

**ENSIGN GLOBAL UNIVERSITY,
KPONG, EASTERN REGION, GHANA**

**FACULTY OF PUBLIC HEALTH
DEPARTMENT OF COMMUNITY HEALTH**

**DETERMINANTS OF INCOMPLETE IMMUNIZATION AMONG CHILDREN
AGED 12 TO 23 MONTHS IN THE LOWER MANYA KROBO MUNICIPALITY,
EASTERN REGION OF GHANA**

BY

**VICTORIA AMA POAVRI
(257100326)**

MAY, 2026

**ENSIGN GLOBAL UNIVERSITY,
Kpong, Eastern Region, Ghana**

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BY

VICTORIA AMA POAVRI

(257100326)

**A THESIS SUBMITTED TO THE DEPARTMENT OF COMMUNITY HEALTH,
FACULTY OF PUBLIC HEALTH, ENSIGN GLOBAL COLLEGE IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE
MASTER OF PUBLIC HEALTH DEGREE**

MAY, 2026

DECLARATION

I, Victoria Ama Poavri, hereby certify that, except for references to other people's work, which I have duly cited, this project submitted to the Department of Community Health, Ensign Global University, Kpong is the result of my own investigation, and has not been presented for any other degree elsewhere.

VICTORIA AMA POAVRI
(ID – 257100326)
(STUDENT)

...

Signature

15th April 2026

Date

(Certified by)

PROF. STEPHEN MANORTEY
(Supervisor)

.....

Signature

.....

Date

(Certified by)

PROF. STEPHEN MANORTEY
(Head of Academic Program)

.....

Signature

.....

Date

DEDICATION

I dedicate this thesis to God Almighty for His mercy, grace, and guidance. He has been faithful through all the years.

ACKNOWLEDGEMENT

I wish to express my profound gratitude to Professor Stephen Manortey, my supervisor, for his enormous and critical contributions to this work. I also wish to acknowledge Dr. James Avoka, Municipal Director of Health, Lower Manya. My appreciation goes to Honourable Francis Akumatey Addo, Mr Eugene Adjetey, Mr Seth Laryea and my family for their assistance during my studies. Finally, I am deeply grateful to the staff of Odumase sub-municipality for their support.

May the Almighty God richly bless them.

DEFINITION OF TERMS

Adverse Events Following Immunization (AEFI)	Any untoward medical occurrence which follows immunization and which does not necessarily have a causal relationship with the usage of the vaccine
Caregiver Vaccination Attitudes Scale (CVAS)	A validated tool design to measure parents' beliefs, confidence and attitudes toward childhood vaccines
Child Welfare Clinic (CWC)	Health facilities or outreach sessions that provide immunizations, growth monitoring, and related child health services for children under five years
Community Health Planning and Services (CHPS)	A community-based health service system designed to provide primary health care at the community level
Dropout Rate	The proportion of children who begin but do not complete the full vaccination schedule
Expanded Programme on Immunization (EPI)	A WHO initiative aimed at providing universal access to vaccines for children and mothers, reducing morbidity and mortality from preventable diseases
Incomplete Immunization	A situation in which a child has not received all recommended vaccine doses according to Ghana's EPI schedule
Second Year of Life (2YL) Vaccines:	Vaccines administered after the first birthday. Example: measles, rubella and meningococcal vaccine
Sub-Municipality	A local administrative unit within a municipality, often responsible for delivering community health services.
Zero-Dose Children	Children who have not received any routine immunization

List of Abbreviations

AEFI.....	Adverse Events Following Immunization
ANC	Antenatal Care
AOR.....	Adjusted Odd Ratio
BCG	Bacillus Calmette Guerin
CHPS.....	Community-Based Health and Planning Services
CI.....	Confidence Interval
CWC	Child Welfare Clinic
DHIMS2.....	District Health Information Management Version 2
DHS.....	Demographic and Health Survey
EPI.....	Expanded Programme on Immunization
GDHS.....	Ghana Demographic and Health Survey
GHS.....	Ghana Health Service
GSS	Ghana Statistical Service
KAP.....	Knowledge, Attitude and Practice
LMICs	Low- and Middle-Income Countries
MR	Measles–Rubella
NIP	National Immunisation Programme
OPV.....	Oral Polio Vaccine
OR.....	Odd Ratio
PNC.....	Postnatal Care
REC.....	Reach Every Child
SDG.....	Sustainable Development Goal
SPSS.....	Statistical Package For Social Sciences
UHC	Universal Health Coverage
UNICEF	United Nations Children’s Fund
WHO	World Health Organization

ABSTRACT

Background: Immunization is a cornerstone of child health, yet coverage gaps persist due to socioeconomic and health system barriers.

Aim: This study examined determinants of incomplete immunization among children aged 12–23 months, focusing on demographic, socioeconomic, and health system factors.

Methodology: A cross-sectional survey of 344 caregivers was conducted. Chi-square tests assessed associations between demographic and health system variables and immunization status, while binary logistic regression identified independent predictors of incomplete immunization.

Results: Of the children studied, 68.9% were fully immunized and 31.1% missed at least one vaccine, with Yellow Fever most frequently missed (13.4%). Chi-square analyses revealed significant associations with age, income, occupation, marital status, distance to facility, transport mode, vaccine availability, waiting time, and clinic crowding. Logistic regression confirmed that age group, income level, vaccine availability, and clinic crowding were independent predictors of incomplete immunization, while occupation lost significance after adjustment.

Conclusion: Both socioeconomic status and health system capacity are pivotal determinants of immunization outcomes. Younger caregivers, low-income households, and those affected by vaccine shortages or clinic crowding are at greatest risk. Strengthening vaccine supply chains, reducing clinic congestion, expanding caregiver education, and addressing socioeconomic inequities are essential strategies to improve immunization coverage and equity.

Contribution: By situating the analysis within the Ghanaian context, this study contributes to the literature on immunization determinants in low- and middle-income countries. It provides actionable evidence for policymakers and health practitioners seeking to achieve universal immunization coverage and safeguard child health.

Keywords: Immunization Coverage, Caregiver Knowledge, Socio-Economic Determinants, Cultural Influences, Odumase, Lower Manya Krobo.

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CHAPTER ONE

INTRODUCTION

1.0 Background

Childhood vaccination is one of the most effective public health treatments, helping to prevent avoidable deaths of up to two to three million resulting from diseases such as measles, diphtheria, pertussis, and tetanus.(Galadima *et al.*, 2021b; Alice Kuuyi & Robert Kogi, 2024). In Ghana, the Expanded Programme on Immunization (EPI) has significantly reduced morbidity and mortality from vaccine-preventable diseases, and national survey data show high coverage of basic vaccines among children aged 12-23 months, with complete vaccination increasing from 85.1% in 1998 to 95.2% in 2014 (Budu *et al.*, 2020b).

Studies conducted at the district level also reveal excellent coverage in certain places. For instance, Techiman Municipality reports 89.5% of residents are fully immunized, with 10.5% reporting insufficient vaccination (Adokiya *et al.*, 2017). Additionally, Nadowli Kaleo and Kassena Nankana West districts have much lower full coverage (55–57% complete immunization according to (Akanpaabadai *et al.*, 2024b); Kuuyi & Kogi, 2024). These averages conceal areas of under-vaccinated and "zero dose" children who are still susceptible to outbreaks and contribute to the ongoing spread of diseases that can be prevented by vaccination (Akanpaabadai *et al.*, 2024b; Ogundele *et al.*, 2025).

The age range of 12 to 23 months is crucial for evaluating immunization performance because, by this time, a child should have finished all of the basic doses that Ghana's EPI schedule recommends, such as BCG, three doses of oral and pentavalent polio vaccine, and measles/rubella by 12 months, with some schedules going up to 18 months (Adokiya *et al.*, 2017; Baguune *et al.*, 2017; Wemakor *et al.*, 2018)

Incomplete immunization in this age group, which is defined as not receiving one or more of the recommended doses, is strongly associated with risks of vaccine-preventable morbidity and mortality and indicates deficiencies in the supply and demand for routine services (Atnafu Gebeyehu *et al.*, 2023; Ogundele *et al.*, 2025; Wemakor *et al.*, 2018). Ghana has established aggressive goals, including ≥ 90 –95% full coverage, but many districts and areas still fall short, and second-year-of-life antigens, like the second dose of measles, sometimes exhibit especially low uptake (Alice Kuuyi & Robert Kogi, 2024).

Incomplete childhood immunization continues to be a significant burden throughout Africa. Approximately 35–36% of African children do not receive all recommended vaccinations, according to a recent systematic analysis (Ogundele *et al.*, 2025). Depending on the vaccinations and definition employed, large multicounty analyses from sub-Saharan Africa show pooled incomplete immunization prevalences of around 36% and 67% (Ogundele *et al.*, 2025; Tsegaw *et al.*, 2024b). Incomplete immunization is consistently associated with socioeconomic disadvantages, such as living in a rural area, giving birth at home, not receiving prenatal and postnatal care, having low maternal education, being unemployed, having a large family, and not having health insurance (Kebede *et al.*, 2025; Ogundele *et al.*, 2025; Tsegaw *et al.*, 2024b).

Within Ghana, multiple studies have begun to map the determinants of incomplete immunization among children aged 12–23 months, revealing both common patterns and contextual differences. Older mothers and those who are married or in stable partnerships tend to have children with higher odds of full vaccination compared with very young or single mothers (Adokiya *et al.*, 2017; Akanpaabadai *et al.*, 2024b; Budu *et al.*, 2020b; Alice Kuuyi & Robert Kogi, 2024)

Evidence from West Africa further underscores this challenge. A pooled analysis from four West African countries found that incomplete vaccination among 12–23-month-olds was common, and that maternal antenatal care use, education, employment, facility delivery, household wealth, and older maternal age all reduced the odds of incomplete vaccination (Ogundele 2025). These findings suggest that improving women's access to and engagement with maternal health services, reducing financial barriers, and strengthening routine immunization systems are central to addressing incomplete coverage in the region.

In Ghana, the proportion of children aged 12-23 months who receive all basic immunisations has dropped from 77% to 73%. During the same era, the proportion of children without childhood vaccinations grew nationwide from 1% to 2% (Chris Guure *et al.*, 2025). The Expanded Programme on Immunisation (EPI) in Ghana has achieved significant progress. When the campaign was first introduced in Ghana in 1978, its main goal was to prevent the six childhood killer diseases.

Currently, the Expanded Programme on Immunization includes 13 vaccine-preventable illnesses. Schedule. Ghana's EPI has significantly contributed to the reduction of five deaths. Immunization performance has become a major health performance indicator for Ghana's whole health sector, and it is tracked at all levels (Baguune, 2017; Walana, Al-Azab, Yabasin, & Abdul-Mumin, 2024). The national target for all antigens in Ghana is 95% coverage; nevertheless, reports suggest that some districts have low immunization rates, impeding progress toward the targets (Alice Kuuyi & Robert Kogi, 2024). Odumase sub-municipality in the Lower Manya Krobo Municipality in the Eastern Region of Ghana, for example, has repeatedly reported coverage rates below 90% for critical antigens such as yellow fever, measles, rubella, and meningococcal vaccination. The study tries to investigate the causes of this inadequate coverage.

1.1 Problem Statement

Childhood immunisation is the cornerstone for under-five survival (Prendergast, 2015). Ghana has made significant progress in increasing coverage over time. In 2016, more than 11 million children were vaccinated against measles and rubella.(Basheer, 2020). Despite these improvements, gaps in coverage remain in some districts

In recent years, Odumase sub-municipality has recorded low coverage for important antigens such as yellow fever, measles, rubella, and meningococcal conjugate vaccination (DHMIS 2, 2024:(Dalaba *et al.*, 2023). A recent home visit report from Community Health nurses in the Odumase-Krobo enclave reveals high defaulter rate among children aged 12 to 24 months with incomplete immunisation. Research frequently studies mother, family, or health-system characteristics in isolation; however, little emphasis is paid to how these determinants interact, such as maternal education reducing the influence of distance to facilities. Practical impediments such as forgetting appointments, transportation challenges and inconvenient clinic time have been documented in various studies but have not been thoroughly examined in relation to systemic flaws such as stockouts or inadequate communication. The lack of district-level evaluations that incorporate maternal, family, health-system, and behavioural determinants hinders the capacity to develop targeted policies. Furthermore, inadequate attention to second-year antigens and the combination of factors create crucial gaps in understanding why children miss doses even when resources are offered. Without addressing these gaps, Ghana risks ongoing epidemics, disparities in child health outcomes, and failure to reach Sustainable Development Goal (SDG) targets linked to universal health coverage and child survival. This project intends to address the gap and develop relevant interventions to boost vaccination coverage in the Odumase sub-municipality.

1.2 Rationale of the Study

Childhood immunization remains one of the most effective public health interventions, yet Ghana's progress toward universal coverage is undermined by persistent inequities in completion among children aged 12–23 months. While national surveys suggest high average coverage, district-level studies reveal striking disparities, with some areas achieving near-universal vaccination and others reporting completion rates as low as fifty five percent. These gaps are not trivial; they represent thousands of children who are vulnerable to vaccine-preventable diseases, sustaining transmission chains and risking outbreaks that can reverse decades of progress. Despite efforts to increase immunization coverage, recent data from the Lower Manya Krobo Municipal Health Directorate and the community health report show that the Odumase sub-municipality has low coverage for yellow fever, measles, rubella, and meningococcal conjugate vaccine. Although past studies have demonstrated that variables such as socioeconomic status and healthcare service factors influence immunization uptake, there is no information specific to the Odumase sub-municipality. The findings from this will contribute to the creation of evidence-based initiatives to boost vaccine uptake in the sub-municipality. The findings will help support the development of evidence-based interventions to increase vaccine uptake in the sub-municipality

1.3 Conceptual Framework

The study will adopt the Andersen (1995) health utilization model. This conceptual framework looks at three angles.

- i. **Sociodemographic (Predisposing) Factors:** These shape the caregiver's likelihood to seek immunisation services. These factors influence attitudes and intentions toward child immunisation, even before any contact with the health system. This may include Age, education, marital status, Cultural beliefs and norms and religious influences. These factors

influence attitudes and intentions toward child immunisation, even before any contact with the health system.

ii. **Health System (Enabling) Factors:** These determine whether caregivers can access immunisation services. It includes Distance to health facility, Availability of vaccines and Health workers' attitude and communication. Even if a caregiver is willing, poor infrastructure or negative experiences can prevent service use.

iii. **Caregiver Knowledge, Attitude, and Practice (Need Factors):** These reflect the caregiver's perceived need and understanding and includes Knowledge of immunisation schedules, Beliefs about vaccine benefits and risks and Past experiences with child illness or immunisation. This dimension directly influences motivation and urgency to seek services.

iv. **Immunisation Uptake:** When all three dimensions align—predisposition, access, and perceived need—caregivers are more likely to utilize immunisation services, improving child health outcomes.

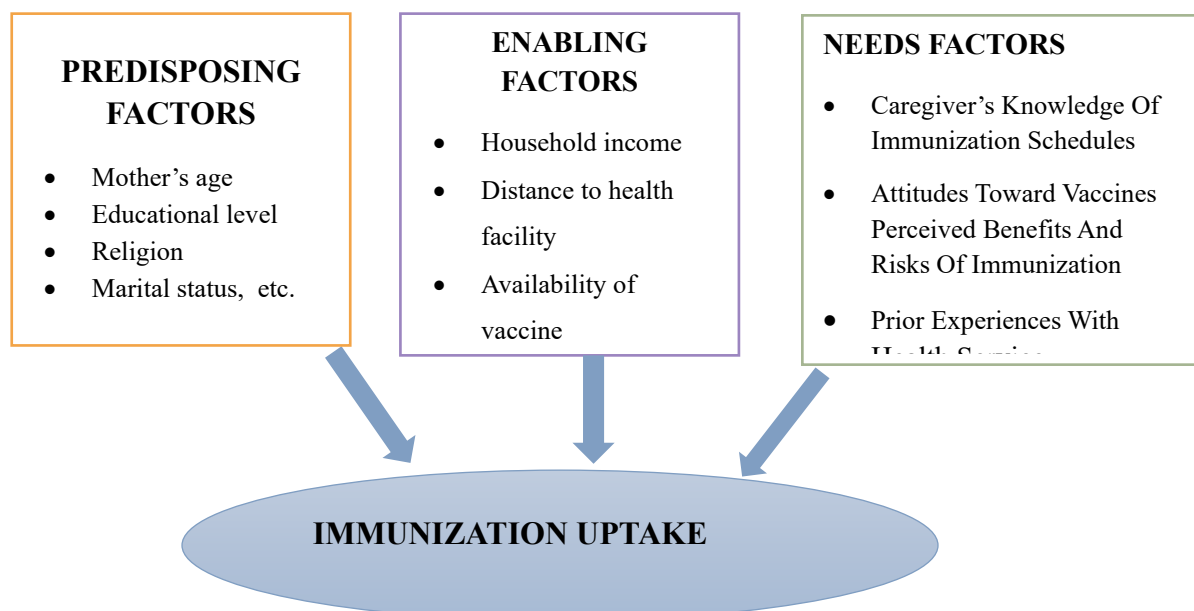


Figure 1. Conceptual Framework Source: Andersen (1995)

1.4 Research Questions

- i. What proportion of children aged 12 to 23 months in Odumase sub-municipality are not completely immunised?
- ii. What health system-related barriers contribute to incomplete immunization?
- iii. What do caregiver know about childhood immunization, and what are their attitudes and practices towards completing the immunisation schedule?

1.5 General Objective

To assess factors contributing to incomplete immunisation among children aged 12 to 23 months in the Odumase sub-municipality of the Lower Many Krobo Municipality in Ghana.

1.6 Specific Objectives

- i. To determine children aged 12 to 23 months in Odumase sub-municipality who have incomplete immunization.
- ii. To identify health systems-related barriers that contribute to incomplete immunisation.
- iii. To assess caregivers' knowledge, attitudes, and practices regarding routine immunisation.

1.7 Profile of the Study Area

Odumase sub-municipality is one of the six sub-municipalities of Lower Manya Krobo Municipal in the Eastern Region of Ghana. Odumase is the administrative capital of Lower Manya Krobo. The municipality covers an area of 1,476 km, constituting about 8.1% of the total land area within the Region (18,310 km). (GSS 2021). The major towns in the district include Odumase Township (which incorporates Atua, Agormanya, and Nuaso), Akuse, and Kpong in the Lower Manya area. The municipal shares Boundaries with Upper Manya Krobo

District to the north, to the south with Dangme West and Yilo Krobo respectively, to the west with Yilo Krobo Municipal, and to the east with Asuogyaman District.

The population of the Municipality, according to the 2021 Population and Housing Census, stands at one hundred and twenty-one thousand, four hundred and seventy-eight.

Odumase sub-municipality has an estimated population of 35,224, representing 28% of the municipal population, making it the second largest sub-municipality (GSS 2021). One hospital, one health centre, one maternity home, and six community health planning and services (CHPS) zones render immunisation activities in the sub-municipality. The sub-municipality conducts 38 monthly outreach child welfare clinic (CWC). Additionally, the hospital operates a daily CWC, while the health centre runs a weekly CWC, and monthly CWCs are organised in all pre-schools in the area. There are 53 communities in the sub-municipality.

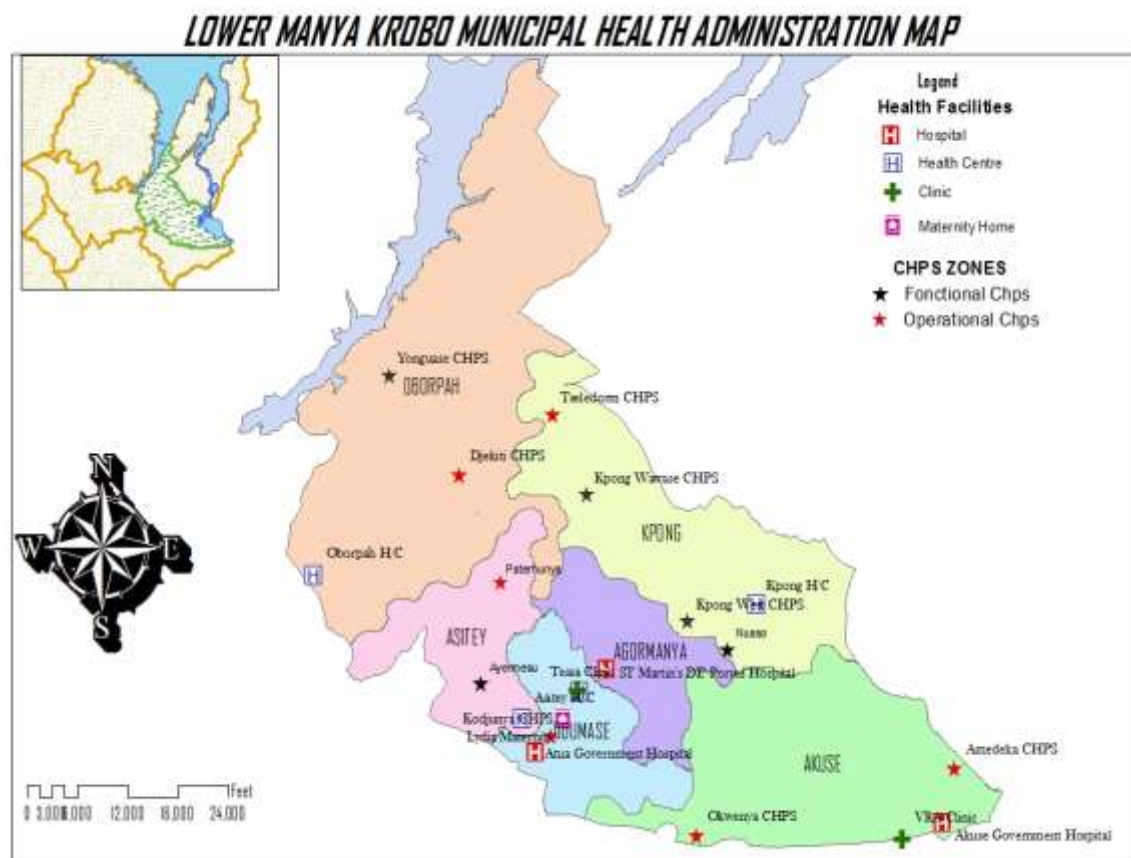


Figure 2. Map of the Lower Manya Krobo Municipality

1.8 Scope of Study

This study focuses on the factors that contribute to inadequate immunization in children in the lower Manya Krobo municipality in Ghana's eastern region who are between the ages of 12 and 23 months. It explores what health system-related obstacles lead to incomplete immunization and what caregivers know about childhood immunization by examining their attitudes and practices regarding finishing the immunization schedule. Finally, it draws conclusions about specific demographics that may contribute to incomplete immunization.

1.9 Organization of Report

This research is presented in six chapters which uniquely tackle various aspects of the study as follows:

The background of the study, the problem statement, the study's purpose and objectives, the research questions, the conceptual framework, and the study's justification are all included in the first chapter, which provides an overview of the entire subject. It also displays the report's format and the study's scope. The study's literature is reviewed in Chapter Two, along with definitions of words and ideas related to children between the ages of 12 and 23 months and the related vaccination protocols. It explores how the immunization process starts, the functions of specific international organizations, and the different viewpoints of obstacles, attitudes, and knowledge of caregivers and the health system as a whole that contribute to complete or incomplete immunization worldwide. The research design, sampling strategies, and data analysis procedures are all covered in Chapter Three's methodology section of the study. The survey results are presented in Chapter Four, and the study's conclusions are discussed in Chapter Five, which draws certain conclusions. A summary of the study's findings and some suggestions for the various stakeholders are provided in Chapter Six.

CHAPTER TWO

LITERATURE REVIEW

2.0 The Expanded Programme on Immunisation (EPI),

The World Health Organization's (WHO) Expanded Programme on Immunisation (EPI), launched in 1974, is a global initiative that offers universal access to life-saving vaccines for children and mothers, significantly lowering mortality from preventable diseases. It covers tuberculosis, polio, diphtheria, tetanus, pertussis, and measles immunisations, which have been expanded to include contemporary vaccines.(WHO, 1983). The primary purpose of this initiative was to ensure that all children, regardless of geography, had access to vaccinations. Vaccines have saved 154 million lives during the last 50 years, or six people per minute (Sim *et al.*, 2020).Immunisation programs are among the most cost-effective public health treatments; however, they now face a critical moment of halted development, disparities, and system-level problems. (Lindstrand *et al.*, 2021) .

2.1 Service Delivery and Operational Components

Core operational domains that are common across settings include routine and outreach delivery, vaccine logistics and cold chain, data and surveillance, and workforce and financing.

2.1.1 Routine and outreach delivery:

With routine and outreach delivery, there are a selection of fixed-site services which are complemented by outreach and campaigns to reach underserved areas (Okwo-Bele & Cherian, 2011; Shibeshi *et al.*, 2020; Lame *et al.*, 2023; Bhadoria *et al.*, 2019).

A Democratic Republic of the Congo mixed-methods study (Ngo-Bebe *et al.*, 2025; Mafuta *et al.*, 2025) found that georeferenced micro-plans improved immunisation planning and outreach (Ngo-Bebe *et al.*, 2025). In Haut Lomami, vaccine coverage rose and zero-dose children decreased (Ngo-Bebe *et al.*, 2025; Mpiongo *et al.*, 2023). A gender component in Kasai initially

increased women's participation, but long-term effects remain to be assessed (Ngo-Bebe *et al.*, 2025). Challenges included poor data quality, low digital literacy, and difficulty tracking mobile populations (Ngo-Bebe *et al.*, 2025; Mutwadi *et al.*, 2024; Mbunga *et al.*, 2024). Recommendations: follow-up studies, improved community engagement, digital literacy, and tracking systems for migrants (Ngo-Bebe *et al.*, 2025; Jain *et al.*, 2022; Mutwadi *et al.*, 2024).

2.1.2 Vaccine logistics and cold chain:

National and regional assessments generally corroborate the claim that vaccine logistics and cold chain systems operate at a "fair" but fragile level, constrained by financing, stock management, and equipment maintenance. In half of the 20 East and Southern African countries (2012-2018), operational funding was insufficient, resulting in the cancellation of outreach services, supportive supervision, and cold chain equipment maintenance (Shibeshi *et al.*, 2020; Shibeshi *et al.*, 2021). Similar financing gaps hinder supervision, outreach, and cold-chain improvement in India's Universal Immunisation Programme (John & Kompithra, 2025). When it comes to cold chain challenges, they include frequent power outages, lack of backup generators, outdated equipment, and inadequate subnational capacity (Shibeshi *et al.*, 2020; Shibeshi *et al.*, 2021).

2.1.3 Data and surveillance:

Vaccine Coverage is normally evaluated using administrative data (doses delivered/target population), household surveys and WHO/UNICEF estimates, but data quality remains a major concern (Harrison *et al.*, 2020). Common issues include inflated numerator, outdated denominator and discrepancies between source causing administrative coverage to exceed 100% (Adetifa *et al.*, 2018; Stashko *et al.*, 2019; Pond *et al.*, 2021; Zuber *et al.*, 2003). In Ethiopia and Kenya, routine methods misclassify coverage by 7 to 20 percentage points when compared to surveys or registry "gold standards" (Adetifa *et al.*, 2018; Pond *et al.*, 2021). Additional problems include Selection bias, recall error, and uneven agreement between

caregiver recall, records, and serology (Cutts *et al.*, 2016; Cutts *et al.*, 2013; Dansereau *et al.*, 2019).

A SAGE working group recommended for country-owned systems, improved denominators, and ongoing quality improvement after concluding that, in addition to accuracy issues, the use of vaccination and surveillance data for program management is inadequate, particularly at the facility level (Scobie *et al.*, 2020). Studies in Ethiopia, Cameroon, and Ghana, local use of data for decision-making is hampered by limited analytical skills, poor documentation, under- or excessive reporting, and missing or incomplete recording instruments (Daka *et al.*, 2025; Saidu *et al.*, 2023; Piu *et al.*, 2024).

2.1.4 Workforce and financing:

Health worker shortages, poor HR management, and funding gaps hinder vaccine introduction and coverage in LMICs (Olayinka *et al.*, 2024). Low pay, weak supervision, and delayed salaries drive low performance (Naveed *et al.*, 2021), while CHWs face inadequate compensation and demanding schedules (Gibson *et al.*, 2023; Ogutu *et al.*, 2024). The immunization funding gap across 94 LMICs was US\$7.6 billion (2016–2020), mainly for service delivery and supply chain (Ozawa *et al.*, 2016). Low-income countries rely on donors for ~70% of vaccination costs (Ikilezi *et al.*, 2021), and poorly planned transitions cause stock-outs and HR losses (Huffstetler *et al.*, 2022). In China, NIP vaccines face budget constraints, while non-NIP vaccines rely on out-of-pocket payments (Zhang *et al.*, 2025; Jiang *et al.*, 2024). Recommendations include fair CHW compensation and stable domestic financing (Gibson *et al.*, 2023; Yim *et al.*, 2024)

2.1.5 Proportion of children aged 12 to 23 months who have incomplete immunization

Numerous studies worldwide indicate that incomplete immunization among children aged 12 to 23 months is common in low- and middle-income settings. A DHS analysis of 48 "resource-limited countries" (including Honduras and Haiti) revealed that 51% of children aged 12 to 23

months had incomplete basic vaccinations overall, with strong gradients by poverty, low maternal education, and rural residence (Getnet, Jejaw, Belachew, Addis, Dellie, Tafere, Worku, Geberu, Yazachew, & Teshale, 2025). Additionally, a 92-country "immunisation cascade" (all LMIC regions) revealed that only 59.9% of children were fully immunised for four basic vaccines; 7.7% received zero doses, and 21.3% received only one or two vaccines (Cata-Preta *et al.*, 2021). Large unvaccinated groups exist in 43 LMICs, including Haiti, sub-Saharan Africa and South Asia (Richardson & Benmarhnia, 2023). A meta-analysis of DHS from 41 LMICs found that 41% lack full basic vaccination (Tamir *et al.*, 2025).

Regional rate include 36.1% incomplete immunization in 16 Sub-Saharan African nations (Tsegaw *et al.*, 2024a). 40.8% in South Africa (Ndwandwe *et al.*, 2020), 27.7% in Togo, (D. Ekouevi *et al.*, 2018). 30.7% Lomé (Zida-Compaore *et al.*, 2019). 24.3% in Gondar, Ethiopia (Yismaw *et al.*, 2019). 24.4% Minjar Shenkora, Ethiopia, (Mekonnen *et al.*, 2019). 44.5% in Nigeria's Enugu State (Eze *et al.*, 2021). According to (Khan *et al.*, 2024), 49.7% of people in Pakistan's peri-urban Peshawar were not fully immunised

Overall, a quarter to almost half of children aged 12 to 23 months are reported to be incompletely immunised overall by numerous recent studies conducted in Africa and Asia; the gaps are larger in rural and impoverished areas (D.Ekouevi *et al.*, 2018; Eze *et al.*, 2021; Mekonnen *et al.*, 2019; Ndwandwe *et al.*, 2020; Tsegaw *et al.*, 2024a; Yismaw *et al.*, 2019)

2.2 Immunization Coverage in Ghanaian Districts: Patterns and Gaps

Ghana has achieved relatively high national immunization coverage, but district-level data show substantial variation and pockets of low or incomplete coverage. Recent studies highlight rural–urban, regional, and population-specific disparities that are masked by national averages.

National DHS-based analyses estimate 56% full vaccination by national schedule (12–35m), with marked regional variation (e.g., 72% in Greater Accra vs 31% in Northern Region)

(Tekeba *et al.*, 2025). Earlier work shows rising national full-immunization over time, but persistent inequalities by wealth, maternal education, and region (Budu *et al.*, 2022; Budu *et al.*, 2020a; Donfouet *et al.*, 2019; Gram *et al.*, 2014). Rural areas now often outperform urban ones, reflecting underserved urban slums and informal settlements (Asuman *et al.*, 2018; Donfouet *et al.*, 2019; Harvey *et al.*, 2025). District-level evidence across multiple regions confirms that incomplete immunization is widespread, especially when stricter “all antigens” definitions or second-dose measles/MR are considered. Hard-to-reach (rural islands, nomadic groups) and urban poor settings emerge as consistent gaps needing targeted reach every district/child” strategies.

In Summary, many districts in Ghana still fall short of full immunization both in overall completion and for specific vaccines like measles/MR2. National progress coexists with sub-national pockets of under- and un-immunized children, underscoring the need for district-tailored, equity-focused interventions.

2.3 Health Systems-Related Barriers that Contribute to Incomplete Immunisation.

Geographic access and transport as barriers to immunisation

Distance, travel time, and transportation continue to be significant obstacles to immunization outside of Africa and Asia, particularly in rural, isolated, and socioeconomically disadvantaged areas. According to (Naderi *et al.*, 2025), even a small amount of additional travel can cause uptake to be delayed. Further research indicates that 43.3% of people worldwide are unable to walk to any medical facility within an hour; motorized transportation significantly increases accessibility but is frequently inaccessible to underprivileged populations in isolated areas (Weiss *et al.*, 2020).

In low-resource rural areas of Latin America and other regions, patients must travel long distances on foot or via unreliable transportation to access services due to rough terrain,

inadequate road networks, and a lack of transportation, according to reviews of healthcare access across high and low-income countries (Dawkins *et al.*, 2021; Weiss *et al.*, 2020). Across regions beyond Africa and Asia, long distances, poor roads, lack of affordable transport, and “vaccine deserts” in rural or marginalized areas continue to limit timely vaccination and deepen inequities in coverage.

2.4 Geographic access and transport as barriers to immunisation in Africa

Long walks to facilities (30-60 minutes or more) increase the likelihood of inadequate immunization, especially in rural and underserved areas (Boke *et al.*, 2022; Ekouevi *et al.*, 2018; Tsegaw *et al.*, 2024; Eze *et al.*, 2021; Malande *et al.*, 2019). Poor roads and inadequate transportation also impede outreach, supervision, and vaccine delivery as seen in rural Uganda (Hoima), where these factors contribute to a high dropout rate and measles outbreak (Malande *et al.*, 2019). In Kampala's informal settlements, long distance, transport cost, and few vaccinators led to 3-6 hours waiting time and missed doses (Babirye *et al.*, 2014).

A systematic review of sub-Saharan Africa confirmed long distances, a lack of nearby facilities, and limited outreach capacity as core health system barriers (Bangura *et al.*, 2020; Oluwafemi *et al.*, 2025; Songane, 2018).

Overall, poor geographic access continuously reduces immunization coverage and hampers outreach, particularly in rural and isolated areas.

2.5 Geographical access, transport, and vaccination in Ghana

In Ghana, distance and transportation constraints consistently hinder vaccination, particularly in rural and hard-to-reach populations. In the Nadowli-Kaleo District, increased distance lowered the probability of being fully vaccinated (Alice Kuuyi & Robert Kogi, 2024).

A national study revealed "difficult-to-reach island communities along the Volta Basin" and limited fixed/outreach EPI sites as important barriers to immunization delivery (Yawson *et al.*,

2017). Inadequate funds and logistics also hindered outreach among pastoralist nomads in four regions, causing mobile populations to frequently miss vaccination rounds (Afari-Asiedu *et al.*, 2024).

It is generally acknowledged that "access" to communities is a significant concern in Ghana's vaccination programs. This suggests that putting vaccinations in facilities or workplaces could improve uptake by reducing travel distance and inconvenience for priority groups, such as the elderly, security services, and health workers (Agboh & Yarney, 2025). Cape Coast vaccine providers also noted that an otherwise vigorous outreach-based campaign was hampered by a lack of transportation options and appropriate locations (Abraham *et al.*, 2023). Evidence from Ghana indicates that timely vaccination is hampered, especially for rural, island, and mobile populations, by bad roads, long and seasonally dangerous walking routes, islands and nomadic mobility, and inadequate transport/logistics infrastructure.

2.6 Service organization and vaccine availability as barriers to immunisation:

Whether or not caretakers finish childhood vaccinations is heavily influenced by the "convenience" and dependability of the health system. Outreach to rural locations, ongoing availability of vaccinations and supplies, and service scheduling are three common problems across contexts. Qualitative research conducted in Malawi and Mozambique reveals that caregivers spend a lot of time traveling and waiting only to discover that vaccines are either out of stock or that the vials have not been opened. This makes subsequent trips seem "not-worth-it" and raises the dropout rate (Lawrence *et al.*, 2025; Powelson *et al.*, 2024; Powelson *et al.*, 2022). Distant communities suffer the most from outreach that is underfunded (few sessions, lack of transportation or fuel, outdoor locations without cover) (Powelson *et al.*, 2024; Powelson *et al.*, 2022).

2.6.1 How inconvenient clinic times and long waits reduce vaccination completion

Long waiting times have been widely recognised as a major barrier to effective service delivery, impacting the uptake and completion of childhood immunisation programmes. Across sub-Saharan Africa, extended waiting periods have been linked to missed work hours, loss of income, and decreased caregiver satisfaction. In Nigeria, delays were attributed to operational inefficiencies such as repetitive documentation and waiting until a critical number of children were present before starting sessions (Ekhaguere *et al.*, 2021).

Quantitative evidence from Cameroon reported a median waiting time of 1 hour and 48 minutes, with delays of up to four hours, contributing significantly to dissatisfaction and reduced service utilization (Saidu *et al.*, 2024). In Ethiopia, waiting times exceeding 30 minutes were significantly associated with lower caregiver satisfaction and poorer adherence to immunization schedules (Dana *et al.*, 2020), while qualitative findings further linked prolonged clinic visits to missed measles vaccine doses, particularly among farming households (Wodajo *et al.*, 2025).

2.6.2 Limited and rigid clinic days/hours

Restrictive vaccination policies, such as limiting multi-dose vials or offering certain vaccines only on specific days, often result in caregivers being turned away if they arrive on the "wrong" day or too late, wasting time and transportation costs and reducing motivation to return (Powelson *et al.*, 2024; Saidu *et al.*, 2024; Vedel *et al.*, 2025). In Guinea-Bissau, such vial-opening regulations confine BCG, measles, and yellow fever vaccinations to designated days, forcing caregivers to endure multiple visits and prolonged waiting periods, which they identify as a significant barrier (Vedel *et al.*, 2025). Cross-sectional evidence from Kenya indicates that 37% of caregivers were unable to maintain appointments due to insufficient time off work, highlighting the need for flexible clinic hours and daily vaccine availability to improve adherence (Muathe *et al.*, 2020). Similarly, a study in Uganda found that flexible service hours

were positively associated with completion of the full immunization schedule, underscoring that scheduling and session organization are modifiable determinants of program adherence (Abor *et al.*, 2022).

2.6.3 Evidence that better timing can help

As an example of how rearranging sessions can directly reduce waiting times and improve the vaccination experience, intervention work from Nigeria demonstrated that replacing batch, in-person health talks with a looped audiovisual education video reduced average clinic time by 13–31 minutes and was well received by caregivers and staff (Ogundele *et al.*, 2025). In general, in many African contexts, long, uncertain wait times, infrequent clinic days, and inconvenient session times combine with caregivers' work and household obligations to increase opportunity costs. As a result, many caregivers, particularly those who work, postpone, skip, or cancel vaccination visits (Powelson *et al.*, 2022; Ekhaguere *et al.*, 2021; Muathe *et al.*, 2020; Saidu *et al.*, 2024; Wodajo *et al.*, 2025; Dana *et al.*, 2020; Powelson *et al.*, 2024).

2.7 Ghana-specific evidence

Long wait times, inappropriate outreach locations, a shortage of furniture, poor intersectoral collaboration, inadequate caregiver knowledge, and budgetary challenges were identified by a Ghanaian study in the same sub-Saharan evaluation as major obstacles to the health system (Bangura *et al.*, 2020).

In summary, inconvenient clinic setup, frequent stockouts, and brittle outreach services consistently lower immunization completion rates worldwide, but particularly in sub-Saharan Africa, especially for working and rural caregivers. This regional picture is supported by Ghana's data, which shows that issues with service organization and availability at the facility and outreach levels are important, changeable factors that influence vaccine dropout.

2.8 Health workforce barriers to childhood immunisation:

2.8.1 Communication, trust, and workload

Through staffing levels, communication quality, and interpersonal behaviour, the health workforce significantly influences caregivers' trust, comprehension, and willingness to return for vaccinations in a variety of situations. Even when healthcare professionals are knowledgeable and supportive in theory, a lack of staff, poor communication skills, and authoritarian behaviour undermine parents' confidence and understanding of vaccination, according to a global thematic review of parents' and healthcare workers' perceptions (Balgovind & Mohammadnezhad, 2022). Parents frequently cite rudeness, insensitivity, and tardiness or absenteeism at immunization clinics as reasons for not returning (Balgovind & Mohammadnezhad, 2022). Globally, health professional shortages and heavy workloads are recognized as persistent issues that result in hurried appointments and little time for counselling (Romakin & Masoud, 2019; Tamata & Mohammadnezhad, 2022).

2.8.2 African view: discouraging encounters and weak AEFI systems

When knowledge of AEFIs is reasonable, poor communication regarding side effects and a lack of knowledge of national AEFI reporting systems further erode confidence (Watyaba *et al.*, 2025; Watyaba *et al.*, 2023). In Malawi and Mozambique, negative interactions between health workers were identified as one of the common "dropout drivers," and one of the most suggested solutions was to improve communication between health workers and caregivers (Lawrence *et al.*, 2025).

2.8.3 Ghanaian view: aligning with African patterns

Research on the immunization workforce in Ghana is limited, though regional analyses suggest patterns similar to other West African contexts, including staff shortages, hurried consultations, and occasional caregiver–provider tension (Balgovind & Mohammadnezhad, 2022; Bangura *et al.*, 2020). Overworked nurses, limited counselling, and minimal follow-up for adverse

events mirror broader African trends and are likely relevant to Ghana's EPI services. Collectively, these factors hostility, inadequate counselling, and poor AEFI management—discourage attendance and completion of childhood immunization schedules, while workforce constraints and weak communication skills undermine caregiver understanding and trust (Balgovind & Mohammadnezhad, 2022; Watyaba *et al.*, 2025; Lawrence *et al.*, 2025; Bangura *et al.*, 2020; Romakin & Masoud, 2019).

2.9 System design and information:

Complete and equitable immunization depends on well-designed records and transparent information flows. Paper immunization cards remain essential globally, yet they are often misplaced only 21–69% of caregivers in several high-burden countries could present a card during surveys, with some children denied vaccination when caregivers lacked documentation, resulting in missed or repeated doses (Wagner, 2019; Edossa *et al.*, 2024). Migrants and disadvantaged groups are particularly affected, as many middle- and high-income countries lack central registers, reliable documentation, or reminder systems, leading to uncertainty about catch-up schedules and lost opportunities (Essa-Hadad *et al.*, 2024). While electronic registries offer potential, their impact is constrained by interoperability, data quality, infrastructure, and workflow challenges (Rahmadhan & Handayani, 2023). Even when vaccines are free, disadvantaged minorities face barriers due to unclear, untranslated information and fragmented guidance. Addressing these gaps requires culturally tailored information, streamlined processes, and effective reminder or recall systems (Essa-Hadad *et al.*, 2024; Crawshaw *et al.*, 2022)

2.9.1 African perspective: card loss, weak data systems, and information gaps

Low vaccination card retention is frequently noted as a practical hindrance to schedule completion as well as a barrier to precise measurement in sub-Saharan Africa. regarding 60–62% of Ethiopian children under three years old had misplaced their cards, which resulted in

missed immunizations, vaccine waste, and uncertainty regarding which doses had been administered (Edossa *et al.*, 2024). Although card loss rates in different African contexts vary greatly (e.g., 26% in Senegal, 33% in Cameroon, and approximately 34% in Uganda), they are frequently identified as a systemic vulnerability ((Edossa *et al.*, 2024; Yakum *et al.*, 2022)

Cameroonian facility level assessments reveal widespread incomplete or incorrectly timed recording, which reflects overworked staff and inadequate standardization, as well as frequent stockouts of data instruments (vaccination cards missing in 57% of facilities) (Saidu *et al.*, 2023). According to systematic evaluations of vaccination communication in Africa, the main obstacles are misinformation and a lack of relevant information, and missed appointments are made worse by inadequate data and reminder systems (Bangura *et al.*, 2020; Ekezie *et al.*, 2024; Galadima *et al.*, 2021a).

2.9.2 Ghanaian setting: relatively strong card retention, but information inequities

Ghana demonstrates relatively high vaccination card retention compared to neighbouring countries, with retention rates ranging from 78–80% nationally and up to 91.5% in some settings, partly supported by policies such as requiring child health records for school enrolment (Konlan *et al.*, 2023). However, incomplete immunization persists, particularly in rural areas, where caregivers report limited awareness of due dates, competing priorities, and inadequate reminder systems (Akanpaabadai *et al.*, 2024a). National evidence further indicates that immunization communication efforts are concentrated in urban centres, leaving rural and marginalized populations underserved and vulnerable to misinformation (Acheampong *et al.*, 2021; Agboh & Yarney, 2025). Overall, despite strong card retention, gaps in reminder systems, rural outreach, and culturally appropriate communication continue to contribute to incomplete immunization, highlighting the need to strengthen both information systems and communication strategies (Edossa *et al.*, 2024; Konlan *et al.*, 2023; Agboh & Yarney, 2025; Essa-Hadad *et al.*, 2024; Akanpaabadai *et al.*, 2024).

2.10 Caregivers' Knowledge, Attitudes, And Practices Regarding Routine Immunisation

Caregiver awareness of immunization schedules and timeliness is a critical determinant of vaccine series completion in low- and middle-income countries. Multi-country evidence indicates that lack of knowledge about vaccination schedules, rather than strong vaccine hesitancy, remains a persistent barrier to timely immunization (Tripathi *et al.*, 2022). In sub-Saharan Africa, caregiver knowledge alongside maternal education and use of ANC/PNC services has been consistently associated with improved completion of vaccination schedules (Li *et al.*, 2025). Evidence from Nigeria further shows that although many caregivers can read immunization cards, accurate knowledge of schedules is strongly linked to actual vaccination behaviour, particularly among caregivers with lower education levels (Sato & Fintan, 2020).

2.10.1 African / sub-Saharan African perspective

In Sub-Saharan Africa. Several studies indicated that children of mothers who had little to no knowledge were unlikely to finish the vaccination series (Bangura *et al.*, 2020). Qualitative research from low-resource Nigerian environments further demonstrates how a lack of knowledge, uncertainty about whether diseases may be prevented by vaccination, and false beliefs about what vaccination might prevent undermine trust and lead to reluctance or complacency (Adeyanju, 2025). According to Tanzanian data, mothers cited information gaps and scheduling confusion, coupled with issues with access and service quality. Delays and missed doses frequently coincide with worries and inadequate literacy (Vasudevan *et al.*, 2020).

2.10.2 Ghanaian perspective

Evidence from Ghana highlights caregiver knowledge as a critical determinant of immunization completion. In Okaikoi Sub-Metro, although 76.7% of caregivers reported awareness of immunization ages, only 33.3% demonstrated good objective knowledge, with poor awareness identified as a major barrier alongside time constraints (Danso *et al.*, 2023). Similarly, a case-control study in Central Tongu District found that caregivers with good

knowledge of vaccine schedules were about 70% less likely to be noncompliant compared to those with poor knowledge (Awutey-Hinidza *et al.*, 2025). Misconceptions, such as the belief that vaccination should be completed by 12 months, further discourage attendance for second-year-of-life vaccines, particularly among children aged 12–23 months (Wolff *et al.*, 2023). Consistent with broader sub-Saharan evidence, maternal knowledge gaps in Ghana have been associated with lower immunization uptake among vulnerable groups (Bangura *et al.*, 2020).

2.11 Evidence on caregivers' attitudes as a barrier to full immunisation (12–23 months)

Although caregivers generally acknowledge the benefits of vaccination, negative attitudes such as mistrust, fear of side effects, and a low perceived need continue to hinder vaccine uptake. Global evidence indicates that caregiver attitudes are shaped by concerns about vaccine safety, mistrust of government or health systems, and beliefs that vaccination decisions should be individualized rather than based on public health recommendations (Cooper *et al.*, 2021). Similar patterns are reported in Uganda, where fear of side effects and caregiver disinterest were identified as key contributors to under-vaccination despite general agreement on vaccine benefits (Vonasek *et al.*, 2016). Evidence from India further shows that misconceptions about vaccine side effects remain a major barrier to schedule adherence, even among caregivers who perceive vaccines as safe and necessary (Anand *et al.*, 2025; Dhaliwal *et al.*, 2020).

2.11.1 African / Sub-Saharan African perspective

Concerns about side effects, belief in anti-vaccine ideas, and mistrust of vaccinations and immunization programs were shown to be common parental barriers in several countries in a systematic evaluation of childhood immunization barriers in sub-Saharan Africa (Bangura *et al.*, 2020). Even after initial doses were approved, parents in several settings voiced concerns about the safety and efficacy of vaccines, which were occasionally bolstered by rumours and religious or cultural narratives. This deterred parents from sticking to the schedule (Bangura *et al.*, 2020).

Despite acknowledging the protective role of vaccines, some caregivers delay or stop further doses due to misinformation and myths about them, religious beliefs, mistrust, and fear of adverse events following immunization, particularly fever and swelling, according to qualitative research conducted in northern Nigeria (Etim *et al.*, 2025). Parents largely supported the benefits of vaccinations, according to another Nigerian study that used the Health Belief Model. However, they also observed moderate barriers, such as discomfort and fear of negative reactions, which influenced hesitation and necessitated focused efforts to resolve (Sahabi *et al.*, 2025).

2.11.2 Ghanaian perspective

Despite the fact that many people in Okaikoi (Accra) supported vaccination in theory, caregivers' ignorance and misinformation regarding side effects were specifically mentioned as factors contributing to vaccine hesitancy (Danso *et al.*, 2023). According to a qualitative study on the acceptability of the malaria vaccine in Ghana, mothers were motivated to get vaccinated and highlighted the vaccine's strong perceived benefits (fewer admissions, cost savings), but some were hesitant to fully support or recommend the vaccine to others due to fear of side effects and "the unknown" (Bam *et al.*, 2023).

The Caregiver Vaccination Attitudes Scale (CVAS) was created as part of a nationwide study conducted in Ghana; its subscales measured opinions regarding the safety and efficacy of vaccines, trust, and their advantages. Significant correlations were found between attitude scores and children's vaccination status and delay, showing that among children aged 12 to 35 months, less positive attitudes (lower perceived benefits/safety, weaker trust) are linked to increased under-vaccination and days under-vaccinated (Wallace *et al.*, 2019).

According to qualitative research conducted with mothers in northern Ghana, the majority of them believe that vaccinations are helpful; however, some may become discouraged from

returning for additional doses due to worries about pain, discomfort, and the possibility of severe side effects, such as paralysis, as well as the lack of clarity provided by medical professionals (Ansah *et al.*, 2025). Perceiving the vaccine as safe and not having "seen or heard something negative" about it are positively associated with adoption, according to Ghanaian polio demand research. This highlights how negative messages or rumours can decrease demand even in situations where services are available (Lohiniva *et al.*, 2023).

2.12 Evidence on caregivers' practices as barriers to full immunisation (12–23 months)

Caregivers in Cape Town identified two major behaviours associated with children leaving facilities without age-appropriate doses: arriving late or lacking the patience to wait (Nnaji *et al.*, 2023).

Despite acknowledging the benefits of vaccinations, caregivers in Sierra Leone indicated that overcrowding, lengthy wait times, the expectation of informal compensation, and the fear of severe side effects sometimes caused them to postpone or avoid follow-up visits (Jalloh *et al.*, 2022). According to Kenyan hospital data, the main causes of non-adherence are caregiver employment, vaccine stockouts, child illness on the due date, and distance to the facility. Caregivers also suggest flexible clinic hours and reminder systems to encourage attendance (Muathe *et al.*, 2020).

2.12.1 African / sub-Saharan African perspective

According to a systematic review conducted across sub-Saharan Africa, parents' forgetfulness, inconvenient clinic hours, long travel times, and conflicting work and home duties are some behavioural and practical caregiver barriers that are common across nations (Bangura *et al.*, 2020; Galadima *et al.*, 2021). Child illness (21%), forgetfulness (18%), inconvenient clinic time (9%), not knowing to return (8%), and vaccination unavailability (6%) were the reasons reported for defaulting in Ethiopia (Galadima *et al.*, 2021a). Caregivers in Hoima, Uganda,

had access that was difficult due to rough terrain, bad roads, and little outreach; poor AEFI management and poor communication deterred return following negative incidents (Malande *et al.*, 2019).

In Mozambique and Malawi, community-based participatory work explains how caregivers begin the schedule but abandon it when subpar service (stockouts, erratic hours, lengthy wait times, rude staff) makes frequent travel seem like a waste of limited time and resources (Powelson *et al.*, 2022; Lawrence *et al.*, 2025). Many mothers bear the burden of vaccinations alone; their capacity to attend appointments is hampered by a lack of family support, several small children, and home labour needs (Powelson *et al.*, 2022; Lawrence *et al.*, 2025).

A multi-country human-centred design study conducted in the Democratic Republic of the Congo, Mozambique, and Nigeria, caregivers of children who have received zero doses or are under-immunised are also less likely to prioritise or stop vaccination visits due to the intersection of poverty, gender roles, distance, and previous negative clinic experiences (Shearer *et al.*, 2023).

2.12.2 Ghanaian perspective

Just 53.3% of children aged 12 to 23 months in Okaikoi (Accra) had received all recommended vaccinations; the main causes of noncompliance were lack of time (25.8%) and forgetfulness (17.5%), in addition to inadequate information (Danso *et al.*, 2023). According to the study, caregivers with higher levels of education and employment were more likely to skip appointments due to hectic schedules, demonstrating how work and conflicting priorities influence daily routines (Danso *et al.*, 2023). Missed visits were also found to be practically caused by improper use of child health record books (not checking dates, misplacing cards) (Danso *et al.*, 2023). Stronger reminder systems and more regular outreach are advised to decrease under-vaccination in the second year of life (Muhoza *et al.*, 2024). Ghana's second

year of life platform analysis reveals that although timeliness has improved, service use still depends on reminder/defaulters tracking systems and caregiver awareness of the 18-month visit. According to earlier Ghanaian research, caregivers' failure to finish schedules is also attributed to unsupportive service environments, lengthy wait periods, and financial hardships (Bangura *et al.*, 2020).

2.13 Summary and Conclusion

The literature consistently highlights that incomplete immunisation remains a significant public health challenge across sub-Saharan Africa. Prevalence estimates vary widely, with some national surveys reporting around one-third of children not fully immunised, while district-level studies reveal pockets of even higher vulnerability. Urban sub-metros, such as those in Accra, have shown nearly half of children only partially immunised, underscoring the uneven distribution of coverage and the persistence of localised gaps.

Health system barriers emerge as a recurrent theme in explaining these disparities. Families often face long travel distances, unreliable transport, and inconvenient clinic hours. Service delivery is further constrained by extended waiting times, frequent vaccine stock-outs, and weak outreach mechanisms. Communication between providers and caregivers is frequently inadequate, compounded by poor record-keeping and fragmented information systems. These systemic weaknesses collectively reduce accessibility and continuity of care, limiting the effectiveness of immunisation programmes.

Caregiver knowledge, attitudes, and practices (KAP) also play a critical role. While trust in immunisation is generally positive, it remains fragile. Many caregivers lack clear knowledge of schedules and benefits, and misconceptions about vaccine safety persist. Practical challenges such as time constraints, forgetfulness, and loss of immunisation cards further contribute to

missed opportunities. These behavioural and informational gaps highlight the importance of strengthening caregiver engagement alongside system-level improvements.

Taken together, the evidence suggests that incomplete immunisation is driven by a complex interplay of structural barriers and caregiver-level factors. For a study in Odumase, this implies three clear directions. First, local surveys using cluster sampling methods can provide robust prevalence estimates to establish the scale of the problem. Second, data collection should be structured around a health systems framework, capturing the multiple dimensions of access, service delivery, workforce, supplies, and information. Third, caregiver perspectives should be systematically assessed through adapted KAP questionnaires, focusing on knowledge of schedules, beliefs about safety and effectiveness, and practical challenges in daily life.

In conclusion, the literature demonstrates that improving immunisation coverage requires both system strengthening and targeted caregiver support. By aligning local research with these established insights, the Odumase study can generate actionable evidence to guide interventions that are responsive to both institutional and community realities.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the research design, philosophical foundations, data collection methods, sample procedures, data analysis approaches, and ethical considerations that support the study. The chapter covers the methodological approaches utilized to effectively answer the research questions and fulfil the study's objectives.

3.1 Study Design

This study used a community-based cross-sectional analytical design because it allows measurement of the prevalence of incomplete immunization among children aged 12–23 months in the community and identification of socio-demographic and health-service factors associated with incomplete immunization at a specific point in time, using standard WHO/DHS methods widely applied in similar studies in low- and middle-income countries (Eze *et al.*, 2021; Getnet, Jejaw, Belachew, Addis, Dellie, Tafere, Worku, Geberu, Yazachew, Teshale, *et al.*, 2025; Mekonnen *et al.*, 2019; Tayu *et al.*, 2022; Touray *et al.*, 2021; Tsegaw *et al.*, 2024a).

3.2 Study Site

The study was conducted in the Odumase sub-municipality of the Lower Manya Krobo Municipality, an urban area in Ghana's Eastern Region where many health institutions offer immunizations through the Expanded Programme on Immunisation (EPI). The Eastern Region has reported gaps in full vaccination coverage, and metropolitan locations in Ghana frequently have lower immunization completion rates despite better physical access to services (Crocker-Buque *et al.*, 2017; C. Guure *et al.*, 2025; Shaum *et al.*, 2023). Conducting the study in Odumase will therefore help to explain sub-municipal variations in coverage within a region known to have gaps, and to understand urban-specific barriers such as caregiver time

constraints, knowledge, and service organization in a context with multiple EPI delivery points (Awutey-Hinidza *et al.*, 2025; C. Guure *et al.*, 2025; Alice Kuuyi & R. Kogi, 2024; Piu *et al.*, 2024; Sally & Kenu, 2017). The findings will be directly relevant for improving urban immunisation strategies and micro-planning within the municipal and regional health systems (Shaum *et al.*, 2023; Walana, Al-Azab, Yabasin, & Abdul-Mumin, 2024; Yawson *et al.*, 2017)

3.3 Study Population

Because child health record cards, also known as weighing cards, are a trustworthy source of recorded immunization history and child health monitoring, the study population, caregivers of children between the ages of 12 and 23 months, is warranted. To accurately measure immunization completeness and promptly identify missing doses, child health cards are essential tools for monitoring vaccination status, growth, and development (Alao *et al.*, 2020; Bakare *et al.*, 2025; Chutiyami *et al.*, 2021; Liyanarachchi *et al.*, 2023).

Verifiable data from caregivers with these documents helps to mitigate inaccurate recall, which is a significant problem in immunization studies that just use caregiver recollection. Because parents who use child health cards typically have children with higher vaccine coverage, retention and usage of the cards have been associated with improved immunization outcomes (Bakare *et al.*, 2025; Chutiyami *et al.*, 2021). Furthermore, concentrating on caregivers who have these records is consistent with immunization coverage survey best practices, guaranteeing data comparability and quality (Yakum *et al.*, 2022). Thus, in the Odumase sub-municipality, evaluating incomplete immunization and related factors is more valid when only caregivers with child health record cards are included.

3.4 Inclusion Criteria and Exclusion Criteria

Caregivers of children aged 12–23 months who have lived in the research area for at least 12 months were included in the study. Caregivers who were unable to provide informed consent

caregivers with children who were not between the ages of 12 and 23, and Children with missing health records were excluded.

The inclusion criteria, which focus on caregivers of children aged 12 to 23 months who have lived in the study area for at least twelve months and have child health/immunization cards, ensure that participants have received adequate exposure to local immunization services and can provide verifiable vaccination data. This age period is essential because children should have completed the majority of standard vaccines, allowing for the assessment of full immunization status and the diagnosis of partial coverage. Residency for at least six months allows for continuous access to local health facilities and lowers confounding from recent migration, which can impair immunization continuity. Consent upholds ethical standards and ensures voluntary participation (Sánchez *et al.*, 2025; Srichalerm *et al.*, 2025). The existence of child health cards enables for objective verification of immunization status, reducing recall bias in caregiver reporting and boosting data accuracy (Stelle *et al.*, 2023).

Exclusion criteria identify caregivers who are unwilling or unable to consent, assuring ethical compliance and data reliability. Excluding children older or younger than 12 to 23 months narrows the study's focus to the target population for routine immunization completion assessment. Children with missing health records are omitted because their immunization status cannot be properly validated, jeopardizing data quality (Stelle *et al.*, 2023). These requirements contribute to the study's methodological rigor by requiring accurate, ethical, and relevant data collecting from a stable population with verifiable immunization histories.

3.5 Sample Size

This study used Yamane's formula (1967), which is a simplified method for estimating sample size from a finite population. The study's total population is 2,137, spread across six zones and two health institutions. Using the Yamane formula;

$$n = \frac{N}{1 + N (e)^2}$$

Where

n = sample size

N = Population of targeted study participants

e = margin of error

Therefore;

$$n = \frac{2,137}{1 + (2,137 \times (0.05)^2)} = 337$$

A 10% non-response rate was estimated on the calculated sample (≈ 34) and then added to it, bringing the total working sample to ($337 + 34 = 371$). The proportional allocation technique was then used to determine the needed stratum size for each of the seven (7) selected CHPS Zone or Facility using the formula;

$$n_h = \left(\frac{N_h}{N} \right) \times n$$

Where;

n_h = projected sample size of a particular CHPS Zone or Facility

N_h = Population size of children per particular facility

N = Total population of children aged 12- 23 months in the sub-municipality.

n = working sample size

Table 1. Populations in zones, health facilities, and required sample sizes

CHPS ZONE /FACILITY	POPULATION OF CHILDREN AGED 12 TO 23 MONTHS	REQUIRED SAMPLE SIZE
ATUA CHPS	314	$\frac{314}{2,137} \times 371 = 55$
ATUA HOSPITAL	305	$\frac{305}{2,137} \times 371 = 53$
KODJONYA	300	$\frac{300}{2,137} \times 371 = 52$
KORLETSOM	324	$\frac{324}{2,137} \times 371 = 56$
MAMPONG	250	$\frac{250}{2,137} \times 371 = 44$
ODUMASE HEALTH CENTRE	180	$\frac{180}{2,137} \times 371 = 31$
ODUMASE NORTH	220	$\frac{220}{2,137} \times 371 = 38$
TOTAL	2,137	371

3.6 Sampling Technique

The multi-stage sampling technique was used in this study. This technique was appropriate for this study because it efficiently handled the Odumase sub-municipality's hierarchical structure by first stratifying into zones and then randomly selecting communities, thereby increasing representativeness across diverse localities (Kamalu *et al.*, 2024; Kassié *et al.*, 2017). This method is especially beneficial in situations when comprehensive population or household listings are unavailable, since it allows for systematic narrowing from bigger to smaller units while retaining randomness and lowering selection bias (Maduekwe & De Vries, 2019; Mukti, 2025).

The use of a random walk method within selected communities compensated for the lack of formal household lists by providing a practical, field-adapted method for selecting households at random, which has been successfully applied in immunization and community health surveys

(Flynn *et al.*, 2013; Lau *et al.*, 2021). Random walk approaches allow for face-to-face recruiting that begins at a central place and moves in a randomly chosen direction, ensuring coverage of various portions of the community without the need for prior mapping (Flynn *et al.*, 2013). Although some research indicates that grid-based or GIS approaches may provide statistical benefits, random walk remains a cost-effective and practicable alternative in resource-constrained settings with limited geographic data (Maduekwe & De Vries, 2019; Shannon *et al.*, 2022). Overall, integrating multi-stage sampling with random walk strikes a balance between methodological rigor and practical constraints, enhancing sample representativeness and data quality in community health research (Kassié *et al.*, 2017; Kamalu *et al.*, 2024).

3.7 Data Collection Tool

A structured questionnaire, adapted from the World Health Organization's Expanded Program on Immunization framework, was administered to eligible caregivers. The instrument was developed in English and, where necessary, translated into the local languages (Krobo or Twi) to ensure clarity and comprehension. The questionnaire was organised into several sections. The first component collected socio-demographic information about caregivers, such as age, educational attainment, marital status, and income. The second portion discussed health system characteristics such as the distance to the nearest health facility, the availability of immunizations, and health personnel's attitudes toward caregivers. The third component looked at caregivers' knowledge and attitudes, with a focus on their understanding of the immunization schedule and their beliefs regarding vaccines. Finally, the questionnaire included child-specific information such as gender, birth order, and number of siblings, as well as verification of immunization status via the child's health record card.

3.7 Pre-Testing

Questionnaires were pre-tested in the Aseity sub-municipality, which has similar characteristics to Odumase. Pretesting questionnaires is critical because it identifies and

corrects ambiguities, misconceptions, and other errors in the questions prior to data collection, ensuring that respondents interpret and answer questions correctly (Grimm, 2010; Hilton, 2017). A pretest with around 10% of the sample size in a similar demographic allows researchers to identify issues with question wording, flow, and sensitivity, hence improving the survey instrument's validity and reliability (Buschle *et al.*, 2021; Collins, 2003). Pretesting feedback allows for questionnaire adjustment to reduce measurement errors, respondent burden, and potential biases, hence improving data quality (Campoamor *et al.*, 2024; Grimm, 2010). It also allows you to examine whether data collectors follow proper protocols during administration, which promotes consistency and objectivity in data gathering (Grimm, 2010). Pretesting improves respondent engagement by clarifying ambiguous questions and assuring cultural or contextual appropriateness for the target group (Buschle *et al.*, 2021; Babonea & Voicu, 2011). Overall, pretesting is an important step in improving the accuracy and credibility of research findings by identifying potential faults early in the survey design process (Hilton, 2017; Collins, 2003; Grimm, 2010). A total of 35 caregivers participated in the pretest. After completing the questionnaire, caregivers were interviewed to assess clarity and understanding of the items. The pretest identified three main issues: unclear questions, missing response options, and unfamiliar terminology.

Amendments were made to address these issues, including rewording unclear questions, adding “transport problems” and “motorcycle” as response options, replacing “meningococcal” with “meningitis vaccine,” and rearranging the order of sections to improve flow.

Reliability testing yielded a Cronbach’s alpha coefficient of 0.82, indicating acceptable internal consistency of the instrument. Pretesting is critical for identifying and correcting errors before data collection (Grimm, 2010).

3.8 Data Handling

Data was gathered by utilising standardised questionnaires. Before processing, all questionnaires were verified to guarantee their completeness and uniformity. The handling of data followed stringent confidentiality rules. Hard-copy questionnaires were safely preserved in a locked cabinet, while electronic data was kept on a password-protected device with an encrypted backup on an external storage medium. Access to physical and electronic data was limited to the lead researcher and academic supervisor. According to ethical norms, all data will be irreversibly erased five years after the study is completed.

3.9 Statistical Analysis

The first objective used descriptive statistics. To ascertain whether variables such as caregiver education, income, distance to a medical institution, and incomplete immunization are related, Pearson's chi-square test was employed. Positively was included in a predictive logistics regression model. The primary components of objective one data, such as caregiver education levels, income categories, and immunization status, were meant to be summarized and presented using descriptive statistics. Before conducting inferential analysis, this gives a concise summary of sample characteristics and immunization coverage (Faisal *et al.*, 2022; Hassan & Hossain, 2024; Onwuchuluba & Uchendu, 2025). Pearson's chi-square test is appropriate for determining whether there is a statistically significant relationship between categorical variables such as caregiver education, income, distance to health facility, and incomplete immunization by comparing observed versus expected frequencies (Hassan & Hossain, 2024; Anandhi *et al.*, 2000). It aids in determining which variables have a bivariate association with immunization status and call for additional research.

In order to model the likelihood of partial immunization while controlling for confounding variables, binary logistic regression then expands on this by including variables that have positive associations in chi-square tests (Hassan & Hossain, 2024; Faisal *et al.*, 2022; Diress *et*

al., 2024). the dependent variable was coded as incomplete immunization (1) and complete immunization (0). Independent variables meeting the inclusion criterion from the bivariate analysis were entered into the binary logistic regression model to estimate their independent effects while controlling for potential confounders. The results were presented as adjusted odds ratios (AORs) with 95% confidence intervals (CIs), and statistical significance was assessed at a p-value of less than 0.05.

The adjusted odds ratios were interpreted to determine the strength and direction of the association between each independent variable and incomplete immunization. An adjusted odds ratio greater than 1 indicated that the variable increased the odds of incomplete immunization, whereas an adjusted odds ratio less than 1 indicated reduced odds of incomplete immunization. Variables with p-values less than 0.05 and 95% confidence intervals that excluded 1 were considered statistically significant independent predictors of incomplete immunization. By estimating adjusted odds ratios, this multivariable method shows how each factor independently affects vaccination uptake. When combined, these techniques offer a thorough analysis: logistic regression finds important predictors of partial immunization, chi-square tests check for connections, and descriptive statistics characterize the data (Dires *et al.*, 2025; Onwuchuluba & Uchendu, 2025; Anandhi *et al.*, 2000). All these were done using the SPSS software after coding and entering the data from the survey.

3.10 Ethical Considerations

Before data collection began, the study received ethical approval from Ensign Global University's Institutional Review Board. All eligible caregivers were asked for their informed consent after being fully told about the study's goals, methods, possible hazards, and expected benefits. Participation was completely optional. Caregivers were guaranteed the freedom to refuse involvement or leave the study at any time without facing any repercussions. Every step of the research process was conducted with strict confidentiality and privacy protection. No

personally identifiable information was shared, and all information was anonymised to safeguard the identities of participants.

Only the researcher and supervisor will have access to the locked cabinet where hard-copy questionnaires will be safely preserved, and electronic data will be saved on password-protected devices with encrypted backups. Only the research team will be able to access the data. The study will always protect the rights and dignity of participants by adhering to the accepted ethical principles of beneficence, justice, and respect for persons.

3.11 Limitations of Study

The study aimed to employ a sample size of 371 people; therefore, more questionnaires were distributed both electronically and in self-assisted printed copies. Two hundred and fifteen recorded electronic data contained inconsistencies that would have affected the statistical outcome of the study. After careful editing and scrutiny, the total sample size for both the electronic and printed questionnaires used in this research amounted to 344 with perfect answers, which was useful for statistical analyses and inferences. The exclusion of 27 questionnaires due to data inconsistencies may have introduced selection bias and reduced statistical power, potentially limiting the detection of weaker associations. However, the final sample of 344 respondents remained adequate for the primary analyses, and the exclusion was necessary to ensure data quality and validity.

Responses were based on caregiver recall and honesty, which could introduce recall bias or social desirability bias. For example, some caregivers may over-report vaccine completion to meet perceived expectations.

Although acceptable for chi-square and logistic regression, the sample size may limit the identification of weaker relationships, especially for less common predictors, such as certain ethnic or religious groupings.

The study was limited to Lower Manya Krobo Municipal. Findings may not generalize to other regions of Ghana or sub-Saharan Africa with different socio-cultural or health system contexts.

Factors such as caregiver health literacy, home decision-making dynamics, and larger community effects were not directly measured, but they may influence immunization outcomes

3.12 Assumptions

1. **Caregiver Knowledge Assumption:** The study assumes that caregivers possess a baseline level of knowledge regarding immunization programs. This foundational understanding is expected to enable them to articulate relevant aspects of incomplete immunization and contribute meaningfully to the study's findings.
2. **Conceptual Framework Assumption:** The study further assumes that the knowledge level of caregivers or study participants is directly correlated with the conceptual framework guiding the research. In particular, caregiver knowledge is presumed to influence perceptions, behaviours, and outcomes related to incomplete immunization, thereby reinforcing the theoretical underpinnings of the framework.
3. **Mental State of Respondents:** It was assumed that the respondents were of sound mind at the time of the collection.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents the analysis and findings from the distributed questionnaires. The results are presented in accordance with the objectives of the study using descriptive statistics, chi-square, and logistic regression analyses. A total of 371 questionnaires were distributed during the data collection period. Out of these, 344 questionnaires were fully completed and suitable for analysis, resulting in a response rate of 92.72%.

4.1 Demographic Characteristics of Respondents

Table 4.1 presents the demographic characteristics of respondents included in the study. The age distribution shows that 51.74% of respondents fall within the 26–35 year bracket, underscoring the dominance of young adults in the study population. This is followed by 22.09% in the 36–45 group, while those aged 15–25 account for 21.22% and those aged 46 and above constitute only 4.94%.

Ethnic representation is heavily skewed toward the Krobo group, which accounts for 60.47% of the sample. The Akan group represents 17.15%, the Ewe 16.86%, while other ethnicities form a small minority at 5.52%.

Educational attainment presents a dual pattern. A significant proportion of respondents, 35.17%, have only primary education, yet a considerable share, 26.45%, has attained tertiary education. Junior High School accounts for 18.90%, Senior High School for 12.50%, while 6.98% of respondents reported no formal education.

Income levels reveal a relatively affluent distribution, with 44.19% of respondents earning above 1,000 Ghana cedis. This contrasts with 28.19% earning between 501 and 1,000 cedis, 16.28% earning between 200 and 500 cedis, and only 11.34% earning less than 200 cedis.

Occupation data reinforces this picture: 37.21% are formally employed, 29.65% are engaged in trade, 19.48% are unemployed, 7.56% are farmers, and 6.10% fall into other categories.

Marital status is strongly tilted toward marriage, with 69.19% of respondents married. Singles form 25% of the population, while divorced individuals account for 0.87% and widowed individuals for 4.94%. Religion is almost entirely homogeneous, with Christianity accounting for 97.97% of respondents. The small Muslim minority represents 2.03%, while traditional and other affiliations are absent, underscoring the religious uniformity of the sample.

Table 2. Demographic characteristics of respondents

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	15–25	73	21.22
	26–35	178	51.74
	36–45	76	22.09
	46 & Above	17	4.94
Ethnic Group	Krobo	208	60.47
	Ewe	58	16.86
	Akan	59	17.15
	Other	19	5.52
Educational Level	None	24	6.98
	Primary	121	35.17
	JHS	65	18.90
	SHS	43	12.50
	Tertiary	91	26.45
Income Level (GHc)	<200	39	11.34
	200–500	56	16.28
	501–1,000	97	28.19
	≥1,000	152	44.19
Occupation	Farmer	26	7.56
	Trade	102	29.65
	Employed	128	37.21
	Unemployed	67	19.48

	Other	21	6.10
Marital Status	Single	86	25.0
	Married	238	69.19
	Divorced	3	0.87
	Widowed	17	4.94
Religion	Christian	337	97.97
	Muslim	7	2.03

Source: Field data, 2026

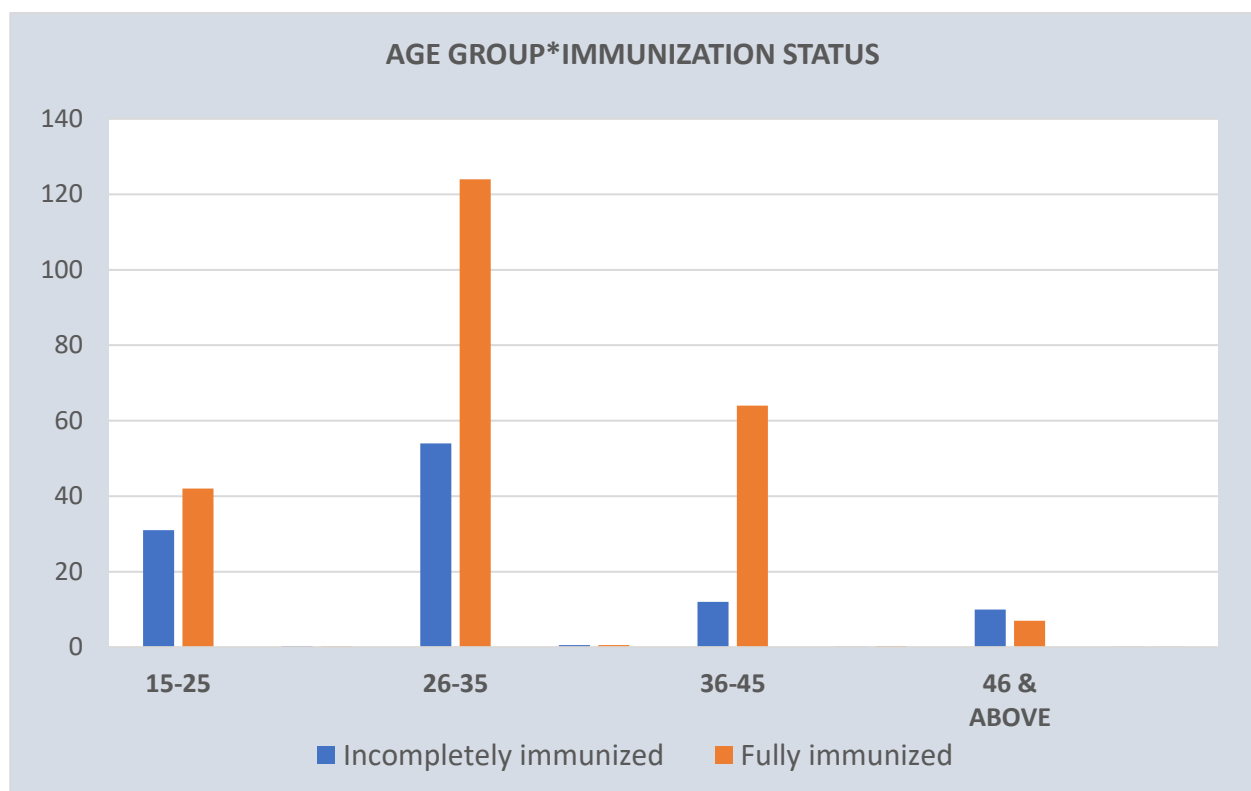


Figure 3. Displaying bar chart for age group versus immunisation status of respondents

EDUCATIONAL LEVEL OF CAREGIVERS

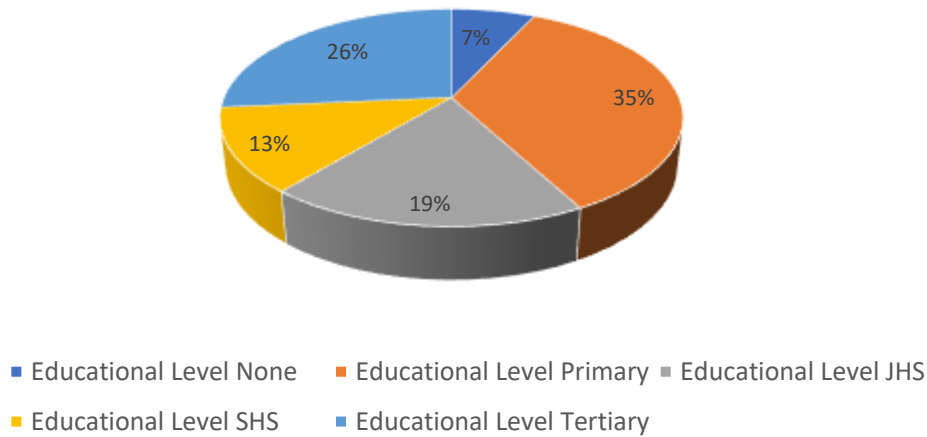


Figure 4. Displaying Pie Chart for the Educational Levels of Respondents

4.2 Objective One: Proportion of Children Aged 12 - 23 Months by Immunization Status.

Table 4.2 presents the immunization status of children 12 -23 months included in the study. The results show that of 344 children, 237 (68.90%) were fully immunised, while 107 (31.10%) missed at least one vaccine dose. Yellow Fever emerges as the most frequently missed vaccine, with 46 children (13.40%) not receiving it. Similarly, Measles-Rubella (5.3%) and Meningococcal (7.3%) vaccines show notable deficits, raising concerns given the high transmissibility and outbreak potential of these diseases. OPV (4.1%) and Pentavalent (1.2%).

Table 3. Immunization Status (Percentages)

Vaccine	Incompletely Immunized (%)	Fully Immunized (%)
OPV	14(4.1)	330(95.9)
Pentavalent	4 (1.2)	340(98.8)
Measles-Rubella	18 (5.3)	326(94.7)
Yellow Fever	46 (13.4)	298(86.6)
Meningococcal	24 (7.0)	320(93.0)
Total	107(31.10)	237 (68.90)

Percentages are calculated against the total sample size of 344 respondents.

Source: Field data, 2026

4.3 Objective Two: Health Systems-Related Barriers to Immunization

The data presented below highlights several health system dimensions that collectively influence immunization uptake. Children residing within 1–5 km of a facility show the highest proportion of incomplete immunization (38.6%). Interestingly, those above 5 km report no incompleteness, which may reflect a small sample size (n=11) or selective attendance by highly motivated caregivers.

Walking is associated with the highest incompleteness (33.4%). Stock-outs or perceived unavailability are strongly associated with incomplete immunization (48.1%). Caregivers who reported “Don’t Know” all completed immunization, possibly reflecting trust in the system or reduced awareness of shortages.

Contrary to expectations, shorter waiting times (<30 minutes) are associated with higher incompleteness (33.6%). Longer waits (>1 hour) correspond with full completion.

Surprisingly, individuals who reported missing due to crowding had a lower incompleteness rate (16.0%) than those who did not report crowding (37.8%). Friendly attitudes are related with slightly higher incompleteness (31.6%) than neutral (28.0%).

Table 4. Comparative Distribution of Immunization Completion by Key Indicators

Variable	Category	Immunization Status		Chi square	P-value
		Incomplete n (%)	Complete n (%)		
Age Group	15–25	31(29.0)	42(17.7)	18.8595	0.001
	26–35	54(50.5)	124(52.3)		
	36–45	12(11.2)	64(27.0)		
	46 & Above	10(9.3)	7(3.0)		
Ethnic Group	Krobo	66(61.7)	142(59.9)	0.4599	0.928
	Ewe	19(17.8%)	39(16.5%)		
	Akan	17(15.9)	42(17.7)		
	Other	5(4.7)	14(5.9)		
	None	12(11.2)	12(5.1)		

Educational Level	Primary	42(39.3)	79(33.3)	9.110	0.058
	JHS	22(20.)	43(18.1)		
	SHS	11(10.3%)	32(13.5%)		
	Tertiary	20(18.7)	71(30.0)		
Income Level (GHc)	<200	19(17.8)	20(8.4)	35.5314	0.001
	200–500	31(29.0)	25(10.5)		
	501–1,000	13(12.1)	84(35.4)		
	≥1,000	44(41.1)	108(45.6)		
Occupation	Farmer	10(9.3)	16(6.8)	26.5983	0.001
	Trade	38(35.5)	64(27.4)		
	Employed	27(25.2)	101(42.6)		
	Unemployed	32(29.9)	35(14.8)		
	Other	0	21(8.9)		
Marital Status	Single	29(27.1)	57(24.1)	8.437	0.038
	Married	68(63.6)	170(71.7)		
	Divorced	0	3(1.3)		
	Widowed	10(9.3)	7(3.0)		
Religion	Christian	105(98.1)	232(97.9)	0.0214	0.884
	Muslim	2(1.9)	5(2.1)		

Source: Field data, 2026

4.4 Bivariate analysis of demographic variables on immunization status

The chi-square analysis provides a statistical examination of the relationship between demographic variables and immunization status, distinguishing between incomplete and complete immunization.

Age group shows a strong and statistically significant association with immunization status, with a chi-square value of 18.8595 and a p-value of 0.001. Respondents aged 26–35 years recorded the highest proportion of complete immunization at 52.3 percent, while those aged 36–45 years had 27.0 percent complete immunization compared to only 11.2 percent incomplete. The youngest group, 15–25 years, had a relatively high proportion of incomplete

immunization at 29.0 percent. This suggests that age is a critical determinant, with older cohorts more likely to have completed immunization schedules.

Ethnic group, by contrast, does not show a significant relationship with immunization status. The chi-square value of 0.4599 and p-value of 0.928 indicate no meaningful differences across Krobo, Ewe, Akan, and other groups.

Educational level presents a borderline association with immunization status, with a chi-square of 9.110 and a p-value of 0.058. While not statistically significant at the conventional 0.05 threshold, the distribution suggests a trend: respondents with tertiary education had 30.0 percent complete immunization compared to 18.7 percent incomplete, while those with no education had higher incomplete rates (11.2 percent) relative to complete (5.1 percent).

Income level demonstrates a highly significant association, with a chi-square of 35.5314 and a p-value of 0.001. Respondents earning $\geq 1,000$ Ghana cedis had the highest proportion of complete immunization at 45.6 percent, while those earning less than 200 cedis had 17.8 percent incomplete compared to only 8.4 percent complete. The middle-income categories also show disparities, with incomplete immunization more common among those earning 200–500 cedis. This indicates that economic capacity strongly influences the likelihood of completing immunization schedules.

Occupation is another variable with a significant relationship, reflected in a chi-square of 26.5983 and a p-value of 0.001. Employed respondents had the highest complete immunization rate at 42.6 percent, while the unemployed had a disproportionately high incomplete rate of 29.9 percent. Traders also showed relatively high incomplete immunization at 35.5 percent.

Marital status shows a moderate but significant association, with a chi-square of 8.437 and a p-value of 0.038. Married respondents had the highest complete immunization rate at 71.7 percent, while singles had 27.1 percent incomplete compared to 24.1 percent complete.

Widowed individuals also showed higher incomplete rates. Religion, however, does not show a significant relationship, with a chi-square of 0.0214 and a p-value of 0.884.

4.5 Bivariate Analyses of Health System Factors versus Immunization Status

Pearson's Chi-square analyses provide a detailed understanding of how health system and access-related factors influence immunization status. Each indicator is examined to determine whether differences in incomplete and complete immunization are statistically significant.

Distance to facility shows a clear association with immunization status, with a chi-square value of 8.510 and a p-value of 0.014. Respondents living within 1 km of a health facility had 71.2 percent complete immunization, compared with 28.8 percent incomplete. Those living between 1–5 km had lower completion rates at 61.4 percent, while incomplete immunization rose to 38.6 percent. Interestingly, all respondents living above 5 km reported complete immunization (100 percent).

Transport mode also demonstrates a significant relationship, with a chi-square of 10.234 and a p-value of 0.017. Walking was the most common mode, with 66.6 percent complete immunization and 33.4 percent incomplete. Public transport users had similar completion rates at 69.7 percent. However, motorcycle and car users reported 100 percent completion, suggesting that access to faster or more reliable transport strongly enhances immunization adherence.

Vaccine availability is highly significant, with a chi-square of 14.054 and a p-value of 0.001. Where vaccines were available, 70.4 percent of respondents completed immunization compared to 29.6 percent incomplete. In contrast, when vaccines were unavailable, incomplete immunization rose sharply to 25 cases, with only 27 completions. Waiting time at clinics also shows a significant association, with a chi-square of 7.194 and a p-value of 0.027. Respondents who waited less than 30 minutes had 67.1 percent completion, while those waiting 30–60

minutes had lower completion rates. No respondents reported waiting more than an hour, suggesting that excessive delays may deter attendance altogether. Shorter waiting times therefore appear to encourage completion.

Crowding at clinics is another strong determinant, with a chi-square of 16.230 and a p-value of 0.001. Among those who missed immunization due to crowding, incomplete immunization was disproportionately high at 17 cases compared to only 8 completions. Conversely, respondents who did not report crowding had much higher completion rates (148 completions versus 90 incomplete). Health worker attitude, however, does not show a significant relationship, with a chi-square of 0.263 and a p-value of 0.608.

Table 5. Health System-Related Barriers and Immunization Status

Indicator	Category/Group	Immunization Status		Chi-square	P-value
		Incomplete n (%)	Complete n (%)		
Distance to Facility	Below 1 km	63 (28.8)	156 (71.2)	8.510	0.014
	1–5 km	44 (38.6)	70 (61.4)		
	Above 5 km	0 (0.0)	11 (100.0)		
Transport Mode	Walk	97 (33.4)	193 (66.6)	10.234	0.017
	Public Transport	10 (30.3)	23 (69.7)		
	Motorcycle	0 (0.0)	7 (100.0)		
	Car	0 (0.0)	14 (100.0)		
Vaccine Availability	Yes	82 (29.6)	195 (70.4)	14.054	0.001
	No	25 (48.1)	27 (51.9)		
	Don't Know	0 (0.0)	15 (100.)		
Waiting Time	<30 minutes	99 (33.6)	196 (66.4)	7.194	0.027
	30–60 minutes	8 (20.0)	32 (80.0)		
	>1 hour	0 (0.0)	9 (100.0)		
Crowding at Clinic	Missed due to crowding	17 (16.0)	89 (84.0)	16.230	0.001
	No crowding reported	90 (37.8)	148 (62.2)		
Health Worker Attitude	Friendly	93 (31.6)	201 (68.4)	0.263	0.608
	Neutral	140(28)	36(72)		

Source: Field data, 2026

4.6 Objective Three: Caregivers' Knowledge, Attitudes, And Practices Regarding Immunisation.

4.6.1 Knowledge on immunization

The results show that a majority of caregivers (59.3 percent) agreed that a child of a specific age should complete immunization, while 40.7 percent did not. This indicates that although awareness of age-specific immunization schedules is relatively high, a substantial minority remain uncertain or uninformed. When asked about their ability to name at least two vaccines, 52.3 percent of respondents were able to do so, while 47.7 percent could not. This limited awareness may affect their confidence in seeking immunization services and underscores the importance of strengthening health education. Knowledge of vaccine-preventable diseases was reported by 55.2 percent of respondents, compared to 44.8 percent who lacked such knowledge. In this sample, 64.0 percent of caregivers reported receiving education, while 36.0 percent did not.

Table 6. Knowledge on Immunization

Variable	Response	Frequency (n)	Percentage (%)
A child of a specific age should complete immunization	YES	204	59.3
	NO	140	40.7
Ability to name at least 2 vaccines	YES	180	52.3
	NO	164	47.7
Knowledge of vaccine-preventable diseases	Yes	190	55.2
	No	154	44.8
The caregiver received education on immunisation	Yes	220	64
	No	124	36

Source: *Field data, 2026*

Overall knowledge on immunization was assessed using multiple knowledge variables. Individual scores were summed to generate a total knowledge score for each respondent, and the mean score of the study population was used as the cut-off point to categorize respondents into “good knowledge” and “poor knowledge”. As shown in **Figure 4.3** below, the majority of

respondents (69.50%) demonstrated good overall knowledge of childhood immunisation, while only 30.50% demonstrated poor knowledge based on the survey responses.

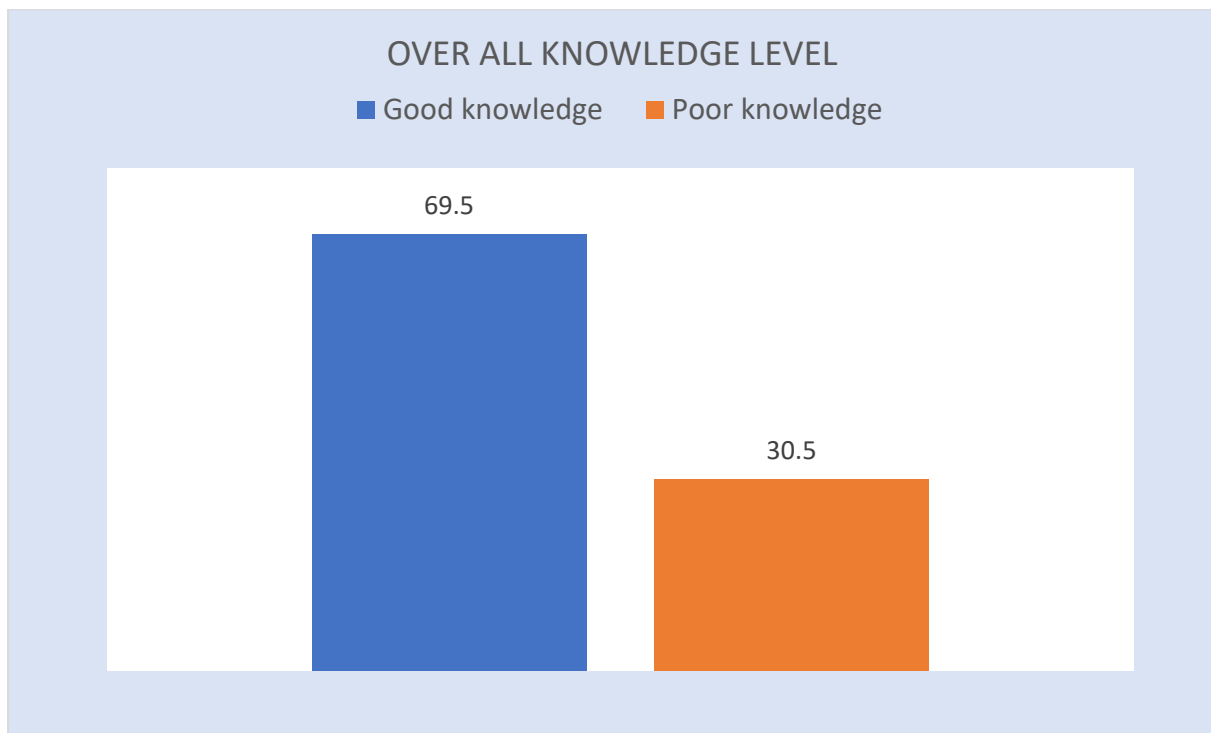


Figure 5. Overall Knowledge of Caregivers

4.6.2 Attitudes of caregivers

A large majority of respondents, 88.7 percent, affirmed that vaccines are important, while 11.3 percent did not. This demonstrates a strong baseline of positive perception, but the minority who question vaccine importance represent a potential barrier to universal coverage. Discouragement from vaccination was reported by 13.1 percent of caregivers, while 86.9 percent indicated they had not been discouraged.

Trust in vaccines provided by the government was nearly universal, with 98.6 percent of respondents expressing trust and only 1.4 percent reporting distrust. This high level of confidence suggests that government-led immunization programs enjoy strong legitimacy and acceptance. Willingness to recommend immunization to other mothers was also very high, with 92.9 percent expressing readiness to encourage peers, compared to 7.1 percent who would not.

Table 7. Attitudes of caregivers

Variable	Response	Frequency (n)	Percentage (%)
Are vaccines important	Yes	305	88.7
	No	39	11.3
Discouraged from vaccination	Yes	45	13.1
	No	299	86.9
Trust vaccines from the government	Yes	339	98.6
	No	5	1.4
Willingness to recommend immunization to other mothers	Yes	320	92.9
	No	24	7.1

Source: *Field data, 2026*

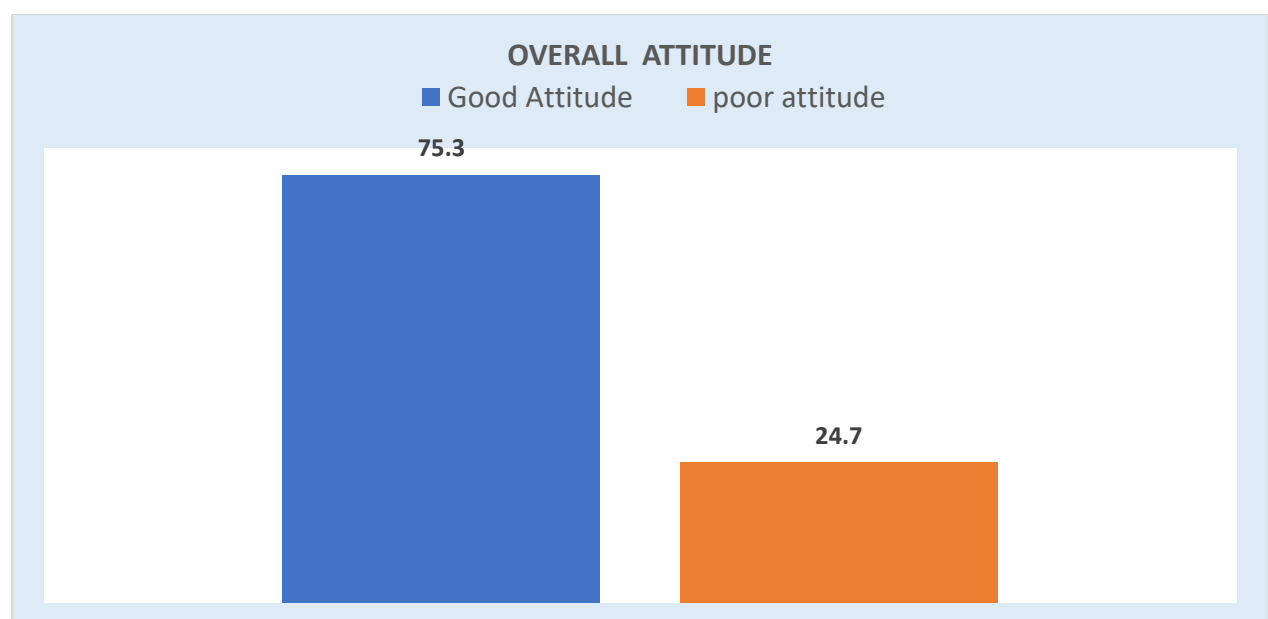


Figure 6. Overall attitude of Caregivers

4.6.3 Practice of caregivers

The data reveal important patterns in health-seeking behaviour among respondents. Out of the total sample, 78.5% reported attending clinic appointments as scheduled, while 21.5% did not. This indicates that although the majority demonstrate adherence to scheduled visits, a significant minority face challenges that interrupt continuity of care. Such barriers may include

logistical constraints, competing priorities, or limited awareness of the importance of timely attendance. Encouragingly, among those who miss appointments, 95.6% return for follow-up visits, suggesting that lapses in attendance are often temporary rather than indicative of disengagement from care. An outstanding finding is that 100% of respondents reported safekeeping of their health cards.

However, the 21.5% who fail to attend clinics as scheduled represent a potential gap in service utilization.

Table 8. Caregivers Practices

Variable	Response	Frequency	Percentage%
Attends clinic as scheduled	YES	270	78.50
	NO	74	21.50
Returns after missed visit	YES	329	95.60
	NO	15	4.40
Safe keeping of card	YES	344	100
	NO	0	0

Source: *Field data, 2026*



Figure 7. Overall practice of Caregivers

4.7 Logistic Regression Analysis of Immunization Status

A binary logistic regression was conducted to examine predictors of incomplete immunization (coded as 1) versus complete immunization (coded as 0). Independent variables included age group, income level, occupation, marital status, and educational level, entered as categorical predictors.

In the unadjusted analysis, incomplete immunisation was more likely among certain socio-demographic groups and service-related conditions. For example, individuals aged 36–45 were significantly less likely to experience escalation, which in this context reflects incomplete immunisation, compared to the 15–25 reference group (COR = 0.41, 95% CI: 0.20–0.83, $p = 0.013$). Income demonstrated a strong protective gradient, with those earning 501–1,000 (COR = 0.25, 95% CI: 0.11–0.56, $p = 0.001$) and $\geq 1,000$ (COR = 0.31, 95% CI: 0.15–0.63, $p = 0.002$) showing markedly lower odds of incomplete immunisation compared to those earning less than 200. Occupation also mattered, as employed individuals had reduced odds relative to farmers (COR = 0.39, 95% CI: 0.16–0.95, $p = 0.039$). On the service side, vaccine unavailability more than doubled the odds of incomplete immunisation (COR = 2.19, 95% CI: 1.19–4.02, $p =$

0.011), while crowding significantly increased risk (COR = 2.01, 95% CI: 1.12–3.61, $p = 0.019$).

After adjusting for confounders, several associations persisted, reinforcing their independent influence on immunisation outcomes. The protective effect of age 36–45 remained significant (AOR = 0.48, 95% CI: 0.23–0.99, $p = 0.046$), suggesting that individuals in this age group are more likely to ensure complete immunisation compared to younger cohorts. Higher income levels continued to demonstrate strong protective effects, with those earning 501–1,000 (AOR = 0.31, 95% CI: 0.14–0.70, $p = 0.004$) and $\geq 1,000$ (AOR = 0.36, 95% CI: 0.17–0.75, $p = 0.006$) maintaining significantly lower odds of incomplete immunisation. The effect of employment attenuated and lost statistical significance (AOR = 0.44, 95% CI: 0.18–1.08, $p = 0.072$), indicating that occupation may be mediated through income and other socio-economic factors. Importantly, vaccine unavailability remained a significant risk factor (AOR = 2.05, 95% CI: 1.08–3.89, $p = 0.029$), and crowding continued to elevate the odds of incomplete immunisation (AOR = 1.89, 95% CI: 1.01–3.54, $p = 0.046$) after adjusting for all other covariates.

Table 9. Logistic Regression Analysis of Immunization Status

Variable	Category	UNADJUSTED			ADJUSTED		
		COR	95% CI	P-value	AOR	95% CI	P-value
Age Group (yrs)	15–25 (<i>Ref</i>)	1	—	—	1	—	—
	26–35	1.21	0.72–2.03	0.47	1.1	0.65–1.87	0.72
	36–45	0.41	0.20–0.83	0.013	0.48	0.23–0.99	0.046
	46 & Above	1.45	0.52–4.01	0.48	1.32	0.47–3.71	0.59
Income Level (GHC)	<200 (<i>Ref</i>)	1	—	—	1	—	—
	200–500	0.62	0.31–1.25	0.18	0.7	0.34–1.43	0.33
	501–1,000	0.25	0.11–0.56	0.001	0.31	0.14–0.70	0.004
	$\geq 1,000$	0.31	0.15–0.63	0.002	0.36	0.17–0.75	0.006
Occupation	Farmer (<i>Ref</i>)	1	—	—	1	—	—
	Trade	0.89	0.37–2.12	0.79	0.95	0.39–2.33	0.91

	Employed	0.39	0.16–0.95	0.039	0.44	0.18–1.08	0.072
	Unemployed	1.18	0.47–2.95	0.72	1.25	0.49–3.18	0.64
Marital Status	Single (<i>Ref</i>)	1	—	—	1	—	—
	Married	0.74	0.43–1.28	0.29	0.81	0.46–1.42	0.46
	Divorced/Widowed	1.29	0.45–3.67	0.63	1.35	0.47–3.90	0.58
Education	None (<i>Ref</i>)	1	—	—	1	—	—
	Primary	0.91	0.37–2.23	0.84	0.97	0.39–2.42	0.95
	JHS	0.76	0.29–1.99	0.58	0.82	0.31–2.16	0.69
	SHS	0.63	0.22–1.81	0.39	0.71	0.25–2.04	0.53
	Tertiary	0.44	0.17–1.12	0.083	0.52	0.20–1.35	0.18
Distance to Facility	<1 km (<i>Ref</i>)	1	—	—	1	—	—
	1–5 km	1.52	0.95–2.43	0.008	1.47	0.91–2.38	0.11
	>5 km	1.88	0.92–3.84	0.082	1.65	0.79–3.45	0.19
Transport Mode	Walk (<i>Ref</i>)	—	—	—	1	—	—
	Public Transport	0.88	0.39–2.00	0.76	0.92	0.40–2.12	0.85
	Motorcycle/Car	0.67	0.28–1.61	0.37	0.74	0.30–1.82	0.51
Vaccine Availability	Yes (<i>Ref</i>)	1	—	—	1	—	—
	No	2.19	1.19–4.02	0.011	2.05	1.08–3.89	0.029
	Don't Know	0.91	0.34–2.43	0.85	0.97	0.36–2.61	0.95
Waiting Time	<30 min (<i>Ref</i>)	1	—	—	1	—	—
	30–60 min	0.49	0.21–1.14	0.098	0.55	0.23–1.31	0.18
	>1 hour	0.72	0.28–1.86	0.49	0.8	0.31–2.08	0.65
Crowding at Clinic	No crowding (<i>Ref</i>)	1	—	—	1	—	—
	Missed due to crowding	2.01	1.12–3.61	0.019	1.89	1.01–3.54	0.046
Health Worker Attitude	Friendly (<i>Ref</i>)	1	—	—	1	—	—
	Neutral	1.12	0.57–2.20	0.74	1.08	0.55–2.12	0.82

Source: Field Data, 2026

CHAPTER FIVE

DISCUSSION AND FINDINGS

5.0 Demographic Characteristics of Respondents

The demographic profile of respondents in this study predominantly youthful caregivers aged 26–35 years—underscores the centrality of women in their reproductive years in shaping immunization outcomes. This age distribution is critical because it situates immunization decisions within households where reproductive responsibilities and economic productivity intersect. Younger caregivers often face competing demands of childcare, employment, and household management, which can influence health-seeking behaviours. This finding is consistent with Bbaale (2013), who reported that maternal age significantly influences child immunization uptake in Uganda, with younger mothers less likely to complete schedules due to limited experience and competing priorities. The polarization in educational attainment, with 35.2% having only primary education and 26.5% attaining tertiary education, reflects persistent inequalities in access to education. This duality suggests that while a growing proportion of caregivers benefit from higher education, a substantial segment remains disadvantaged, potentially limiting their ability to access, interpret, and act upon health information. Antai (2012) similarly reported that maternal education is a strong predictor of full immunization, with higher education associated with improved uptake. This observation is reinforced in other studies that noted socioeconomic gradients in immunization are steep, with maternal education consistently associated with completion rates (Cata-Preta *et al.*, 2021; Budu *et al.*, 2022).

Income and occupation emerged as significant predictors of immunization status, aligning with Wiysonge *et al.* (2012), who emphasized household wealth as a determinant of vaccine coverage across sub-Saharan Africa. Higher income not only facilitates access to transportation and healthcare services but also reduces opportunity costs associated with clinic visits.

Occupation, particularly formal employment, may provide greater financial stability but can also constrain caregivers' availability for clinic attendance due to rigid work schedules. The findings from Cata-Preta et al. (2021) corroborates this, highlighting that wealth disparities remain a consistent determinant of immunization completion across LMICs (Cata-Preta *et al.*, 2021).

The dominance of Christianity (98%) in the sample reflects regional demographics, but as Budu *et al.* (2020) observed, religion itself is less predictive of immunization outcomes compared to socioeconomic status. This finding suggests that while cultural and religious contexts shape community norms, structural determinants such as income and education exert stronger influence on immunization behaviours.

Taken together, these findings highlight the interplay between demographic characteristics and immunization outcomes. Socioeconomic diversity and educational polarization shape health behaviours and access to services, while age and marital status influence caregiving dynamics. For instance, targeted educational campaigns for caregivers with limited schooling, coupled with workplace policies that support maternal health responsibilities, could enhance immunization uptake.

In summary, the demographic profile of respondents reveals a complex interplay of age, education, income, occupation, and cultural context in shaping immunization outcomes. Younger caregivers, often balancing reproductive and economic responsibilities, face unique challenges in completing immunization schedules. Educational polarization reflects both progress and persistent inequality, with higher education facilitating uptake while limited schooling constrains health literacy. Income and occupation strongly influence access to services, consistent with broader evidence of wealth gradients in immunization. Religion, while dominant in the sample, appears less predictive than socioeconomic status. These findings

agree with regional and global literature, reinforcing the conclusion that demographic characteristics are pivotal determinants of immunization outcomes. Addressing these factors requires integrated strategies that combine socioeconomic empowerment, educational outreach, and supportive health system policies to ensure equitable access to immunization services.

5.1 Proportion of Children Aged 12–23 Months and Immunization Status

The finding that 68.9% of children in the study were fully immunized, with 31.1% missing at least one vaccine, provides important insight into both progress and persistent gaps in immunization coverage. This level of completion is relatively high compared to many low- and middle-income countries (LMICs), yet it still leaves nearly one-third of children vulnerable to vaccine-preventable diseases. The most frequently missed vaccine was Yellow Fever (13.4%), followed by Meningococcal (7.0%) and Measles Rubella (5.3%). These results highlight systemic challenges in vaccine delivery and align with global evidence that specific antigens often lag behind others due to supply chain, scheduling, and outreach constraints.

The high rate of missed Yellow Fever vaccines is consistent with WHO (2020) reports that coverage remains uneven in West Africa due to supply chain disruptions and fragile cold chain systems. Literature review corroborates this, noting that vaccine logistics and cold chain systems in Africa are operational but fragile, with frequent stockouts and inadequate infrastructure (Shibeshi *et al.*, 2020; Shibeshi *et al.*, 2021). These systemic weaknesses often result in prolonged vaccine shortages, undermining the reliability of immunization programs. In Ghana, district-level bottleneck studies have similarly identified “hard-to-reach island communities along the Volta Basin” and limited fixed/outreach EPI sites as barriers to vaccine delivery (Yawson *et al.*, 2017). Thus, the missed Yellow Fever doses in this study reflect broader structural challenges rather than caregiver reluctance.

The missed Measles Rubella doses (5.3%) are particularly concerning given the outbreak potential of measles. Ekouevi *et al.* (2018) reported that incomplete measles coverage in Togo contributed to recurrent outbreaks, while Ndwandwe *et al.* (2020) found that 40.8% of South African children aged 12–23 months were not fully vaccinated, underscoring the regional challenge of measles coverage. Literature review further emphasizes that incomplete measles immunization remains widespread across LMICs, with pooled DHS data showing that 36% of children in sub-Saharan Africa lack full vaccination (Tsegaw *et al.*, 2024). These findings suggest that even relatively small gaps in measles coverage can have significant public health consequences, given the disease’s high transmissibility.

Comparatively, Ghana’s coverage of 68.9% is higher than the pooled prevalence of incomplete immunization reported in sub-Saharan Africa (36.1%) (Tsegaw *et al.*, 2024), and higher than rates observed in Ethiopia (Yismaw *et al.*, 2019; Mekonnen *et al.*, 2019) and Nigeria’s rural areas (Eze *et al.*, 2021). However, it remains below the threshold required for herd immunity against highly contagious diseases such as measles. Literature review highlights that Ghana has achieved relatively high national immunization coverage, but district-level data reveal substantial variation and pockets of low or incomplete coverage, particularly in underserved urban slums and rural islands (Tekeba *et al.*, 2025; Budu *et al.*, 2022). This suggests that while national averages appear encouraging, localized disparities persist and require targeted interventions.

The relatively lower missed rates for OPV (4.1%) and Pentavalent (1.2%) in this study are encouraging, as they suggest that routine vaccines with strong outreach and established delivery mechanisms are more consistently administered. Literature review supports this observation, noting that routine and outreach delivery systems, when adequately funded and supported, can achieve high coverage even in resource-constrained settings (Okwo-Bele &

Cherian, 2011; Shibeshi *et al.*, 2020). However, the fragility of logistics and cold chain systems means that even these vaccines remain vulnerable to disruptions, particularly in remote or underserved areas.

Taken together, these findings highlight the dual nature of immunization progress in Ghana: relatively high coverage compared to regional averages, but persistent gaps in specific antigens that reflect systemic bottlenecks. The literature consistently emphasizes that incomplete immunization among children aged 12–23 months is widespread across LMICs, with prevalence ranging from 23% in Ethiopia’s Dabat district (Boke *et al.*, 2022) to nearly 50% in peri-urban Pakistan (Khan *et al.*, 2024). Ghana’s performance, while better than many peers, still underscores the need for district-tailored, equity-focused interventions to address both supply chain weaknesses and localized disparities.

In summary, the immunization status of children aged 12–23 months in this study reflects both progress and persistent challenges. While 68.9% completion is relatively high compared to regional averages, the missed Yellow Fever, Measles Rubella, and Meningococcal vaccines highlight systemic bottlenecks in supply chains, cold chain infrastructure, and outreach. These findings agree with global and regional literature, which consistently identifies fragile logistics, stockouts, and uneven coverage as barriers to universal immunization. Ghana’s relatively strong performance must therefore be interpreted with caution, as national averages mask significant district-level disparities. Addressing these gaps requires targeted interventions that strengthen vaccine logistics, improve outreach to hard-to-reach populations, and ensure reliable supply of all antigens, particularly those with high outbreak potential.

5.2 Health Systems-Related Barriers Contributing to Incomplete Immunization

The study identified health system barriers—distance to facilities, transport mode, vaccine availability, waiting time, and crowding—as critical determinants of incomplete immunization.

Distance was significantly associated with immunization status, with incomplete immunization highest among those living 1–5 km away (38.6%). This finding is consistent with Chapter Two, which highlights geographic access as a persistent barrier in Ghana and across LMICs. Kuuyi and Kogi (2024) reported that increased distance to health centers in Ghana’s Upper West Region significantly reduced the likelihood of full immunization. Similarly, Atuoye *et al.* (2015) emphasized that defining “access” as a 5 km walking distance is misleading, as road conditions, seasonal flooding, and terrain often exacerbate travel challenges.

Transport mode further influenced completion rates, with walking associated with higher dropout compared to motorcycle or car use. This aligns with Weiss *et al.* (2020), who found that 43.3% of people worldwide cannot walk to a medical facility within an hour, and motorized transport significantly improves accessibility but remains inaccessible to disadvantaged populations. In Ghana, Abraham *et al.* (2023) noted that outreach campaigns were hampered by inadequate transport options, confirming that mobility disparities translate into inequities in vaccine uptake.

Vaccine availability was highly significant, with stockouts doubling the risk of incomplete immunization. This finding resonates with evidence that cold chain fragility and funding gaps frequently result in prolonged stockouts across Africa (Shibeshi *et al.*, 2020; John & Kompithra, 2025). Caregivers in Malawi and Mozambique similarly reported frustration when traveling long distances only to find vaccines unavailable, leading to dropout (Lawrence *et al.*, 2025; Powelson *et al.*, 2022).

Crowding at clinics also emerged as a strong determinant, with missed appointments due to overcrowding significantly increasing incomplete immunization. Babirye *et al.* (2014) documented similar experiences in Kampala’s informal settlements, where overcrowded facilities and long waits discouraged caregivers. Interestingly, shorter waiting times were

paradoxically associated with higher incompleteness in this study, possibly reflecting under-resourced facilities with fewer services. This contrasts with Ekhaguere *et al.* (2021), who found that lengthy waits in Nigeria discouraged attendance, but it underscores that both extremes—too short or too long—signal systemic inefficiencies.

Overall, these findings confirm that structural barriers—distance, transport, vaccine availability, and clinic organization—are more influential than interpersonal factors such as health worker attitudes, which were not significant. This agrees with Favin *et al.* (2012), who concluded that health system bottlenecks often outweigh caregiver attitudes in determining immunization outcomes.

5.3 Caregivers' Knowledge, Attitudes, and Practices Regarding Immunization

Caregiver knowledge in this study was moderate but uneven, with nearly half unable to name at least two vaccines. This reflects broader evidence that while caregivers often value vaccines, detailed knowledge remains limited. Adokiya *et al.* (2017) found similar patterns in Northern Ghana, where caregivers recognized the importance of immunization but lacked specific knowledge about vaccine-preventable diseases. Chapter Two also highlights data quality and communication gaps, noting that poor documentation and limited analytical skills undermine local decision-making (Daka *et al.*, 2025; Saidu *et al.*, 2023).

The finding that 36% of caregivers did not receive education from health workers underscores missed opportunities for reinforcing positive behaviours. Rainey *et al.* (2011) identified health worker communication as a critical determinant of uptake, while Ngo-Bebe *et al.* (2025) demonstrated that community engagement and gender-sensitive outreach improved coverage in the Democratic Republic of Congo.

Attitudes were overwhelmingly supportive, with 98.6% trusting government-provided vaccines and 92.9% willing to recommend immunization to peers. This aligns with emphasis

on trust and outreach as key drivers of sustained coverage (Ngo-Bebe *et al.*, 2025). However, the 13.1% reporting discouragement reflects pockets of hesitancy, similar to Olufowote (2011), who documented resistance to polio campaigns in Nigeria due to misinformation. Such scepticism, though limited, can undermine coverage if not addressed through targeted education and peer advocacy.

These findings emphasize the need for strengthening caregiver education, improving health worker communication, and leveraging peer networks to sustain high immunization rates. As Chapter Two notes, community engagement and outreach strategies are particularly effective in reaching underserved populations (Powelson *et al.*, 2024; Ngo-Bebe *et al.*, 2025).

5.4 Results from Logistic Regression and Chi-Square Analyses

The chi-square analyses revealed significant associations between immunization status and age group, income level, occupation, and marital status, while ethnicity and religion were not significant. Education approached significance, suggesting that while knowledge gaps exist, socioeconomic and structural factors exert stronger influence. These findings align with Antai (2012), who reported that inequities in immunization uptake in Nigeria were driven primarily by socioeconomic status rather than cultural or religious identity.

The logistic regression analysis further refined these findings, showing that age group, income, vaccine availability, and clinic crowding remained independent predictors after adjustment. Respondents aged 36–45 were significantly less likely to have incomplete immunization compared to those aged 15–25, consistent with Lakew *et al.* (2015), who found maternal age to be protective in Ethiopia. Higher income (≥ 501 GHc) remained strongly protective, echoing Cata-Preta *et al.* (2021), who reported steep wealth gradients in immunization across LMICs.

The strong effect of vaccine availability and crowding underscores the importance of health system capacity, aligning with the literature review conclusion that fragile logistics and

inadequate service organization are major barriers (Songane, 2018; Lawrence *et al.*, 2025). Occupation lost significance after adjustment, suggesting mediation by income, a finding consistent with Wiysonge *et al.* (2012).

Together, these analyses confirm that both individual socioeconomic status (age, income) and health system capacity (vaccine supply, clinic crowding) are pivotal determinants of immunization outcomes. Addressing these factors simultaneously—through socioeconomic empowerment, reliable vaccine supply, and improved clinic efficiency—offers the most promising pathway to improving coverage and equity.

5.5 Overall Summary

The results consistently show how socioeconomic position, caregiver expertise, structural impediments, and demographic traits interact to influence vaccination outcomes. The findings support regional and international research showing that inadequate immunization among children between the ages of 12 and 23 months is still common and is caused by both household-level and health system factors. Although Ghana's coverage is very high when compared to regional averages, district-level discrepancies and ongoing gaps in certain antigens highlight the need for equity-focused measures. Evidence points to the need for integrated approaches like socioeconomic empowerment to lessen wealth-related gaps in order to improve immunization results. improved cold chain and logistics to guarantee a consistent supply of vaccines. enhanced outreach and clinic organization to lessen traffic, wait times, and geographical obstacles. Peer advocacy and improved caregiver education are needed to maintain positive attitudes and combat areas of reluctance. By addressing both structural and individual determinants, Ghana can move closer to universal immunization coverage, reducing vulnerability to vaccine-preventable diseases and advancing equity in child health.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study shows that inadequate immunization among children aged 12-23 months is influenced by both socioeconomic variables and health-care barriers. Nearly one-third of youngsters missed at least one immunization, with Yellow Fever having the greatest deficiency. Chi square analyses revealed that age, income, employment, and marital status are significant demographic predictors, whereas logistic regression demonstrated that age, income, vaccine availability, and clinic crowding are independent predictors of incomplete immunization.

According to the data, younger caregivers, low-income households, and those who face systemic hurdles such as vaccine shortages and clinic crowding are most likely to receive partial immunization. After correction, occupation lost relevance, implying that its effect is mediated by income and other socioeconomic factors. Overall, the study emphasizes the importance of integrated treatments that combine socioeconomic empowerment and health system strengthening. Addressing both home vulnerabilities and systemic delivery issues is the most promising method to increase vaccination coverage, reduce disparities, and protect children from vaccine-preventable diseases.

6.2 Recommendations

The study's findings have substantial policy and practice implications for Ghana's efforts to achieve universal vaccination coverage. Based on the evidence, several solutions are recommended to improve immunization coverage and equity. Each recommendation is accompanied by a clear statement of responsibility to ensure accountability and effective implementation.

6.2.1 Socioeconomic Empowerment

Since higher income was demonstrated to be protective against insufficient immunization, interventions should concentrate on low-income households. Increasing economic assistance and social protection programs can reduce financial obstacles to accessing healthcare.

Responsible actors:

- Government of Ghana (Ministry of Gender, Children and Social Protection, Ministry of Finance) must lead the design and scaling of social protection schemes such as cash transfers, school feeding, and livelihood support.
- Local Government Authorities/District Assemblies must implement community-level income support and monitor vulnerable households.
- Development Partners (UNICEF, World Bank, NGOs) must provide technical and financial support for poverty alleviation programs.
- Civil Society Organizations must advocate for equitable distribution of resources and monitor accountability in program delivery.

6.2.2 Health System Strengthening

To ensure a consistent supply of vaccines, especially for Yellow Fever and Measles Rubella, better stock management and logistics are essential. Clinic overcrowding can be reduced and missed opportunities can be minimized by more staff, appointment scheduling, and longer service hours. Expanding mobile immunization services and community outreach programs would help caregivers who depend on walking have better access.

Responsible actors:

- Ministry of Health (MoH) and Ghana Health Service (GHS) must oversee vaccine procurement, distribution, and cold chain management; recruit and train additional staff; extend clinic hours.

- District Health Directorates must manage local stock monitoring, outreach planning, and supervision of health facilities.
- Community-Based Health Planning and Services (CHPS) Compounds must deliver mobile and outreach services to hard-to-reach populations.
- International Partners (WHO, Gavi, UNICEF) must provide funding, technical assistance, and monitoring support for logistics and cold chain strengthening.

6.2.4 Targeted Outreach and Education

For younger caregivers (ages 15–25), who are more likely to have incomplete immunizations, specific communication plans should be created. Caregivers must be educated about immunization schedules, diseases that can be prevented, and the significance of completion through health worker-led education. Encouraging caregivers who support vaccines to take on the role of community champions is one way to harness peer advocacy.

Responsible actors:

- Ghana Health Service (Health Promotion Department) must design culturally appropriate communication campaigns targeting younger caregivers.
- Frontline Health Workers (nurses, CHPS staff) must provide direct education during clinic visits and outreach sessions.
- Community Leaders and Faith-Based Organizations must mobilize communities, reinforce positive attitudes, and counter misinformation.
- Caregiver Advocates/Peer Networks must act as role models and disseminate accurate information within communities.
- Media Outlets must support dissemination of educational content through radio, television, and social media platforms.

6.2.5 Policy Integration

By incorporating vaccine equity into larger health policy frameworks, systemic and socioeconomic barriers must be tackled simultaneously. To identify susceptible groups and assess progress, immunization outcomes should be monitored by socioeconomic and demographic variables.

Responsible actors:

- Ministry of Health and Ghana Health Service must integrate immunization equity into national health strategies and ensure alignment with Universal Health Coverage goals.
- National Immunization Technical Advisory Group (NITAG) must provide evidence-based recommendations on policy integration and equity-focused interventions.
- Parliament and Policy Makers must enact legislation that secures funding and institutionalizes equity-focused immunization policies.
- District Health Directorates must collect and analyse disaggregated data to monitor local disparities.
- Academic and Research Institutions must conduct operational research to inform policy adjustments and evaluate equity outcomes.
- Development Partners (WHO, UNICEF) must support monitoring frameworks and provide technical assistance for data systems.

6.3 Summary of Responsibility Allocation

- Government Ministries (MoH, Finance, Gender) must lead national policy, funding, and program design.
- Ghana Health Service & District Health Directorates must operationalize interventions, manage logistics, and supervise frontline delivery.

- Community-Level Actors (CHPS, leaders, caregivers) must implement outreach, education, and advocacy at the grassroots.
- International Partners (WHO, UNICEF, Gavi, World Bank) must provide financial, technical, and monitoring support.
- Civil Society & Academia must advocate, monitor, and generate evidence to strengthen accountability and policy refinement.

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APPENDICES

APPENDIX I- (QUESTIONNAIRE)

Good morning/afternoon, Madam

My name is Victoria Ama Poavri, a student of Ensign Global University, Kpong. I am researching determinants of incomplete immunization among children aged 12 to 23 months. Kindly take a few minutes to complete this questionnaire. Your answers, in combination with those of others, are critical in building knowledge on the determinants of incomplete immunization among children aged 12 to 23 months in Odumase sub-municipality. Your responses will remain confidential. Participation is voluntary, and you may withdraw at any time without penalty. Thank you.

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF CAREGIVER

1. Age of caregiver: ____ years
2. child relationship:
☐ Mother ☐ Father ☐ Grandparent ☐ Other: _____
3. Marital status:
☐ Married ☐ Single ☐ Divorced ☐ Widowed
4. Highest level of education:
☐ None ☐ Primary ☐ JHS ☐ SHS ☐ Tertiary
5. Occupation:
☐ Farmer ☐ Trader ☐ Employed ☐ Unemployed ☐ Other: _____
6. Monthly household income (GHS):
☐ <200 ☐ 200–500 ☐ 501–1000 ☐ >1000
7. Religion:
☐ Christian ☐ Muslim ☐ Traditional ☐ Other: _____

8. Ethnic group:

☐ Krobo ☐ Ewe ☐ Akan ☐ Other: _____

SECTION B: CHILD CHARACTERISTICS

9. Sex of child: ☐ Male ☐ Female

10. Birth order of child:

☐ 1st ☐ 2nd ☐ 3rd ☐ 4th or more

11. Total number of children: _____

12. Place of birth of child:

☐ Health facility ☐ Home

13. Current age of child (months): _____

14. Has the child been seriously ill for more than one week before?

☐ Yes ☐ No

SECTION C: IMMUNIZATION STATUS OF CHILD

15. Does the child have an immunization/health card?

☐ Yes ☐ No

16. **Verified from card:**

☐ Fully immunized by 12 months

☐ Incompletely immunized

17. Which vaccines were missed (if any)?

☐ BCG

☐ OPV

☐ Pentavalent

☐ Measles–Rubella

☐ Yellow Fever

☐ Meningococcal

☐ None missed

18. Main reason for missed vaccination(s)?

☐ Forgot appointment

☐ Child was sick

☐ Facility closed

☐ No vaccines available

☐ Distance too far

☐ Lack of money

☐ Belief against vaccines

☐ Long waiting time

☐ Other: _____

SECTION D: HEALTH SYSTEM FACTORS

19. Distance to nearest health facility:

☐ <1 km ☐ 1–5 km ☐ >5 km

20. Means of transport to clinic:

☐ Walk ☐ Public transport ☐ Motorcycle ☐ Car ☐ Other: _____

21. Are vaccines always available when you visit?

☐ Yes ☐ No ☐ Don't know

22. Attitude of health workers:

☐ Friendly ☐ Neutral ☐ Unfriendly

23. Waiting time at clinic:

☐ <30 minutes ☐ 30–60 minutes ☐ >1 hour

24. Has a health worker visited your home in the last 6 months?

☐ Yes ☐ No

25. Have you ever missed vaccination because the clinic was too crowded?

☐ Yes ☐ No

SECTION E: CAREGIVER KNOWLEDGE ON IMMUNIZATION

26. Do you know at what age a child should complete routine immunization?

☐ Yes ☐ No

27. Mention any **two vaccines** given to children:

1. _____ 2. _____

28. Mention **one disease prevented by vaccines**:

29. Have you ever received health education on immunization?

☐ Yes ☐ No

SECTION F: CAREGIVER ATTITUDES TOWARD IMMUNIZATION

30. Do you believe vaccines are important for your child's health?

☐ Yes ☐ No ☐ Not sure

31. Have you ever been discouraged from immunizing your child?

☐ Yes ☐ No

32. If yes, source of discouragement:

☐ Family ☐ Religious leader ☐ Rumors ☐ Social media ☐ Other: _____

33. Do you trust vaccines provided at government facilities?

☐ Yes ☐ No ☐ Not sure

34. Would you recommend immunization to another mother?

☐ Yes ☐ No

SECTION G: CAREGIVER PRACTICES ON IMMUNIZATION

35. Do you usually take your child to the clinic on the exact scheduled date?

☐ Yes ☐ Sometimes ☐ No

36. If you miss a date, do you return later?

☐ Yes ☐ No

37. Do you keep your child's immunization card safely?

☐ Yes ☐ No

APPENDIX II- (INFORMED CONSENT)

DETERMINANTS OF INCOMPLETE IMMUNIZATION AMONG CHILDREN 12 – 23 MONTHS IN LOWER MANYA KROBO MUNICIPAL IN THE EASTERN REGION OF GHANA.

INTRODUCTION AND INFORMED CONSENT FORM TO PARTICIPANTS

My name is VICTORIA AMA POAVRI, a student at Ensign Global University, Kpong. I am conducting research on Determinants of incomplete immunisation among children 12 – 23 months in Lower Manya Krobo Municipal, Eastern Region of Ghana.

This study forms part of my academic work and may also help inform future health policies. I would be very grateful if you could help in answering this questionnaire. For further information, kindly contact me on 0244430160

Confidentiality.

Your name will not appear on the questionnaire; instead, a number will be assigned to your questionnaire.

All information from this research will be kept private and under lock and key. These responses will be used for academic purposes only

Risks

This survey might require you to give very personal details about yourself and your child's immunisation status. Please note that your participation is entirely voluntary; you are not required to explain your reasons if you choose not to take part in the study.

Benefits

Please note that there are no direct material or financial benefits for participating in this study.

However, your participation might assist us in identifying factors that influence the uptake of immunisation, which can help improve immunisation programs.

Duration

This study will involve some questions about your perception and experiences related to immunization and might take about 15 to 25 minutes to complete.

Participation is completely voluntary and you're not obliged to answer any or all the questions.

Voluntary Withdrawal

You are free to withdraw and discontinue this interview at any time without providing any reason.

Do you have any questions regarding this study?

Do you want to participate in the study? YES NO

Name of Interviewer _____

Date: _____

Respondent's signature or thumb print: _____

APPENDIX III- (ETHICAL APPROVAL LETTER)



OUR REF: ENSIGN/IRB/EL/SN-326/02
YOUR REF:

December 4, 2025.

INSTITUTIONAL REVIEW BOARD SECRETARIAT

Victoria Ama Poavri
Ensign Global University
Kpong.

Dear Victoria,

ETHICAL CLEARANCE TO UNDERTAKE POSTGRADUATE RESEARCH

At the General Research Proposals Review Meeting of the *INSTITUTIONAL REVIEW BOARD (IRB)* of Ensign Global University held on Wednesday, December 3, 2025, your research proposal entitled **"Determinants of Incomplete Immunization Among Children Aged 12 to 23 Months in Lower Manya Krobo Municipality, Eastern Region, Ghana"** was considered.

You have been granted Ethical Clearance to collect data for the said research under academic supervision within the IRB's specified frameworks and guidelines.

We wish you all the best.

Sincerely,

A handwritten signature in black ink, appearing to read "Rebecca Acquah-Arhin", is written over a horizontal line.

Dr. (Mrs.) Rebecca Acquah-Arhin
IRB Chairperson

APPENDIX IV- (PERMISSION LETTER)

GHANA HEALTH SERVICE		
In case of reply, the number and the date of this letter should be quoted		Core values of the Ghana health service • People – Centered • Professionalism • Team Work • Innovation • Excellence • Discipline • Integrity
<u>LOWER MANYA KROBO MUNICIPAL HEALTH DIRECTORATE</u>		
P. O. Box 64, Odumase – Krobo	Tel: 0551933991/0245625255	Email: lowermanyakrobodha@gmail.com
My Ref.: No. LMKM/EAS/010/25		Date: 15 th OCTOBER 2025
Your Ref.:		

Ensign Global University

Institutional Review Board.

PERMISSION TO CONDUCT RESEARCH

This is to acknowledge receipt of a request from **Ms Victoria Ama Poavri**, a Master of Public Health (MPH) student at Ensign Global University, Kpong, seeking permission to conduct a research study titled:

“Determinants of Incomplete Immunisation Among Children Aged 12–23 Months in Lower Manya Krobo Municipality, Eastern Region, Ghana.”

The Directorate has reviewed the request and has **granted permission** for Ms Poavri to carry out the said study within the Lower Manya Krobo Municipality. The research may be conducted in selected health facilities and communities under the supervision of the Ensign Global University Institutional Review Board.

The Directorate expects that the research will be conducted ethically and will not disrupt routine health service delivery. All data collected should be handled confidentially, and a copy of the final report should be submitted to the Municipal Health Directorate upon completion of the study.

We wish Ms Poavri every success in her research work.

Thank you.

Yours faithfully,



Dr. James A. Avoka
Municipal Health Director
Lower Manya Krobo Municipal Health Directorate
Eastern Region, Ghana

MUNICIPAL DIRECTOR OF HEALTH SERVICES
LOWER MANYA KROBO
P. O. BOX 64
ODUMASE