi ndiofunika kwambiri chifukwa adzathandizira kuchepetsa imfa zomwe zimadza kamba ka malungo komanso kudwala malungo kwa ana osakwana za zisanu komwe kumadza kamba ka malungo.

Cholinga cha kafukufuku

Kafukufukuyi akufuna ndikupeza zinthu zomwe zimapangitsa kuti katemera wa malungo alandiridwe. Cholinga chachikulu chakafukufukuyi ndi kupititsa patsogolo kalandiridwe ka katemera wa malungo m'boma la Nsanje ndi madera ena a mdziko lino pofuna kuchepetsa imfa

ndi matenda obwera kwa ana kamba ka malungo. Zotsatira za kafukufukuyi zizadziwitsa adindo okhudzidwa za momwe angalambikitsire ntchito yoti ana ambiri azilandira katemera wa malungo m'boma la Nsanje ndi maboma ena.

Zomwe zizachitike

Makolo/olera ana omwe adzatenge nawo gawo mukafukufukuyi adzafunika kupereka mayankho okhudzana ndi kulandira katemera wa malungo kwa ana awo. Izi zili chonchi chifukwa choti anawa sanafike poziimira paokha ndipo makolo/olera ndi amene amasankha/kuchitapo kanthu m’malo mwa ana awo apankhaniyi. Tidzafunanso komanso kuona nawo mu chiphaso cha mwana cha kuchipatala. Zidzatenga mphindi zosadudza makumi atatu ndi mphambu zisanu kuti muyankhe mafunso.

Phindu lomwe mungapeze

Kafukufukuyi sangapindule mwachindunji kwa ofunsidwa mafunso ndi mwana wanu koma phindu kwa anthu onse komanso mibado yamtsogolo. Kafukufukuyi adzathandiza a zaumoyo m’boma la Nsanje ndi mabungwe ena kukhazikitsa njira zopitsira patsogolo kalandiridwe ka katemera wa malungo.

Ziopsyezo

Palibe choyopsya chilichonse chomwe mudzakumane nacho potenga nawo gawo mukafukufukuyi. Mafunso omwe azafunsidwe adzakhala okudza inu ndi mwana wanu.

Chinsisi

Mayankho onse omwe mudzapereke adzasungidwa mwa chinsinsi. Mayankho anu sadzaonedwa ndi aliyense amene sali m’gulu lakafukufukuyu.

Dipo lolowa nawo mkafukufukuyi

Simudzapereka ndalama iliyonse kuti mutenge nawo gawo mukafukufukuyi. Sipadzakhala ndalama zomwe mudzalndire potenda nawo gawo mukafukufuku ameneyu. Izi zili nchonchi chifukwa anthu azakafukufukuyi azachita kukupezani panyumba yanu.

Chirolezo cha kafukufuku

Chirolezo chopanga kaafukufukuyi chidzapemphedwa kuchokera ku National Health Sciences Research, Ministry of Health, P. O Box 30377, Lilongwe, Malawi, kapena imbani lamya kwa Dr. Collins Mitambo, nambala ya lamya iyi; +265 999 397 913, imelo adiresi: research@mail.gov.mw.

Ndalama zopangira kafukufuku

Kafukufukuyi adzathandizidwa ndi European Union (EU) pa pulojekiti yotchedwa European and Developing Countries Clinical Trials Partnership 2 (EDCPT2) ndipo thandizo la ndalama lidzadzera la ku bungwe lotchedwa African Population and Health Research Center (APHRC)

Komwe mungapeze thandizo ngati muli ndi mafunso

Ngati muli ndi mafunso kapena vuto lililonse lokhudzana ndi kafukufukuyi muntha kuyankhulana ndi mkulu wa kafukufukuyi bambo Atusaye Joaquim Simbeye pa ma nambala awa a lamya +265 881 9500 31/+265 991 739 168.

Ngati mukufuna kuyankhulana za kafukufukuyi ndi munthu yemwe si mkulu wa kafukufukuyi, chonde lembani kalata kwa komiti yaikulu, National Health Sciences Research, Ministry of Health, P. O Box 30377, Lilongwe, Malawi, Kepana imbani lamya kwa Dr. Collins Mitambo pa nambala iyi; +265 999 397 913 kapena imelo adiresi iyi; research@mail.gov.mw

Ufulu ovomera kapena kukana

Ngati mwavomera zotenga nawo gawo mu kafukufukuyi mudzapemphedwa kusaina fomu kusonyeza kuvomera. Mukasaina fomuyi muli omasuka kutuluka mu kafukufukuyi nthawi ili yonse. Mukatuluka mukafukfukuyi muli mkati moyankha mafunso, fomu yanu idzabwezedwa kwai nu kapena kung'ambidwa.

Kuvomereza ndi kusaina

Ndamvetsetsa zomwe mwafotokoza komanso ndinali ndi mwayi ofunsa mafunso. Ndamvetsetsa kuti ndi ndiufulu kutenga nawo gawo mufukufukuyi komanso ufulu wotuluka nthawi iliyonse. Ndipo ndamvetsetsa kuti ndisaina ma fomu awiri ndipo imodzi ikhala ndi ine.

Ndikuvomera mwakufuna pandekha kutenga nawo mbali mu kafukufukuyi

Dzina la otenga mbali:………………………………………………………………………………
Kusaina/Chidindo cha chala:…………………………………………………………………..
Tsiku:………………………...

Dzina la mboni:………………………………………………………………………………………
Kusaina/Chidindo cha chala ………………………...

Tsiku:………………………………………………………………………………………….

Dzina la munthu amene wafotokoza za kafukufukuyi.......…………….…………………………
Kusaina………………………...

Tsiku:………………………………………………………………………………………….

Appendix 3: Data collection tool

Questionnaire in English and local language (Chichewa)

No.	Question (Funso)	Response (Yankho) (write and/or tick as appropriate) (Lembani kapena chongani yankho lokhoza)	Code
Part A: Parent/caregiver characteristic (Zokhudza Kholo/mlezi)			
1.	Age (Zaka)		
2.	Sex (Mamuna/Mkazi)	Male (Mamuna) [ ]	1
	If the caregiver is female ask Q3 if male go to Q4 (Ngati mlezi ali wa mkazi funsani funso lachitatu ngati ali wammuna funsani funso lachinayi)	Female (Mkazi) [ ]	2
3.	Number of pregnancies carried to term (Ngati mlezi ndi wammuna, Nambala ya mimba zimene mwakhala mukutenga mpaka kubereka)		
4.	If caregiver is female, Number of children alive (Nambala ya ana anu amene ali moyo)		
5.	Parent or caregiver? (Kholo kapena **mlezi)**	Parent (Kholo) [ ]	1
		Caregiver **(Mlezi)** [ ]	2
6.	**If caregiver, what is the relationship with child? (Ngati mlezi , ubale wake ndi otani ndi mwanayi)**	Relative's child (Wachibale) [ ]	1
		Friend's child (Nzake) [ ]	2
		NA (Palibe yankho) [ ]	9
7.	**If caregiver, for how long? (Ngati muli mlezi, mwakhala mlezi kwa nthawi yaitali bwanji?)**	Less than 1 month (Kuchepera mwezi umodzi) [ ]	1
		1-6 months (Kuyambira mwezi umodzi kulekera miyezi isanu ndi umodzi) [ ]	2

		6 months-year (Kuyambira miyezi isanu ndi umodzi kulekera chaka) [ ]	3
		NA (Palibe yankho) [ ]	9
8.	**If caregiver, why? (Ngati muli mlezi, ndi chifukwa chani?)**	Mother has travelled (Mayi ake anachokapo) [ ]	1
		Mother is sick (Mayi ake akudwala) [ ]	2
		Mother not alive (Mayi ake anamwalira) [ ]	3
		Mother unconcerned about vaccination (Mayi ake alibe nazo ntchito za katemera). [ ]	4
		Other (Zina) [ ] (tchulani)	8
		NA (Palibe yankho) [ ]	9
9.	**Highest education level (Maphunziro anu apamwamba kwambiri)**	No formal education (Simnapange maphunziro alionse) [ ]	0
		Primary education (Maphunziro aku pulayimale) [ ]	1
		Secondary education (Maphunziro aku sekondale) [ ]	2
		Tertiary education (Maphunziro akukoleji) [ ]	3
10.	**Highest education level of partner (Maphunziro apamwamba kwambiri a wokondedwa anu)**	No formal education (Sanapange maphunziro alionse) [ ]	0
		Primary education (Maphunziro aku pulayimale) [ ]	1
		Secondary education (Maphunziro aku sekondale? [ ]	2

		Tertiary education (Maphunziro akukoleji) [ ]	3
11.	**Marital status (Ndinu okwatira kapena Ayi)**	Single (Osakwatira) [ ]	1
		Married (Okwatira) [ ]	2
		Divorced (Banja linatha) [ ]	3
		Widowed (Wokondedwa anamwalira) [ ]	4
		Cohabiting (Kukhalira limodzi) [ ]	5
12.	Religious affiliation (Chipembedzo chanu)	Christianity (Mkhristu) [ ]	1
		Islam (Msilamu) [ ]	2
		Traditionist (Chipembedzo cha makolo) [ ]	3
		Other (Zina) [ ] (tchulani)	8
13.	Religious affiliation of partner (Chipembedzo cha okondedwa anu)	Christianity (Mkhristu) [ ]	1
		Islam (Msilamu) [ ]	2
		Traditionist (Chipembedzo cha makolo) [ ]	3
		Other (Zina) [ ] (tchulani)	8
14.		Unemployed (Simuli pa ntchito) [ ]	0

	Occupation (Ntchito yomwe mumagwira)	Self-employed (Ozilemba nokha ntchito) [ ]	1
		Farmer (M'mimi) [ ]	2
		Civil servant (Wogwira ntchito m'boma) [ ]	3
15.	Occupation of partner (Ntchito yomwe amagwira wokondedwa anu)	Unemployed (Sali pa ntchito) [ ]	0
		Self-employed (Ozilemba nokha ntchito) [ ]	1
		Farmer (M'mimi) [ ]	2
		Civil servant (Ogwira ntchito m'boma) [ ]	3
16.	Number of ANC visits (When pregnant with the child under review) (Munapita ma ulendo angati ku sikelo ya amayi oyembekezera)	Number (Nambala):	
		Cannot recall (Sindingakumbukile) [ ]	7
		NA (Palibe yankho) [ ]	9
17.	Where was the child delivered? (Mwana anabadwira kuti?)	Home (Pakhomo) [ ]	1
		Health facility (Kuchipatala) [ ]	2
		Don't know (Sindikuziwa) [ ]	7
Part B: Parent/Caregivers knowledge and experience with vaccines in general (Zomwe makolo kapena alezi amadziwa kapena anakumana nazo zokhudza katemera wa ana)			
18.	What is the main reason why children are vaccinated (Cholinga chachikulu chomwe ana amalandilitsidwa katemera)	Don't Know (Simukuziwa) [ ]	1
		Protect them against diseases (Kuwatetezera ku matenda) [ ]	2
		Make them breastfed well (Kuti aziyamwa bwino) [ ]	3
		Other (Zina) [ ] (tchulani)	8

19.	What are some of the diseases childhood vaccines prevent? (**mention as many as you can remember) (Ndi matenda ati omwe ana amatetezedwa ndi katemera?) (Tchulani ambiri momwe mungathele)		
	Vaccine preventable diseases Tuberculosis (Chifuwa chachikulu) [ ] Influenza (Chimfine) [ ] Poliomyelitis (poliyo) [ ] Hepatitis B (matenda a chiwindi) [ ] Tetanus (kafumbata) [ ] Pertusis (Zilonda zakukhosi) [ ] Pneumonia (Chibayo) [ ] Measles (Chikuku) [ ] Diarrhoea (kutegula mmimba) [ ] Yellow fever (Matenda a chikasu) [ ] Diphtheria (Chifuwa chokoka Mtima)[ ] Malaria (malungo) [ ]	Number mentioned(Nambala imene yatchulidwa)	
		**No correct disease mentioned (palibe nthenda yolondora yomwe yatchulidwa) [ ]	0
		** Up to 3 correct diseases mentioned (matenda atatu olondora omwe atchulidwa) [ ]	1
		** 4 up to 8 correct diseases mentioned (Matenda asanu ndi atatu olondora omwe atchulidwa) [ ]	2
		**Any correct disease but including malaria (Nthenda iliyonse yolondora yomwe yatchulidwa kuphatikizira malungo)	3
20.	Has any of your children suffered any adverse reaction following the administration of any vaccine? (Alipo mwa ana anu amene anasonyeza zizindikiro zachilendo atalandira katemera?)	Yes (Eya) [ ]	1
		No (Ayi) [ ]	0
21.	If “yes” to Q20, what was it? (Ngati eya, zizindikiro zake zinali zotani?)	Fever (Kutentha thupi) [ ]	1
		Diarrhoea/vomiting (Kutsegura m'mimba/kusanza) [ ]	2
		Abscess(Chotupa) [ ]	3
		Other (Zina) [ ] (tchulani)	8

			9
		NA (Palibe yankho) [ ]	
22.	Has this influenced your decision to take other vaccines for your child (Zimenezi zakupangitsani kuti musinthe maganizo anu omubaitsa mwana wanu katemera wina?)	Yes (Eya) [ ]	1
		No (Ayi) [ ]	0
		NA (Palibe yankho) [ ]	9
23.	How many minutes does it take you to get the vaccination centre?(Nthawi yaitali bwanji yomwe mumatenga kuti mukafike malo kolandilitsa katemera?)	Less than 30 minutes (Kuchepera mphindi makumi atatu) [ ]	1
		30 minutes – 59 minutes (Pakati pa mphindi makumi atatu ndi mphindi makumi anayi ndi mphambu zisanu ndi zinayi) [ ]	2
		1 hour – 2 hours (Pakati pa ola imodzi _ maola awiri) [ ]	3
		More than 2 hours (Osachepera maola awiri) [ ]	4
24.	How do you usually get to the vaccination centre? (Mumayenda bwanji kuti mukafike ku malo kolandilitsa katemera?)	Walking (Kuyenda wapansi) [ ]	1
		Commercial (motorbike/bike) (Kulipira njinga yamoto kapena yakapalasa) [ ]	2
		Personal vehicle (car/bike/motorbike) (Galimoto yanga kapena njinga yanga kapena njinga yanga yamoto) [ ]	3
	Have you attended hospital and failed to vaccinate your child (Munayamba mwapita ku chipatala koma	Yes (Eya)	1
		No (Ayi)	2
		NA (Palibe yankho)	9

	kulephera kumubaitsa mwana wanu katemera?)		
25.	Are you required to pay any money at the vaccination centre?(Mumayenera kupeleka ndalama iliyonse kolandira katemera?)	Yes (Eya) [ ]	1
		No (Ayi) [ ]	0
26.	If "yes" to Q25, how much?(Ngati eya, zingati?)		
		NA (Palibe yankho) [ ]	9
27.	How do you know when your child's vaccination is due?(Mumaziwa bwanji kuti tsiku loti mwana wanu akalandile katemera lakwana?)	Ask friends (Mumafunsa anzanu)	1
		Check child's health passport (Mumaona chiphaso cha mwana chakuchipatala)	2
		I go there every month (Ndimapita mwezi uliwonse)	3
		The Health Surveillance Assistants tell us (Azaumoyo amatiuzani)	4
		The volunteer from my village tell us (Avolontiya amudzi mwathu amatiuza)	5
		Other (Zina) [ ] (tchulani)	8
28.	How will you describe the attitude of health care workers who attend to you during under 5 clinics?(Mungafotokoze motani chikhalidwe cha azaumoyo	Excellent (Bwino kwambiri kopambana) [ ]	1
		Very good (Bwino kwambiri) [ ]	2
		Good (Bwino) [ ]	3

	omwe amakuthandizani ku chipatala kwa ana?)	Bad (Choipa) [ ]	4
		Very bad (Choipa kwambiri) [ ]	5
		NA (Palibe yankho) [ ]	9
29.	Do you think vaccines has long term side effects?(Mukuganiza kuti katemera ali ndi zotsatira za nthawi yaitali?)	Yes (Eya) [ ]	1
		No (Ayi) [ ]	0
30.	If 'yes' to Q29, what are some of the side effects?(Ngati eya, zina mwa zotsatira zimenezi ndi ziti?)	Infertility (Kusabereka) [ ]	1
		Mental retardation (Kuzelezeka) [ ]	2
		Stroke (Kufa ziwalo) [ ]	3
		Other (Zina) [ ] (tchulani)	8
		NA (Palibe yankho)	9
Part C: Parents/Caregivers knowledge and experiences with malaria vaccine (Zomwe makolo kapena alezi amadziwa kapena anakumana nazo zokhudza katemera wa malungo)			
31.	Have you heard about malaria vaccine? (Munayamba mwamvapo za katemera wa malungo?)	Yes (Eya) [ ]	1
		No (Ayi) [ ]	0
32.	If 'yes' to Q31, where did you first hear about the malaria vaccine? (Ngati eya,ndi malo ati oyamba omwe munamva za katemera wa malungo?)	Under 5 clinic (Chipatala cha ana) [ ]	1
		Health facility announcement (Zolengeza zakuchipatala) [ ]	2
		Radio (Wailesi) [ ]	3
		Friend/Relative (Nzanga/achibale) [ ]	4
		Community announcement (Olengeza a m'mudzi) [ ]	5

		Other (Zina) [ ] (Tchulani)	8
		NA (Palibe yankho) [ ]	9
33.	How many times is a child supposed to take the malaria vaccine? (Correct number is 4 times) (Mwana akuyenera kulandira katemera wa malungo kangati?)	Number mentioned (Nambala yomwe yatchulidwa)	
		**Correct number (Nambala yolondora) [ ]	1
		**Incorrect number (Nambala yosalondora) [ ]	0
		Don't know (Sindikuziwa) [ ]	7
		NA (Palibe yankho) [ ]	9
34.	What specific ages (in months) is child supposed to take the malaria vaccine? (Ndi miyezi it imene mwana akuyenera kulandira katemera wa malungo?) (Correct order 5,6,7 and 22-36 months)	**Correct order (ndondomeko yolondora) [ ]	1
		**Incorrect order (ndondomeko yosalondora) [ ]	0
		NA (Palibe yankho) [ ]	9
35.	Have you heard about any negative report/issue concerning the malaria vaccine? (Munamvapo nkhani zokhuza kuipa kwa katemera wa malungo?)	Yes (Eya) [ ]	1
		No (Ayi) [ ]	0
		NA (Palibe yankho) [ ]	9
36.	If 'yes' for Q35, from where? (Ngati eya,munamva kuti?)	Radio (Wailesi) [ ]	1
		Friends/Relatives (Anzanga/achibale [ ]	2
		Health workers (Ogwira ntchito ku chipatala) [ ]	3
		Religious leaders (Atsogoleri a mpingo)	4
		Other (Zina) [ ] (tchulani)	8

		NA (Palibe yankho)	9
37.	What report/issue was it? (Inali nkhani yotani?)	Malaria vaccine is not safe (Katemera wa malungo ndi osatetezeka) [ ]	1
		Children are being used for experiment (trials) (Ana amagwiritsidwa ntchito kuyeselera katemera) [ ]	2
		The malaria vaccine will affect children's development (Katemera wa malungo amasokoneza kakulidwe ka ana) [ ]	3
		Other (Zina) [ ] (tchulani)	8
		NA (Palibe yankho) [ ]	9
39.	Are you given the option of deciding to let your child be given the malaria vaccine at under 5 clinic? (Mumapatsidwa mwayi opanga chiganizo kuti mwana wanu alandire katemera kapena ayi ku chipatala kwa ana?)	Yes (Eya) [ ]	1
		No (Ayi) [ ]	0
		NA (Palibe yankho) [ ]	8
40.	What do you think about the introduction of malaria vaccine to our children? (Mukuganiza bwanji ndikubwera kwa katemera wa malungo kwa ana?)	Vaccines becoming too many for our children (makatemera akuchuluka kwa anthu) [ ]	1
		There is no problem with that (sindikuonapo vuto lililonse) [ ]	2
		Don't know (sindikudziwa) [ ]	3
		Other (specify) (Zina) (tchulani)	8

Part D: Checklist to check RTS,S uptake from child's health passport (Kuona kuchokera mu chiphaso cha mawa cha kuchipatala ngati analandira katemera wa malungo)					
41.	Child's date of birth (Tsiku lobadwa la mwana)		……../…………../…………..		
42.	Age of child (in months) (Miyezi ya mwana)				
43.	Sex (Mamuna kapena mkazi)		Male (Mamuna) [ ]		1
			Female (Mkazi) [ ]		2
44.	Doses of RTS,S child has received (Nambala ya katemera wa malungo amene mwana wanu walandira)		None (Palibe) [ ]		0
			RTS,S 1 only (Woyamba yekha) [ ]		1
			RTS,S 1 and 2 only (Woyamba ndi wachiwiri yekha) [ ]		2
			RTS,S 1, 2 and 3 only (Woyamba, wachiwiri ndi wachitatu yekha)		3
			RTS,S 1,2,3 and 4 (Woyamba, wachiwiri, wachitatu ndi wachinayi)		4
45.	Dates child took RTS,S (Masiku amene mwana analandira katemerayo)				
	Dose (Katemera)	Date received (Tsiku lomwe analandira)	**Age(Months) write 'NA' if child has not taken vaccine (Nthawi yomwe analanddirayo anali ndi miyezi ingati)**	**Recommended month? (Mweni oyenera?)**	
	RTS,S 1	………/……./…………		Yes (Eya) [ ]	1
				No (Ayi) [ ]	0
	RTS,S 2	………/……./…………		Yes (Eya) [ ]	1
				No (Ayi) [ ]	0

	RTS,S 3	………/……./…………		Yes (Eya) [ ]	1
				No (Ayi) [ ]	0
	RTS,S 4	………/……./…………		Yes (Eya) [ ]	1
				No (Ayi) [ ]	0
46.	What is the reason why your child has not taken ANY of the four doses of malaria vaccine? (Chifukwa chani mwana wanu sanalandire katemera wina aliyense wa malungo?)		Personal decision to refuse vaccine (Zifukwa zodziwa ndekha) [ ]		1
			Partner's decision to refuse vaccine (Zifukwa za Mamuna wanu/mkazi wanu) [ ]		2
			Did not know child was eligible (Simumaziwatu kut mwana yo ndi oyenera kulandira katemera) [ ]		3
			Other (Zina) [ ] (tchulani)		8
			NA (Palibe yankho) [ ]		9
47.	What is the reason why your child has not taken ALL the four doses of the malaria vaccine (Chifukwa chani mwana wanu sanalandire katemera yense wa malungo?)		Did not know when next one was due (Simumaziwa kuti katemera wina alandilidwa liti) [ ]		1
			Did not take previous dose on time (Simunalandile katemera wapitayo nthawi yake) [ ]		2
			Not comfortable with side effects (Simusangalala ndi zotsatira za katemera) [ ]		3
			Not comfortable with issues surrounding the vaccine (Simumasangalala ndi mphekesera za katemera wa malungo)[ ]		4
			Money charged for previous dose (Amalipilitsa ndalama) [ ]		5
			I was not around (Kunalibeko) [ ]		6

		Other (Zina) [ ] (tchulani)	8
		NA (Palibe yankho) [ ]	9
Part D: Community level factors (Zifukwa za mmadera)			
48.	**Do traditional leaders in your community support malaria vaccination? (Atsogoleri a m'mudzi mwanu amalimbikitsa katemera wa malungo?)**	Yes (Eya)	1
		No (Ayi)	2
		I don't know (Sindikudziwa)	7
		NA (Palibe yankho)	9
48.	**Do religious leaders in your community support malaria vaccination? (Atsogoleri a mpingo ku dera kwanu amalimbikitsa katemera wa malungo?)**	Yes (Eya)	1
		No (Ayi)	2
		I don't know (Sindikudziwa)	7
		NA (Palibe yankho)	9
50.	Do community health volunteers support malaria vaccination? (Azaumoyo a m'dera mwanu amalimbikitsa katemera wa malungo?)		
		Yes (Eya)	1
		No (Ayi)	2
		I don't know (Sindikudziwa)	7
		NA (Palibe yankho)	9
51.	**Do people in your household support children to receive malaria vaccine? (Kodi anthu a m'banja mwanu**	Yes (Eya)	1
		No (Ayi)	2
		I don't know (Sindikudziwa)	7

	amalimbikitsa ana kulandira katemera wa malungo?)	NA (Palibe yankho)	9
52.	Who makes a decision for a child to receive malaria vaccine? (Amapanga chiganizo choti mwana alandire katemera wa malungo ndi ndani?)	Mother (Mayi)	1
		Father (Bambo)	2
		Both (Onse)	3
		Other (specify) (zina tchulani)	
Part E: Practices towards malaria vaccine uptake (Machitidwe omwe amakhudza kalandiridwe katemera wa malungo)			
53.	Was the vaccination completed on Schedule? (Kodi katemera analandiridwa motsata ndondomeko komanso munthawi yake?) (Check in the health passport) (Onani mu chiphaso cha mwana chakuchipatala)		
	If 'Yes' move to Q53 If 'No' to Q52, why? (Ngati eya, chifukwa?)		
54.	What will you do if you child has developed adverse effects following malaria vaccine immunization? (Kodi mwana wana ataonetsa zotsatira zoipa atalandira katemera wa malungo mungatani)		
55.	Will you recommend other parents to get their children receive malaria vaccine? (Mungalimbikitse makolo anzanu kuti ana awo alandire katemera wa malungo?)		

	If 'Yes' to Q55, why? (Ngati eya, chifukwa?)		
	If 'No' to Q55 why? (Ngati ayi, chifukwa?)		
Part F: Please explain your thoughts and opinion toward malaria vaccine immunization (Chonde fotokozani maganizo anu okhudzana ndi katemera wa malungo)			
56.	Do you think it is important for your child to receive malaria vaccine? (Probe for reasons) (Kodi mukuganiza kuti mkofunikira kuti mwana wanu alandire katemera wa malungo) (funsani zifukwa)		
57.	In your opinion, do you think it is important to follow vaccination schedule (Probe for reasons) (Kodi muganiza kuti ndikofunika kubaitsa mwana katemera munthawi yake) (funsani zifukwa)		
58.	Do you think your child can suffer from malaria if you did not vaccinate her/him with malaria vaccine (probe for reasons) (Kodi mukuona ngati mwana wanu atha kudwala malungo ngati sanalandira katemera wamalungo) (funsani zifukwa)		
59.	Have you ever gone to the under five-clinic to vaccinate your child malaria vaccine and failed to vaccinate your child? (Munayamba mwapitako kokabaitsa mwana wanu katemera wa		

	malungo koma mkubwerera osamubaitsa?		
	If 'Yes' to Q59, what were the reasons? (Ngati eya, chifukwa?) If no to Q59 move to Q60		
60.	Do you think that malaria vaccine has side effects on your child? (Mukuganiza kuti katemera wa malungo ali ndi zotsatira zoipa zilizonse kwa mwana wanu?)		
	If 'Yes' to Q60, what are these side effects? (Ngati eya, zoipa zake ndichani?)		
	If 'No' to Q60, why? (Ngati ayi, chifukwa?)		
61.	Do you think that malaria vaccine is safe (mukuganiza kuti atemera wa malungo ndisosaopsya)		
	If 'Yes' to Q61, why do you think so? (Ngati eya, mukuganiza choncho chifukwa chani?)		
	If 'No' to Q61, why? (Ngati ayi, chifukwa?)		
62.	What are the main concerns or fears concerning malaria vaccine? (Nkhawa		

	kapena mantha akulu ndi chani okhudzana ndi katemera wa malungo?)		
63.	Can you recommend other mothers/caregivers to allow their children get malaria vaccine (Probe for reasons) (Mutha kuwalangiza amayi azanga/alezi kuti akalandiritse ana awo katemera wa malungo) (funsani zifukwa)		

Appendix 4: Malawi Ministry of Health Ethical Review Committee Approval

Telephone: + 265 1 789 400
Facsimile: + 265 1 789 431
E-mail: research@mail.gov.mw
All Communications should be addressed to: The Secretary for Health

In reply please quote No. MED/4/36c
Ministry of Health
P.O. Box 30377
Lilongwe 3
Malawi

2nd March 2023

Atusaye Joaquim Simbeye

Jaramogi Oginga Odinga University of Science and Technology

Dear Sir/Madam

RE: Protocol 23/02/3167: Exploring Factors Influencing Malaria Vaccine Uptake for Children Aged 24-36 Months in Nsanje District, Malawi

Thank you for the above titled proposal that researcher submitted to the National Health Sciences Research Committee (NHSRC) for review. Please be advised that the NHSRC has **reviewed** and **approved** the above named study.

- **APPROVAL NUMBER** **:3167**
- The above details should be used on all correspondences, consent forms and documents as appropriate.
- **APPROVAL DATE** **:02/03/2023**
- **EXPIRATION DATE** **:01/03/2024**
  This approval expires on **01/03/2024**. After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the NHSRC Secretariat should be submitted one month before the expiration date for continuing review.
- **SERIOUS ADVERSE EVENT REPORTING:** All serious problems having to do with subject safety must be reported to the NHSRC within 2 working days using standard forms obtainable from the NHSRC Secretariat.
- **MODIFICATIONS**: Prior NHSRC approval using forms obtainable from the NHSRC Secretariat is required before implementing any changes in the protocol (including changes in the consent documents). You may not use any other consent documents besides those approved by the NHSRC.
- **TERMINATION OF STUDY**: On termination of a study, a report has to be submitted to the NHSRC using standard forms obtainable from the NHSRC Secretariat.
- **QUESTIONS**: Please contact the NHSRC on phone number *+265 999397913* or by email on mohdoccentre@gmail.com.
- **OTHER**: Please be reminded to send in copies of your final research results for our records (Health Research Database).

Kind regards from the NHSRC Secretariat.

National Health Sciences Research Committee
2023 -03- 02
APPROVED

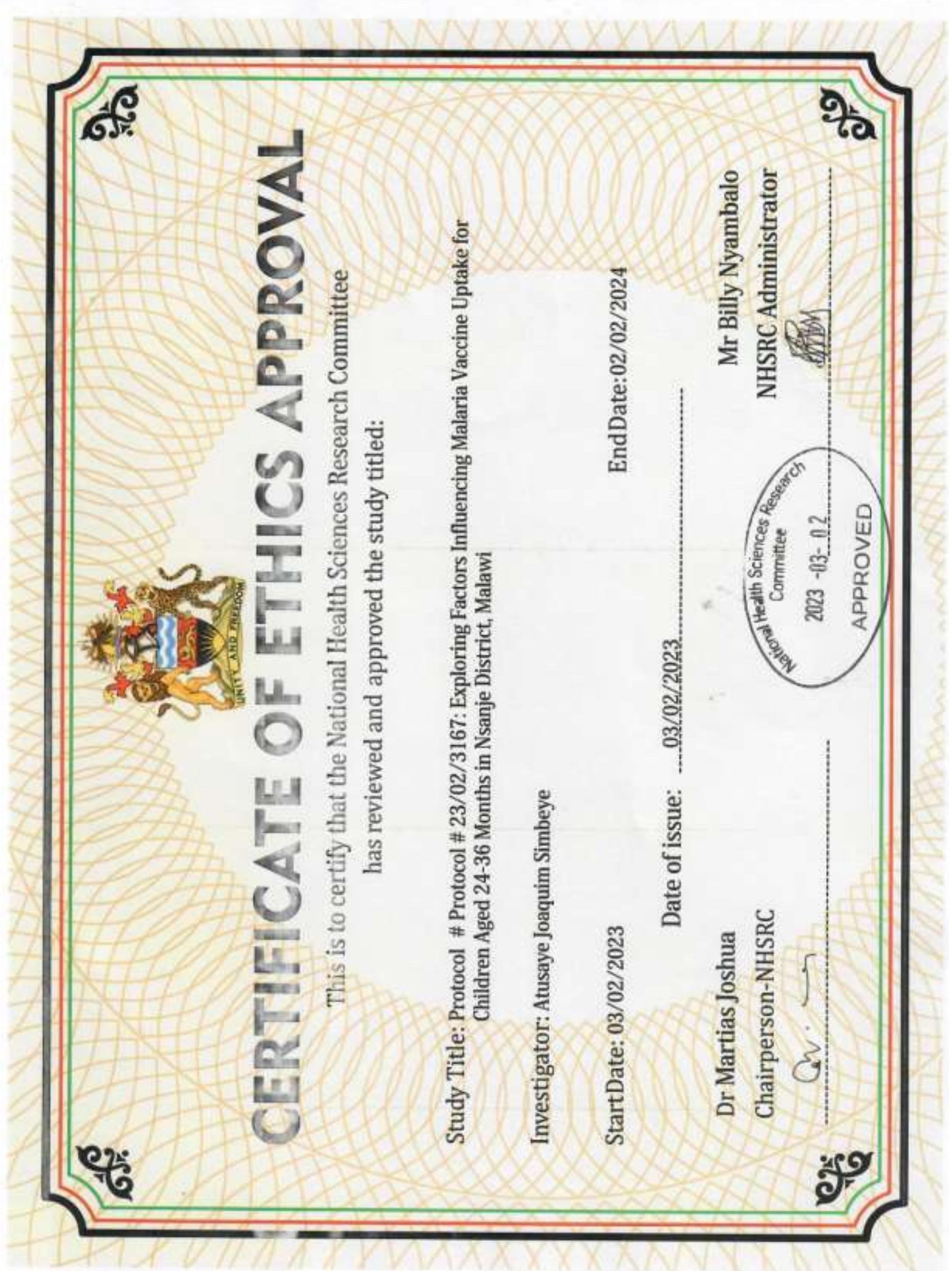
....

CHAIRPERSON, NATIONAL HEALTH SCIENCES RESEARCH COMMITTEE
Promoting Ethical Conduct of Research

1

Executive Committee: Dr M. Joshua (Chairperson), Dr S. Mndolo(Vice-Chairperson)
Registered with the USA Office for Human Research Protections (OHRP) as an International IRB/IRB Number IRB00003905 FWA00005976

Appendix 5: Malawi Ministry of Health Ethical Review Committee Certificate



UNITY AND FREEDOM

CERTIFICATE OF ETHICS APPROVAL

This is to certify that the National Health Sciences Research Committee
has reviewed and approved the study titled:

Study Title: Protocol # Protocol # 23/02/3167: Exploring Factors Influencing Malaria Vaccine Uptake for Children Aged 24-36 Months in Nsanje District, Malawi

Investigator: Atusaye Joaquim Simbeye

StartDate: 03/02/2023 EndDate: 02/02/2024

Date of issue: 03/02/2023

Dr Martias Joshua
Chairperson-NHSRC

National Health Sciences Research Committee
2023 -03- 02
APPROVED

Mr Billy Nyambalo
NHSRC Administrator

Appendix 6: JOOUST Ethical Review Committee Approval

JARAMOGI OGINGA ODINGA
UNIVERSITY OF SCIENCE AND TECHNOLOGY

DIVISION OF RESEARCH, INNOVATION AND OUTREACH
JOOUST-ETHICS REVIEW OFFICE

Tel. 057-2501804
Email: erc@jooust.ac.ke
Website: www.jooust.ac.ke

P.O. BOX 210 - 40601
BONDO

OUR REF: JOOUST/DVC-RIO/ERC/E4

5th April, 2023

Joaquim Simbiye
SHS
JOOUST

Dear Mr. Simbiye,

RE: APPROVAL TO CONDUCT RESEARCH TITLED "EXPLORING FACTORS INFLUENCING RTS,S/AS01 MALARIA VACCINE UPTAKE FOR CHILDREN AGED 24-36 MONTHS IN NSANJE DISTRICT, MALAWI"

This is to inform you that JOOUST ERC has reviewed and approved your above research proposal. Your application approval number is **ERC 37/04/23-5/05.** The approval period is from 5th April, 2023– 4th April, 2024.

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations and violations) are submitted for review and approval by JOOUST IERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to NACOSTI IERC within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks of affected safety or welfare of study participants and others or affect the integrity of the research must be reported to NACOSTI IERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to JOOUST IERC.

Prior to commencing your study, you will be expected to obtain a research permit from National Commission for Science, Technology and Innovation (NACOSTI) https:oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

Prof. Francis Anga'wa
Chairman, JOOUST ERC

Copy to: Deputy Vice-Chancellor, RIO   Director, BPS   DEAN, SHS

Adm

Appendix 7: Clearance to conduct this study in Nsanje District

Telephone: +265 (0) 1 456 222/242
+265 997 451 860
E-mail: chapweteka47@gmail.com

All Communications should be addressed to:
Director of Health & Social Services

In reply please quote,
Ministry of Health,
Nsanje District Hospital,
P.O. Box 30,
NSANJE.

Date: 7/11/2022

Atusaye Joaquim Simbeye

Jaramogi Oginga Odinga University of Science and Technology School of Health Sciences

P.O. Box 2014061

Bondo

Kenya

Dear Sir,

PERMISSION TO CONDUCT RESEARCH IN NSANJE DISTRICT

Following your application for permission to conduct academic research in Nsanje district and having presented to the research committee, am pleased to inform you that your request to conduct a research study in Nsanje has been approved by the District Research Coordinating Committee. The approval gives you an opportunity to carry out the research titled "**Exploring Factors Influencing RTS, S/AS01 Malaria Vaccine Uptake for Children aged 24-36 Months in Nsanje District, Malawi'**

This means that you have access to Ministry of Health facilities and data in the district and that you can work with government staff and communities to assist in the research process.

We expect you to operate within the ethical standards of both training institution and Nsanje District Council, and that you will share a report on your findings.

Yours faithfully,

Chancy Banda

Chairperson for Nsanje DHO Research Coordinating Committee

MINISTRY OF HEALTH
DIRECTOR OF HEALTH AND SOCIAL SERVICES
07 NOV 2022
NSANJE DISTRICT COUNCIL
PRIVATE BAG 1, NSANJE