

**DETERMINANTS OF UPTAKE OF IMMUNIZATION SERVICES AMONG
CHILDREN AGED BELOW 12 MONTHS IN ALDAI SUB-COUNTY, NANDI COUNTY.**

By

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DECLARATION

I Kemboi Daniel Kiprono does hereby declare that this research project titled “determinants of uptake of immunization services among children aged below 12 months in Aldai Sub-County, Nandi County is my original work that has not been submitted elsewhere for academic research of funding purposes

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DEDICATION

I dedicate this research project to my dear family most importantly my wife and children.

ACKNOWLEDGEMENT

My honest and deep thanksgiving first goes to my Heavenly Father for giving the strength and ability to complete this work. It's through Your grace sufficient Father that this work has progressed to this piece that I can confidently present as complete work.

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ABBREVIATIONS

ANC	-	Antenatal Care
AOR	-	Adjusted Odds Ratio
BCG	-	Bacillus Calmette-Guerin
CI	-	Confidence Interval
CWC	-	Child Welfare Clinic
FIC	-	Fully Immunized Child
KEPI	-	Kenya Expanded Programme for Immunization
KHIS	-	Kenya Health Information System
TB	-	Tuberculosis
UNICEF	-	United Nations Children's Fund
WHO	-	World Health Organization

ABSTRACT

Immunization remains as one of the most powerful tool of disease prevention and control worldwide and is thus considered to be a very crucial part of global and national disease prevention and control policies. Kenya's immunization uptake, currently at 83.2% remains below WHO recommended uptake of 90% indicating that there is a good proportion of children exposed to vaccine preventable diseases. Uptake of immunization varies across regions with some regions doing better in uptake of some vaccines and worse in others. The main purpose of undertaking this study was to investigate the elements capable of influencing uptake of immunization services for children below 12 months in Nandi County, Aldai Sub-County. The study used a cross – sectional survey design. Three immunizing health facilities in the following categories: Sub-County hospital, health centre and dispensary were sampled. Primary data was collected by use of a self-administered questionnaire from caregivers at the Child Welfare Clinic. A binary response model was used for this study with the dependent variable immunization service uptake being denoted as Y with only 2 possible outcomes 1 and 0. A probit analysis provided statistically significant of which the independent variables increase or decrease the probability of uptake. The study findings reveal that the uptake of immunization decreases with the increase in the caregiver's age. Regarding the marital status of the care giver, the probit model results reveal that married care givers are more likely to have their children fully immunized compared to unmarried care givers. Educated caregivers were found to have a higher likelihood of having the children vaccinated compared to the children of parents who have no formal education at all. Regarding occupation type, the findings posit that engagement in skilled occupation was found to increase uptake of immunization among the households compared to engagement in semi and unskilled occupations. Further, the possession of the knowledge in vaccines was found to increase the likelihood of having the child being fully vaccinated compared to lack of knowledge on vaccines. For child characteristics, adherence to full vaccination was found to increase with lower child's age. In terms of child gender, the regression model results posit that male children are less likely to be fully vaccinated compared to female children. The childbirth order was found to increase the likelihood of the child being fully immunized. Regarding environmental or health system characteristics, distance was found to have a negative effect on immunization uptake. The rural residence was found to increase the likelihood of seeking for immunization services among the households compared to urban residence. Women who had received ANC services had a higher likelihood of having their children as opposed to those who missed out on the ANC services. Similar findings were reported for place of delivery whereby facility – based delivery was found to increase the likelihood of immunization uptake compared to home delivery. Lastly, vaccine stock outs were found to increase the likelihood of children being fully vaccinated compared to absence of vaccine stock outs. The study recommends the need for the county government to educate and sensitize women and caregivers on the need to adhere to the immunization schedule for children. Further, expansion of the healthcare services in the rural areas would be helpful in enhancing healthcare access among the rural dwellers.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Immunization which is an action of making a person or an animal immune to infection, typically by inoculation has been regarded as the most powerful weapon against many infectious diseases including tuberculosis, measles, whooping cough, mumps, cervical cancer and recently covid-19 ; diseases commonly referred to as vaccine preventable diseases. Through immunization primary individuals are protected from infectious diseases and their resultant effects which include disability and death to the worse. Immunization also has the capacity to eradicate some diseases preventing future outbreaks and is thus considered an economically viable way of disease prevention and control; it is known to save lives and protect future generations.

Immunization involves use of various types of vaccines classified as: live, attenuated vaccines which are made through passing the disease causing virus through a series of cell cultures or animal embryos making the virus unable to replicate enough to cause a disease but provoke an immune response that can protect against future infection; killed or inactivated vaccines which are made by inactivating a pathogen using heat or chemicals like formalin destroying the pathogens ability to replicate while still keeping it intact for the immune system to recognize it; toxoids vaccines which contain an inactivated toxin and thus considered killed or inactivated vaccines; and lastly, subunit and conjugate vaccines which only contain a piece of the pathogen they are meant to protect against. They are created through genetic engineering or by isolating a specific protein from a pathogen and presenting it as an antigen on its own (Plotkin and Plotikin, 2011).

WHO has identified a total of 29 diseases whose vaccines are available the recent among them being covid-19. A child is expected to complete his/her immunization by age of 12 months for him/her to be declared a Fully Immunized Child (FIC) after which specific booster vaccines are given up to age 5 years. A child is first exposed to Bacillus Calmette-Guerin (BCG) against Tuberculosis (TB) and oral polio vaccine at birth; at 6 weeks, 10 weeks and 14 weeks a child receives 3 doses of penta-valent vaccine, hepatitis B, oral polio and pneumococcal vaccine; and measles vaccine is then administered at 9 months after which a child is said to be fully immunized (World Health Health Organization, 2019).

Immunization has been known to benefit nations and individuals due to its potential of impacting the nation's economy in both direct and indirect ways through reduced heavy load of ill health resulting from reduced expenses that goes into treatment of diseases by individuals, their families and the nation as a whole. This is according to (Ozawa, 2016) who found out that vaccination alone is able to cause a profit of \$44 for every dollar that is put into the immunization service and (Sim, 2020) who stated that a dollar invested into vaccination against ten pathogens under their study has a return of \$26.1 from the year 2011-2020 and \$19.8 from 2021-2030 in 94 countries under study. According to So Yoon Sim et al. (2020) vaccination therefore has the capacity to prevent \$1510.4 billion in cost of illness in the 94 modeled countries compared with a situation where there is no vaccination thus immunization generating \$5662.7 billion in benefits. This is a true demonstration that putting funds into immunization is not a waste of resources but a meaningful investment that should be embraced by nations and individuals.

In 1974 the World Health Organization (WHO) launched a program known as Expanded Programme for Immunization with a prime aim of controlling and reducing deaths caused by vaccine preventable diseases having been motivated by earlier success of the small pox eradication. As a result of this countries of the world developed their national immunization programme to facilitate effective running of the immunization services and thus the birth of Kenya Expanded Programme On immunization (KEPI) in June 1980. Hereafter routine immunization programs were adapted and made part of the health care system to ensure that all children benefit from immunization programs through improved access. In addition, WHO recommended that each country puts immunization timetable for children under five years as a public funded program (World Health Health Organization, 2019). Kenya Expanded programme for Immunization adopted the below (table 1) vaccine schedule from the EPI schedule comprising of both childhood and adult vaccine in order to ensure that all children receive the prescribed vaccines at the right time. Private facilities in addition have continued to offer other childhood vaccines not offered by public health facilities bringing about inequality in vaccine uptake though still contributing to child morbidity and mortality

Table 1.1 : EPI Vaccine schedule

Age at administration	Vaccine	Site/Mode of Administration	Diseases Prevented
At birth	BCG (Baccili calmette-guleria)	Injection in Arm or leg	Tuberculosis
At birth, 6 th , 10 th and 14 th week	Oral polio	Oral	Polio
6 th , 10 th and 14 th week	DPT -HepB-Hib (Diphtheria, Pertussis (Whooping cough), Tetanus, Hepatitis B and Haemophilus influenza type b)	Left Thigh Intramuscular	Diphtheria, Pertussis (Whooping cough), Tetanus, Hepatitis B and Haemophilus influenza type b
6 th , 10 th and 14 th week	Pneumococcal Vaccine (PCV 10)	Right thigh	Pneumonia, Meningitis and Sepsis
6 th and 10 th week	Rotarix vaccine	Oral	Diarrhea and vomiting
14 th week	Inactivated Polio Vaccine (IPV)	Right upper outer thigh Intramuscular	Polio
9 th months, 18 th months	Measles	Upper right arm subcutaneous (deltoid muscles)	Measles
9 th months	Yellow fever	Upper arm	Yellow fever
6 th months, 7 th months, 9 th months, 24 th months	Malaria vaccine	Intramuscular upper thigh	Malaria
Children aged 7-14 years, Women of Child Bearing Age (WCBA), pregnant women	Tetanus Toxoid (TT)	Non-dominant upper arm	Tetanus

10 years +6 months	HPV	Injection upper arm	Cervical cancer
6 th , 12 th , 18 th , 24 th , 30 th , 36 th , 46 th , 48 th , 54 th , and 60 th months. Less 6 weeks postpartum mothers	Vitamin A	Oral	Proper growth and development, cell recognition, vision, immune function and reproduction
Other vaccines not on the KEPI schedule but offered in private health facilities			
6 th month, 7 th month	Flu vaccine		Flu
9 th month, 11 th month	Chicken pox 1 and 2 vaccine		Chicken pox
9 th month	Meningitis 1 vaccine		meningitis
15 th month	Mumps, measles, rubella (MMR) vaccine		Mumps, measles, rubella
2 years and above	Typhim	Upper arm	Typhoid

(World Health Organization, 2019).

At the global level immunization has been estimated to avoid 3 million deaths that could have occurred among children below 5 years as a result of diseases that are preventable through immunization. This is according to WHO (2018). Despite this quite significant benefits gained globally through prevention of deaths from infectious diseases, some African countries have continued to register low coverage performing below the 90% target set by WHO in the 2012 Global Vaccine Action Plan. Among these African countries are Uganda, Tanzania and Kenya who reported 55%, 75% and 78% as reported in the respective demographic health surveys (UDHS, 2016; TDHS, 2016; KDHS, 2014). However in the year 2014, Zimbabwe as a country in Africa was able to register the Global Vaccine Action Plan (GVAP) Diphtheria, Pertussis and Tetanus threshold of 80% and above, a benchmark that has been established to show performance of vaccine uptake. (GVAP, 2016).

Although WHO has put in concerted efforts to make sure that nations work towards the greater than 90% recommended immunization coverage that ensures herd immunity (Brown, 2011),

immunization has not been able to achieve its full potential with 1.5 million children dying across all age groups from diseases that can be prevented through immunization. Nations and their constituents in Africa have continued to experience low performance in immunization coverage remaining below other regions of the world. It has been estimated that 1 in 5 children fail to get the required vaccines resulting into thirty million children getting affected from illnesses that can be averted through immunization annually in Africa and 0.5 million deaths annually which is 58% of the world deaths related to immunization preventable diseases. This is according to Business Case for WHO immunization activities on the African Continent 2018-2030. In WHO ministerial conference on immunization in Africa it was reported that in 2016 one out of every five children had not received their jab with the people living in marginalized parts of African countries taking the largest share of those who missed their life saving vaccines.

According to WHO 2020 fact sheets global immunization coverage dropped to 83% in 2020 from 86% in 2019 with as almost 23 million children below 24 months missing out on vaccination and thus increasing the number of unvaccinated children by 3.4 million although this is attributed to the covid-19 pandemic that devastated the health system of the world, it leaves many questions unanswered concerning the preparedness of the health system to handle immunization issues. WHO and UNICEF estimates of national coverage as at June 29, 2020 report indicates that children under one year in Kenya who received measles vaccine in Kenya in 2019 was 82% while Kenya Health Information System reports 83.2% coverage in 2020 indicating that as a nation we are still operating under the 90% WHO recommended target. Nandi County which is one of the 47 counties in Kenya registered 83.1% coverage with its sub-counties reporting coverage of between 93% and 75.6% with Aldai Sub-County being the lowest at 75.6% (KHIS, 2021).

Kenya as a country has continued to experience disparities in vaccine uptake with some counties performing better in coverage while others performed extremely poor. According to KDHS 2014 North Eastern only managed a coverage of 48.3% while the coastal region achieved a coverage of 77.6% .Understanding the key predictors of immunization uptake therefore is important in the efforts to strengthen campaign strategies aimed at increasing immunization coverage to reduce morbidity and mortality rates that result from vaccine preventable diseases. According to various studies conducted in relation to seeking of health services including immunization several factors have been attributed to these disparities and include socio-demographic, economic and health

system related factors as they tend to influence uptake of vaccinations either positively or negatively.

Social demographic factors such as caregiver's age, marital status, education level, occupation, income and knowledge of vaccines have been studied and reported to have an impact on vaccine uptake (Shaham, 2020; Anokye, 2018).

Various studies have been conducted to find the association between environmental and health system factors and immunization uptake establishing that these factors have the ability to influence the uptake of immunization services, such factors include distance to the health facility, residence, antenatal care services, place of delivery (Rup, 2008; Logullo, 2008; Mukungwa, 2015; Mutua, 2011).

Knowledge, attitudes and perceptions of caregivers on immunization services have been studied to see whether they impact positively or negatively the uptake of immunization (Gunnala, 2016).

Child characteristics that include age of the child, birth order of the child and sex of the child have been studied to try and establish their link to uptake of immunization services (Oladokun, 2020; Duru, 2016; Herliana, 2017).

In lieu of the above studies it is thus important to try and establish the relationship between the factors mentioned in the studies that include socio-demographic, socio-economic, child characteristics and; environmental and health system factors and the use of health services. It is upon this background that this study seeks to explore the determinants of uptake of immunization services in Aldai Sub-County of Nandi County which had the lowest immunization coverage and had no previous study conducted to establish this relationship.

1.2 Statement of the problem

Immunization remains as one of the most powerful tool of disease prevention and control worldwide. Despite its usefulness uptake of immunization services still remain unacceptably low making the vaccine preventable diseases to top the list of contributors to childhood morbidity and mortality with an estimated 1.5 million deaths among children being associated with diseases that can be averted through immunization as stated by WHO, 2018. The governments of many nations Kenya included, Non -Governmental Organization and the private sectors have continued to put

in concerted efforts to ensure availability and accessibility of the vaccines so as to maximize use by the children below 12 months. Whereas programs to ensure this is possible have been rigorous, uptake seems to remain low yet expanded availability and accessibility of immunization services. But to what extent are these services actually used? If these services are made readily available and accessible what are the factors that will influence their uptake by the intended population?

These seem to be the unanswered questions which this study seeks to provide answers to. Kenya as a country has continued to put in strategies that have been adopted by 47 counties to boost uptake of immunization services and ensure every child gets protection against vaccine preventable diseases. These strategies include: Integrated outreach programs, mass immunization campaigns, increase in number of vaccinating facilities by making sure all government facilities and private facilities stock and offer vaccination services, media campaign on vaccination; advocacy, communication and social mobilization activities toward promoting vaccination, community health strategy ensuring every household is attached to a community health volunteer. Despite these efforts the country has continued to register low immunization uptake falling behind the WHO target of 90% with the current uptake standing at 83.2% (KHIS, 2021).

This uptake obtained because of efforts put in by the 47 counties immunizing facilities as per the national targets requirement given to each county tends to conceal challenges experienced by the counties, the sub-counties and their immunizing facilities in relation to access to immunization. Achievements by counties in uptake of immunization services with Nandi County uptake being at 83.1% vary across the sub-counties and immunizing facilities with Aldai Sub-County registering the lowest uptake of 75.6% and Nandi Hills Sub-County registering the highest uptake of 94.9% (KHIS, 2021) indicating discrepancies in immunization uptake within the same country and county and thus indicating that a substantial number of children in Aldai Sub-County are still exposed to the dangers caused by vaccine preventable diseases including death and disability prompting this study that seeks to unravel the determinants of immunization uptake among children below 12 months. Though studies on uptake of immunization services do exist, they are minimal and yet still there is no study that seeks to address this challenge of immunization in Aldai Sub-County leave alone Nandi County.

1.3 Research Questions

The following research questions guided the study.

- i. What are the patterns of immunization services uptake for children below 12 months in Aldai Sub-County?
- ii. What factors influence uptake of immunization services for children below 12 months in Aldai Sub-County?
- iii. What are the policy options that would facilitate uptake of immunization services for children below 12 months in Aldai Sub-County.

1.4 Research objectives

The general objective of this study was to investigate the factors that influence uptake of immunization services for children below 12 months in Nandi County, Aldai Sub-County. Specifically the objectives of the survey are:

- i. To determine the pattern of immunization services uptake for children below 12 months in Aldai Sub-County
- ii. To examine the factors that influence uptake of immunization services for children below 12 months in Aldai Sub-County
- iii. To provide some policy options that would facilitate uptake of immunization services following objective 2 above.

1.5 Justification of the study

Immunization is a cost-effective way of averting costs associated with managing the heavy burden of morbidity and mortality caused by vaccine preventable diseases (Sim, 2020). However, underutilization of immunization services resulting to low coverage means most children are not vaccinated at all or partially vaccinated as witnessed in 2020 where 17.1 million children missed an initial dose of DPT vaccine and 5.6 million partially vaccinated (World Health Health Organization, 2019). This has the potential to result into outbreak of vaccine related diseases like tuberculosis, polio and measles which are costly to manage as it means more money would be spent in managing the diseases including mass campaigns to prevent future outbreaks which might be costly to a nation. It is therefore important that measures that can improve adherence and

compliance to immunization services are known and addressed accordingly. This study would investigate the factors that undermine the uptake of immunization services by the caregivers of the children less than 1 year. The evidence from this study would help in development of programs including policies and health promotion programs that are aimed at improving immunization indicators.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter brings out an overview of the theoretical literature that has been advanced to explain the uptake of immunization services. In addition it also provides the literature review on empirical studies on factors that affect uptake of immunization services and finally gives an overview of the literature.

2.2 The Theoretical literature

Andersen's generic behavioral model, developed by Ronald M. Andersen in 1968 shall inform this study. This is a model that categorizes determinants of utilization of health services into three important classes with the first class acknowledging the existence of predisposing factors namely: occupation, gender, age, religion, ethnicity, possession of disease knowledge as factors that cause some individuals to have a higher likelihood to use health services as compared to others. The second class which is of enabling factors acknowledges that even though some people may be liable or qualified to have a health services, they will still not use it unless they are enabled. This is informed by factors such as availability of the service, financial capacity to buy the service, having a health insurance and access to social network support. The last category is that of need factors which allude to the fundamental and straight stimulant to the utilization of health services. This is explained by the fact that for one to use a health service they need to feel that they require it resulting from their awareness of the magnitude of the illness, sum of days spent sick in bed, sum of days incapacitated to attend work or to attend school and help of care they are likely to receive from other outside sources.

The enablers will investigate whether the immunization services were available, affordable and the capacity to have supportive facilities that enable use of the immunization services and lastly the need factors will be used to reveal the understanding of caregivers on the use of vaccines to prevent consequences of missing out on vaccines that include ill-health, disability and death and the wider effect on the society.

2.3 Empirical Literature

Both recent and past research has shown the existence of various factors that could have a significant relationship on uptake of immunization services. Here we thus explore literature on various studies that have been conducted on factors influencing uptake of immunization services. The factors to be explored can thus be classified as those to do with the socio-demographic characteristics of the child's parent/caregiver, those to do with the characteristic of the child and finally those concerned with the environment or the health system. Socio-demographic characteristics of a child's caregiver have been advanced as key determinants of immunization uptake as parents' understanding of immunization services and level of education tend to determine their response to immunization program. Parent's sexes, age, marital status, level of education, occupation are some of the factors that have been explored to find their relationship with immunization service uptake.

Okoro (2015) in a cross-sectional survey examining the influence of sociodemographic factors on immunization of children in Enugu, Nigeria found out that mother's education status had a significant impact on immunization completion with mothers who had lower academic credentials tending to register low immunization uptake as opposed to mothers with higher academics. The study focused on children suffering from chronic neurological disorders. The study findings concur with results from an earlier cross-sectional study by Odiit (2003) who found children who had parents with advanced education had increased chances of adhering to the recommended vaccine schedules as compared to children whose parents had no formal education. In addition, (Girmay, 2019) found that mothers who had attained post primary education had a 2.39 times high chance of having their children complete immunization as compared to those with low levels of education in Ethiopia. This was in a community based cross-sectional survey that sought to establish the influencers of childhood immunization among children aged 12-23 months.

Understanding the vaccines and their impact has been found to have a positive impact on the uptake and completion of immunization as revealed by various studies. Findings from a cross-sectional multi stage study seeking to establish how mother's understanding of vaccination contributes to immunization in Jos North, Nigeria revealed that mothers who possess desired levels of understanding on vaccines had higher tendency of having their children complete immunization with 89.6% of the 232 respondents in the study having desirable levels of knowledge on

immunization (Otubor, 2015). Knowledge on immunization as a precursor to the uptake of immunization is further supported by (Olumiya, 2008) in a cross-sectional study on the determinants of immunization status in children in rural areas of Nigeria which revealed that mothers with adequate knowledge on immunization tend to have their children complete the prescribed vaccines as compared to those with less or no knowledge with 87% of the mothers interviewed having adequate knowledge on immunization.

(Sanou, Simboro and Kouyate, 2009) examined the status of children immunization among 12-23 months old in Burkina Faso. The cross-sectional study found that caregivers who had some good level of understanding on the importance of having children vaccinated were best placed to have their children receive the prescribed immunization services as compared to those who had no idea. In Northern Nigeria, a two-stage household level cluster survey to establish routine vaccination coverage targeting 40 districts that were considered as of high risk when it came to polio outbreak, reported maternal lack of knowledge on vaccines as the main reason why uptake of vaccination was low (Gunnala, 2016). Mothers with some level of understanding about immunization and diseases that could be prevented by means of vaccination in Sinama District Southeast Ethiopia were found to have high chances of exposing their children to the stipulated vaccines as opposed to those who had no understanding. This was from a community based cross-sectional survey that employed bivariate analysis from which multiple regression method was done for all the characteristics that seemed to have a significant correlation in bivariate analysis (Legesse and Dechasa, 2015)

Likewise, this study established that having a father who had attained education beyond primary level (AOR=3.1; 95%CI: 1.3,7.4) increased the likelihood of vaccine uptake. (Awosan, 2018) found that women who had understanding on issues of immunization were very probable of having their children receive their vaccines as opposed to those who lacked awareness. These findings of a cross-sectional survey at how mother's understanding and view of vaccination affects adherence to vaccination in Nigeria reveal that education is a positive predictor to immunization uptake as it has the capacity to expose and equip one with knowledge on the importance of vaccines contributing to positive health behavior of which immunization is part of.

Ahmad (2020) while analyzing the 2015 Afghanistan Demographic and Health Survey found that mother's age seems to have a significant impact to immunization uptake for children aged 12-23

moths in Afghanistan. A cross sectional descriptive study employing study on factors influencing the completion of vaccination among children below age of 2 years at Nanyongera Health Centre, Tororo District of Uganda established that age of the mother among other factor such as marital status and education level of the child's caretaker greatly influenced compliance to the immunization schedule thus affected immunization uptake positively (Jonathan, 2018). However, a cross-sectional study using data from the 2003 Philipines Demographic and Health survey to identify the determinants of immunization in Philipines failed to establish a relationship between mothers age and immunization uptake (Bondy, Thind and Koval, 2009).

In China, (Ke and Zheng, 2014) examined childhood immunization and risk factors. The cross-sectional study found that mother's occupation is likely to have an impact as their children receive the recommended childhood vaccines thus a positive predictor of immunization uptake. (Anokye, 2018) had similar findings in a cross-sectional descriptive study that sought to find out how social and demographic factors affected completion of childhood vaccination in Koforidua, Ghana which established that mothers who were employed had increased chances of having their children complete the prescribed vaccines with those working as full-time workers having a higher probability of ensuring their children are fully vaccinated. In contrast a community based cross-sectional study done in Nigeria looking at factors that contributed to vaccination rank and area of reach for children below 5 years found out that a mother's occupation had no significant association immunization uptake with those with occupation reporting no different results from those without (Duru, 2016).

A cross-sectional descriptive study conducted by (Anokye, 2018) seeking to establish the effects of social and demographic factors on completion of vaccination of children in Koforidua, Ghana found out that mothers who had walked out of their marriages had a higher probability of having their children complete vaccination as opposed to those who were in their marriage (Anokye, 2018). Contradicting findings are reported from a cross-sectional multi stage study seeking to establish how mother's understanding, point of view and custom on vaccination in Jos North, Nigeria affects uptake of immunization stating that women who lived with their spouse had quite some good level of information on matters concerning vaccination and were therefore likely to have their children undergo vaccination as compared to those who were unmarried (Otubor, 2015). (Oyefara, 2014) cross-sectional study looking at mother's characteristics and immunization status of children

below 5 years in Ojo, Nigeria established that being married or not married had no statistic relation at multivariate level with having the child achieve full vaccination.

The attitudes and perceptions that mother have toward immunization services have a significant impact on uptake; this is as revealed in a two-stage household level cluster survey to establish routine vaccination coverage targeting 40 districts that were considered as of high risk when it came to polio outbreak in Northern Nigeria (Gunnala,2016) and in another descriptive cross-sectional study in Nigeria seeking to find out why children were not completing vaccination (Oladokun R. et al., 2010) with the results from the two studies showing that mothers who possessed a bad view on immunization registered low uptake of immunization services. Similarly, those who were of the view that taking a child to a vaccinating centre to receive vaccination was wastage of their time opted not to have their children vaccinated fully (Gunnala, 2016).

Ahmad (2020) while analyzing the 2015 Afghanistan Demographic and Health Survey found that mother's age seems to have a significant impact to immunization uptake for children aged 12-23 moths in Afghanistan. A cross sectional descriptive study employing study on factors influencing the completion of vaccination among children below age of 2 years at Nanyongera Health Centre, Tororo District of Uganda established that age of the mother among other factor such as marital status and education level of the child's caretaker greatly influenced compliance to the immunization schedule thus affected immunization uptake positively (Jonathan, 2018). However, a cross-sectional study using data from the 2003 Philipines Demographic and Health survey to identify the determinants of immunization in Philipines failed to establish a relationship between mothers age and immunization uptake (Bondy, Thind and Koval, 2009).

Accordingly, caregivers who felt that vaccines had the capacity to give their children good health outcomes did not hesitate to have their children vaccinated thus registering improved uptake of vaccination as revealed in a case – control study looking at what contributes to making children default on vaccine in the district of Arbegona situated in the Southern parts of Ethiopia on looking at the issues of children vaccination for their children in Nigeria, Kaduna estate, (Negussie, Kassahun and Assegid, 2015). In Tanzania caregivers who seemed to be well pleased with the quality of immunization services given to them had increased chances of having their children abide with the vaccine calendar as opposed to those who had negative perception with the quality of services offered. This is as revealed from a cross sectional study in Ileje District, Tanzania on

the perceptions of the community on vaccines and its resultant impact on uptake among children aged 12-23 years (Chambongo, 2016).

The impact of perceptions on vaccine uptake is not only a positive predictor in childhood vaccines but also in vaccines involving the adult population as revealed by (Marcus, 2014) in a combined web/postal survey on perceptions and socio-demographic factors influencing vaccination uptake and precautionary behaviors in response to the A/H1N1 influenza in Sweden whereby the main reason for many people taking the vaccine was because of their perceived fears of infecting those closer to them including family and spreading the disease to the community. This study also established that if one had trust in the positive outcomes of the vaccines they will opt for vaccination. He also established that women were the most beneficiaries of the vaccine with those who had young children or felt to be at more risk of infection choosing to go for the vaccination.

In another retrospective cohort study conducted in Maccabi, Israel looking at personal and social pattern predicting influenza vaccination decision by Shaham (2020) it was found out that vaccination uptake was mostly associated with age, socioeconomic status and geographical location likewise the study established that people who had previously been diagnosed with a vaccine preventable disease or been previously vaccinated had higher chances of becoming vaccinated.

Paternal factors have come out as influencers of uptake of vaccination services though much interest in studies have been on mothers. (Aalemi, 2020) in the analysis of Afghanistan 2015 Demographic and health survey to establish factors influencing vaccination coverage among children aged 12-23 months found out that having a father who had some professional occupation increased the chances of having the child vaccinated with those who had fathers in a professional occupation scoring 3.8 times higher chances of being vaccinated. (Phimmasane, 2010) while seeking to find factors affecting compliance with measles vaccination in Lao using cross-sectional descriptive study established that having a father with high academic status increased chances of compliance with vaccination.

(Donfouet, 2019) while seeking to unravel the causes of unequal distribution of vaccination services among young ones of ages above 12 months and less than 2 years in Kenya, Ghana and Ivory Coast by use of demographic and health surveys and multiple indicator cluster surveys

found out that vaccination inequalities tend to favor those economically able households basing on the fact they are more knowledgeable about the positive outcomes of vaccines and have increased access to the facilities thus increasing their demand compared to their counterparts in the lower quintile. The findings of this study tends to register similar results when it comes to inequalities on economic empowerment with a cross-sectional study seeking to establish the determinants of immunization coverage of children aged 12-59 months in Indonesia that showed poverty as one of the determinants stating that children who were born from poor families had decreased chances of being immunized as well as those who had no medical cover and those who came from families where parents had no or minimal exposure to media (Herliana and Douiri, 2017).

The characteristic of a child being born in a family in terms of birth order, sex and age has been shown to influence uptake of immunization service with the position of a child in a family being found to be significant when it comes to uptake of immunization services with those born after the first or second born having reduced chances of being vaccinated. This is as revealed by (Mukungwa, 2015) in his cross-sectional study seeking to unravel factors associated with full immunization coverage among children aged 12-23 months in Zimbabwe with 69% of the 978 in the study in the category of first birth order completing the prescribed vaccines as compared to 59% of children born in the position of number five to six and 45% of children in the 6th and above position. This implies that as more children are born in the family the uptake of vaccination dwindles.

These results tend to agree with the findings of a case-control study by (Negussie, Kassahun and Assegid, 2015) seeking to establish what leads to children not completing their prescribed vaccines as per the vaccine schedule in Arbegon region of Southern parts of Ethiopia which found out that a child born beyond first born in a family was at a higher risk of defaulting on vaccination. Similar results are registered in a cross sectional study carried out by (Herliana and Douiri, 2017) seeking factors affecting coverage of immunization services offered children aged 12-59 months in India which revealed that children born after the first child had reduced likelihood of receiving vaccination with the chances of vaccination diminishing as more children are born into a family.

Contrasting the findings on birth order of a child are results from a cross-sectional household census survey study on determinants of immunization scope affecting those under 59 months of

age in Angola which showed that children born in a family with children below two had reduced chances of getting vaccinated as compared to children who are in a family that has 2 or more children stating that mothers with more children are likely to have been more exposed to information on immunization thus in a better position to take their children for immunization (Oliveria, 2014). This Study also revealed child's age to be of significance in immunization as it found the existence of increased immunization uptake in children below the age of one year and agrees with another community based cross-sectional study in Nigeria (Duru C. et al, 2016).

On a child's sex a study conducted in Ibadan, Nigeria a descriptive cross-sectional study seeking to find out why children were not completing vaccination revealed that a boy child was given priority when it came to immunization thus having a three times likelihood of being vaccinated than a girl child (Oladokun, Adedokun and Lawoyin, 2010). Cross-sectional study conducted in China revealed that a child's age positively predicted the immunization status of a child (Ke and Zheng, 2014). However, the Ethiopian 2006 expanded program on immunization survey and the Kenyan demographic health survey of 2008-2009 found no significant gender - immunization services uptake (Diddy, 2009).

Various studies have attributed uptake of immunization services to environmental and health system factors establishing that these factors have the ability to influence the uptake of immunization services, such factors include distance to the health facility, residence, antenatal care services, place of delivery. In India, Rup (2008) while seeking to determine what affects coverage of immunization in relation to children in a cross-sectional study in Assam India found that children born in families residing within a 2 kilometer radius tend to comply with the immunization schedule unlike their peers living outside the 2 kilometer. Similar results are reported by (Logullo, 2008) case-control and explanatory study on factors affecting compliance with measles vaccination schedule in a Brazilian City attributing accessibility to healthcare facilities as having the ability to increase uptake of vaccines. In Zimbabwe, (Mukungwa, 2015) in a cross-sectional study on determinants of immunization coverage affecting under 5s found that distance to a vaccinating facility has a significant contribution to vaccine uptake by stating that children with caretakers who reported having no issue with access to a vaccinating facility had an increased likelihood of having their children fully vaccinated as opposed to those who reported to have an issue with the distance to the hospital.

In another cross-sectional study done in Sudan by (Ibnouf, 2007) it was revealed that having to walk to the nearest immunizing facility had a strong relationship with the up to date adherence to the immunization schedule of the child with mothers who walked for 30 minutes or less to the health facility reporting a 3.4 times higher likelihood of having their children comply with the vaccine calendar as opposed to those out of the less than 30 minutes' walk. A WHO cluster-sample survey study conducted in Kenya established that caretakers living near immunizing health facilities had a higher probability of having their children get vaccinated as compared to those living miles away from the facility (Ndiritu, 2006)

Closely related to distance is the place of residence with those residing in urban areas having much access to health services and information that can easily influence their decision for positive health seeking behavior thus increased uptake of immunization services as found out by (Herliana and Douiri, 2017) in a cross-sectional research in India that sought to establish the determinants of immunization coverage in children of 12-59 months of age showing that geographical location was one of a significant contributor to immunization coverage with more children living in urban areas receiving their vaccines as prescribed than those living in rural areas. (Olumiya, 2008) findings in a cross-sectional study looking at what leads to children partially receiving immunization services in Nigeria seems to agree with the concept of resident as a significant contributor to immunization uptake by deducing that children born in urban areas had improved chances of being vaccinated than their counterparts who resided out of the urban set-up.

Antenatal care is care given to a mother during her pregnancy period. This care is very important as it ensures the safety of the baby and the mother during pregnancy and also prepares her for birth in and subsequent care of the child one it is born as the mother is made aware of child welfare clinics for immunization services. This can therefore be the reason that studies have established a relationship between antenatal visits and immunization. An analysis of the Afghanistan 2015 Demographic and Health Survey by (Aalemi, 2020) on what contributes to vaccination of young ones between the age of 12 and 23 months in Afghanistan found out that children born to mothers who made at least 3 visits had 70% higher chance of being immunized than their counterparts born to mothers who had no antenatal care visit during their pregnancy period. This aspect of visit to antenatal care clinic as a determinant to vaccine uptake is further emphasized in the findings of a cross sectional study by (Mukungwa, 2015) in Zimbabwe that established that women who had

gone for at least 4 and above visits had increased probability of having their children acquire all the stipulated vaccines than their counterparts who had gone for lesser visits.

Etana (2012) in a cross-sectional community study examined vaccination in Central Ethiopia among 12 to 23 months old children. The study found that antenatal care follow-up, birth in a hospital, mother's knowledge on immunization compliance significantly affected uptake and completion of immunization. These findings have some similarities with the finding of a cross-sectional survey by (Legesse and Dechasa, 2015) whose study looking coverage of immunization and its influencers in Southeast Ethiopia established that a child was likely to be fully immunized if there was antenatal care follow up on the mother, was born to a farmer, the father had secondary or post-secondary education, the household had an income greater than 52 USD, the immunizing facility was located within a less than one hour walk, the mother received some information on immunization from a health extension worker and or the mother had sufficient knowledge on immunization in Ethiopia.

Results with some similarities are also registered by a community based cross sectional survey seeking to find the factors associated with full vaccination in children aged 12-23 months in hard to reach areas of Ethiopia with findings that mothers who had adequate knowledge on vaccination had an increased likelihood of having their children complete vaccination than those with inadequate information, likewise those parents who lived within a 30 minutes distance to the health facility were likely to have their children complete their vaccine schedule (Girmay, 2019). Other similar results reported to greatly influence immunization uptake by (Girmay, 2019) study include; children born in a family with 5 or more children having a low chance of being vaccinated as compared to those born in household with fewer children; and children born in households that are economically well having increased chances of being vaccinated.

(Lifalaza, 2016) established that uptake of immunization services in Nangama District, Namibia was affected by the ability of the users to demand the services stating that being not able to pay ones transport to a health facility, lacking assistance from one's spouse or the community affected their ability to have their children get vaccinated. The qualitative exploratory study seeking to analyse the effect of mother's perception on what causes underutilization of immunization services also established that the health system factors also affected uptake of this important service and this included factors such as inability of the providers to give adequate information on vaccination

to the caretakers, healthcare workers attitude, poor management of data on immunization, lack of supportive supervision, offering services during times that were not agreeable with the client's, inadequate health workers. Further her results revealed that caretakers who having had information or previous experience with measles attacks had increased demand of immunization services their education level, assistance from a husband or family members, time conveniences and presence of health services not being a hindrance.

Vaccine stock-outs have been known to cause a pose to delivery of immunization services with children missing out on their stipulated vaccines as per the vaccine schedules. In Kenya BCG and pentavalent vaccines stock out has been more prevalent. This is as stated by (Lyndon, 2017) while looking at vaccine stock-outs around the world. This has the potential of discouraging caregivers from taking their children for immunization services thus affecting uptake of immunization services. (Babirye, 2012) while conducting a cross sectional study to assess how timeliness of vaccines affects vaccination services in Kampala Uganda found out that inadequate supply of vaccines to immunizing facilities had a significant impact on uptake of vaccination

Religious beliefs have continued to pose challenges to uptake of immunization services with a section of the population believing that vaccines are always mixed with some chemicals that can cause harm to the proper development and functioning of the child even as it grows into adulthood thus making parents avoid taking their children for immunization services. This is according to a qualitative study assessing reasons for childhood immunization defaulting in Southern Ethiopia (Zewdie., 2016). However, a community based cross sectional study by (Legesse and Dechasa, 2015) on determinants of childhood immunization seems to refute these claims finding no significant relationship between religious beliefs and immunization uptake.

In order to improve immunization uptake there is need to employ various strategies that would support routine immunization services offered at the vaccinating facilities. Various governments including Kenya have thus introduced mass immunization campaigns offered during the National Immunization Days and community outreaches especially targeting those areas with low uptake of immunization services.

2.4 Overview of the literature

Looking through the literature review above it can be established that there are factors that can be positively associated with uptake of immunization services. These factors can be categorised as paternal centered factors and include age, sex, marital status, education status, occupation and knowledge of immunization (Ahmad, 2020; Jonathan, 2018; Anokye, 2018; Ke and Zheng, 2014; Okoro, 2015; Odiit, 2003; Girmay, 2019;); child centered factors including sex, birth order and age (Mukungwa, 2015; Herliana and Douiri, 2017; Oladokun, 2020; K Han, 2014; Oliveria et al., 2014; Duru C. et al., 2016); and finally environmental or health system factors that include distance to the facility, residence of the caregiver, antenatal care visit and hospital delivery (Rup KP et al., 2008; Logullu et al., 2008; Mukungwa, 2015; Putri Herliana et al., 2017; Adedokun S. et al., 2017; Ahmad, 2020; Vonasek, 2016; Belachew, 2012; Adedire et al., 2016). The literature further reveals that religious beliefs (Zewdie et al., 2016) and vaccine stock-outs in the immunizing facilities (Babirye, 2012) negatively affects uptake of immunization services.

Regarding determinants of uptake of immunization services among children below 12 months in Aldai Sub-county, Nandi County, Kenya the reviewed literature has revealed that no study has been done in to address such an area in this county, although from the literature reviewed there have been studies done on immunization of children 12-23 months old children in Kenya (Donfouet, 2019). A clear understanding of the determinants of uptake of immunization services would direct decision making placing decision makers at a good position to come up with policies that will be county specific targeting the right channels of implementation so as to improve uptake of immunization services in Nandi County. The aim of this study therefore is to bring into perspective the determinants of vaccine uptake in Aldai Sub-county, Nandi County.

CHAPTER THREE METHODOLOGY

3.1 Introduction

This chapter outlines the overall methodology to be used in carrying out the study. It explains the design adopted, discusses the model estimation, and defines the variables to be used in the study together with their measurements and expected sign. The chapter also outlines the data source, sample size and the sampling technique.

3.2 Conceptual Framework

From the literature review on that factors that contribute to uptake of immunization services, the dependent and independent variables can be represented as follows:

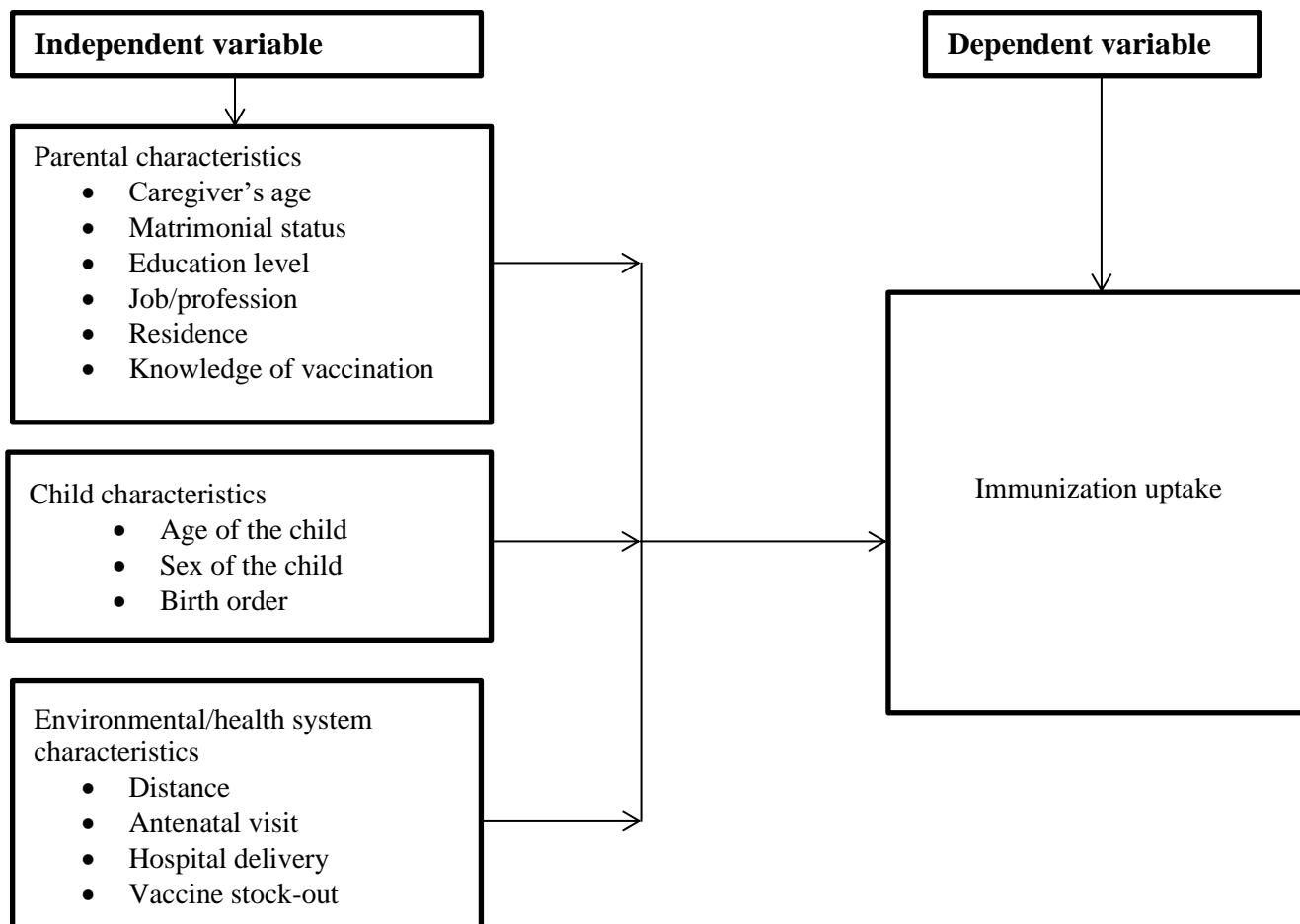


Figure 3.1: Conceptual framework

(Source: Researcher, 2021)

In this study the above framework was adopted to help us understand the factors associated with vaccine uptake as per the study objectives. As shown in the figure above uptake of immunization services is determined by factors such as particular characteristics of the parents/caregivers that include age, marital status, education, occupation, knowledge of vaccines. Child related characteristics and environmental/health system factors are also shown to determine the uptake of immunization services

3.3 Economic Model

Since this study dependent variable, uptake of immunization services denoted as Y which was a binary response model and therefore have only 2 possible outcomes (Uptake and Non-uptake of immunization services) which can be denoted as 1 and 0.

The model will thus take the form;

$$\Pr(Y=1/X) = \Phi (X_1\beta);$$

Where \Pr denotes the probability of whether a caregiver of the child under study took the child to receive the prescribed vaccines. X_1 is a vector of the regressors which are assumed to influence the outcome Y and Φ is the Cumulative Distribution Function of the probit model and β is a vector of parameter estimates.

This implies thinking towards the probability of making a choice of 1 and in terms of probability this can be written as follows:

$$\Pr(Y_1=1) \text{ and } \Pr(Y_1^* \geq 0) = \Pr(\beta X_i + \varepsilon_i \geq 0) = \Pr(\varepsilon_i \geq -\beta X_i) \text{-----} (1)$$

ε_i is a random variable which is assumed to be normal in probit models. Y_1^* is a latent discrete variable ranging between 1 and 0. If $Y_1 = 1$ we know $Y_1 > 0$ and if $Y_1 = 0$ we know $Y_1 < 0$. thus the probit model by taking the probabilities into account can be written as:

$$\Pr(Y_1=1) \Pr(\varepsilon_i \geq -\beta X_i) = 1 - \Phi (-\beta X_i) = \Phi (\beta X_i) \text{-----} (2)$$

The last equal sign arises since standard normal distribution is symmetrical about zero. In addition since $\Pr(Y_1=0) = 1 - \Pr(Y_1=1)$ and this could also mean $\Pr(Y_1=0) = \Phi (-\beta X_i)$.

Thus the probit model $p(Y_1)$ is defined by noting that $\Pr(Y_1=1) = \Phi (\beta X_i)$ and $\Pr(Y_1=0) = \Phi (-\beta X_i)$.

3.4 Model estimation

Based on this model the following probit is developed;

$$UI(Y) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \varepsilon_i \text{-----} (3.1)$$

Where $UI(Y)$ is the probability of uptake of immunization services

β_0 is the intercept/constant representing the mean value of the response variable when all of the predictor variables in the model are equal to zero ($X=0$).

ε in this study represent the error term and highlighted how observed data in this study is likely to be different from the true study population. This error term contains all that separates this model from the actual reality thus reflecting non-linearities, unpredictable effects, measurement errors and left out variables. Uptake of immunization services Y is the dependent variable which is a dummy with a value of 1 for uptake and a value of 0 for non-uptake. β is a vector of parameter estimates, X is a vector of individual characteristics which are shown in the following table of variable, definition, measurements and signs.

The probit model was thus be used to estimate both the influence of independent variables on uptake of immunization services and to predict probabilities of changes in uptake of immunization services under several simulated variable levels. The model assumes that the error term for the model is distributed normally. The probit model is generally presented as follows:

$$y_i^* = \alpha + \beta X_i + \varepsilon_i \text{.....} (3.2)$$

Where y^* is unobserved/ latent variable.

x' is vector of independent variables such as social and demographic factors.

α is the constant coefficient

Probit model assumes y^* to be a normally distributed random variable. From equation 3.1 above,

3.5 Definition, measurements and expected sign of the variables

3.5.1 Dependent variable

The study dependent variable was immunization services uptake which is a binary variable measured as uptake of the prescribed vaccines with the first measles vaccine as the measure for

full immunization. Uptake of vaccination/adherence to the vaccine schedule for under 1 year was considered as 1 while otherwise was 0.

3.5.2 Independent variable

This study has several independent variables that are hypothesized to influence uptake of immunization services.

The parental characteristics that were used as predictor variables include: age, marital status, education level of the caregiver, occupation, knowledge of immunization as a prevention tool for vaccine preventable diseases, perceptions and attitude of the caregiver on the service. For child characteristics the child's age, gender and birth order were used. The environmental/health system factors that were used as predictor variables include: distance to the health facility, residence of the caregiver, antenatal care visit, hospital delivery, vaccine stock-outs and shortage.

Table 3.1: Definition, measurements and expected sign of the variables

Variable	Definition	Measurement	Expected sign
Dependent variable			
Uptake of immunization services	An enquiry on whether the respondent took the child for all the under 12 months prescribed vaccines or not and the reasons for non-compliance	Fully immunized = 1 Not fully immunized = 0	
Independent variable			
Age of the caregiver	Years at the time of giving birth to the child under study	Continuous variable	+ Ahmad (2020)
Marital status	Whether in marriage or not at the time of interview	Dummy variable Married = 1 Single = 0	- Otubor (2015)

Education status	Highest level of education attained	Dummy variable Primary = 1 Otherwise = 0 Secondary = 1 Otherwise = 0 Tertiary & college = 1 Otherwise = 0	+ (Okoro et al. 2015)
Occupation	Type of job that caregiver & spouse does to earn a living	Dummy variable Skilled = 1 Otherwise = 0	+ Anokye, (2018)
Knowledge of vaccines	The caregivers can mention vaccines that are given to the children	Dummy variable Yes = 1 No = 0	+ Otubor (2015)
Knowledge of vaccine preventable diseases	The caregiver knows the diseases that are prevented by the mentioned vaccines	Dummy variable Yes = 1 No = 0	+ Olumuyiwa (2008)
Age of the child	Completed months	Continuous variable	+ Duru (2016)
Sex of the child	Gender of the child	Dummy variable Male = 1 Female = 0	
Birth order of the child	Ordinal position in which the child was born in the family	Dummy variable 1 st = 1 Otherwise = 0 2 nd = 1 Otherwise = 0 3 rd = 1 Otherwise = 0 4 th = 1 Otherwise = 0	+ Mukungwa (2015)

Distance to the health facility	In Kilometres	Continuous variable	+ Rup (2008)
Residence of the caregivers	Usual residence of the respondent	Dummy variable Rural = 1 Urban = 0	+ Herliana (2017)
Antenatal care visits (ANC)	Number of ANC visits made by the mother during her pregnancy	Dummy variable At least 4 visits = 1 No ANC visit = 0	+ Ahmad (2020)
Hospital delivery	Means the child was born at a health facility	Dummy variable Hospital delivery = 1 Home delivery = 0	+ Douiri (2017)
Vaccine stock-outs	Means the health facility at some point run out of vaccines in the last 1 year	Dummy variable Stock-out = 1 No stock-out = 0	+ Babirye (2012)

3.6 Data source

Quantative design by use of primary data was be used for this study whereby a questionnaires were administered to caregivers of children under study.

3.7 Data collection tool

This was a cross-sectional study involving caregivers of children 0-12 months attending child welfare clinic. Quantative methods were used to generate data that will help identify determinants of vaccination uptake in Aldai Sub-county.

3.8 Study population

Study population comprised of children aged 0-12 months living with their parents/caregivers in Aldai Sub-County, Nandi County. The respondents for this study were the parents/caregivers of the children under study. Caregivers in the sense that they are the ones taking care of the health needs of these minors including ensuring they get vaccinated on schedule. The age bracket of the children were extended to 12 months so as to cater for children who get their measles vaccine after the scheduled 9 months.

3.9 Target population

The target population for this study was caregivers which comprise of parents and guardians to children aged 0-12 months attending child welfare clinic in selected health facilities in Aldai Sub-County. 0-12 months is the age bracket during which children receive critical vaccines for vaccine preventable diseases. From 12 months to 59 months most vaccines received are booster vaccines.

3.10 The sampling Frame

The sampling frame for this study was from 3 government health facilities in Aldai Sub- County offering immunization services categorised as level 2, level 3 and level 4.

To sample out the facilities to participate in this study, multi-stage sampling technique was employed whereby a total of 3 health facilities were selected. Numbers of children 0-12 months were generated for each health facility from the Kenya Health Information System. Using the generated information on the number of children per the three health facilities, systematic sampling technique will be applied whereby the nth value was used to get the proportionate sample for each of the selected health facility. The first child in each health facility was then randomly selected while the rest was systematically selected.

Table 3.10: Sampling frame and sample proportion

Name of facility	Projected Population (<12 mths)	Proportion of respondents	Total no. of respondents
Kaptumbo Sub-County hospital (Level 4)	710	$710/970 \times 369$	270
Koyo Health Centre (Level 3)	183	$183/970 \times 369$	70
Kipsigak Dispensary (Level 1)	77	$77/970 \times 369$	29
Total	970		369

3.11 Sample size and sampling procedure

The sample size for this study was determined using Yamane (1967). This formula is simple and appropriate for calculating the sample size for a target population.

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

Where n=sample size when the population

N = population size

e= level of precision (0.05)

N which is the estimate size of the population size i.e. children below 12 months in Aldai Sub-County is 4791

Therefore:

$$n = \frac{4791}{1 + 4791(0.05)^2}$$

$$n = 368.$$

3.12 Data Issues

Multicollinearity defined as the occurrence of high inter-correlation between two or more independent variables in a multiple regression model can result to wrong outcomes when one tries to understand the influence of each predictor variable on the dependent variable in a statistical model as it can give high confidence intervals resulting to unreliable probabilities. To solve the problem of multicollinearity in this study, Variance Inflation Factors shall be employed to identify the independent variable that shows to be highly collinear and incase the variance inflation factor is above 10 then the variables be singled out and omitted from the study or combined into a single variable.

Heteroscedasticity which is a systematic change in the spread of residuals or error term in study results occurring as a result of the variability of the dependent variable being unequal across a range of independent variables predicting it was tested in this study by the use of residual plots and solved using STATA software through detection of standard errors

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents results on parental characteristics, child characteristics and environmental/health system characteristics that determine the uptake of immunization among children aged below 12 months in Aldai sub-county, Nandi County in Kenya. In addition, analyses of the probit model result for are presented in this chapter.

4.2 Descriptive Statistics

From the analysis results, adherence to full vaccination among the sampled households is quite low. From the results, only 21.4 percent of the 398 sample households reported having fully vaccinated their children aged below 12 months in Aldai sub-county, Nandi County. This represents very low adherence to full children vaccination. From the parental characteristics, descriptive statistics reveal that the average age of the caregiver is approximately 28 years with the youngest caregiver aged 15 years and oldest aged 47 years. Regarding marital status of the care giver, 69.6 percent of the caregivers in the sample 398 household are married.

The education attainment of the caregivers reveal that 3.3 percent have no any form of education, 38.2 percent have primary education, 42.7 percent possess secondary education while 15.8 percent have college / tertiary education. Regarding the type of occupation, 30.4 percent of caregivers are engaged in skilled occupations against 69.6 percent who are engaged in semi and unskilled occupation.

Over three – quarters of the caregivers cited having good knowledge of the vaccine for children under 12 months at 76.4 percent. The child characteristics finding reveal that only 12.2 percent of the children were aged above 12 months implying that for the sampled households majority had children below 12 months at 87.8 percent. From the sampled households, 51.5 percent of the children were of male gender. Further, majority of the children were of firth order birth being accounted for by 37.2 percent, 23.1 percent were second order birth children, 17.8 percent were of third order birth, 13.3 percent were of fourth order births while decimal 8.5 percent of fifth order birth.

The descriptive statistics for environmental or health system characteristics indicate that 23.9 percent of the households live beyond 5 kilometers away from the nearest health facility. This finding indicate that majority of the households have close proximity to the nearest health facilities. The household residence indicates that majority of the sampled households are rural dwellers at 92 percent. Further, 97.2% were found to have visited a health facility for ANC services during their pregnancy period. In addition, in terms of place of delivery, results indicate that 87.2 percent of women from the sampled households delivered in a health facility. Lastly, an inquiry behind missing vaccines or child being not fully vaccinated found that 12.3 percent of the household cited vaccines stock out of the reason behind none full vaccinated among under 12 months children.

Table 4.1 Descriptive statistics of model variables

Variable		Obs	Mean	Std.Dev.	Min	Max
Fully vaccinated	Fully immunized = 1 Otherwise = 0	398	0.214	0.41	0	1
Caregiver's age		398	27.688	7.773	15	47
Marital status	Married = 1 Otherwise = 0	398	0.696	0.461	0	1
Care giver education level		398	2.711	0.767	1	4
	No education	398	0.033	0.178	0	1
	Primary	398	0.382	0.486	0	1
	Secondary	398	0.427	0.495	0	1
	College	398	0.158	0.365	0	1
Occupation	Skilled = 1 Otherwise = 0	398	0.304	0.461	0	1
Knowledge of vaccine	Yes = 1 Otherwise = 0	398	0.764	0.425	0	1
Child's age	Above 12 months = 1 Below 12 months = 0	398	0.015	0.122	0	1
Child sex	Male = 1 Otherwise = 0	398	0.515	0.500	0	1
Child birth order		398	2.329	1.322	1	5
	First order	398	0.372	0.484	0	1
	Second order	398	0.231	0.422	0	1
	Third order	398	0.178	0.383	0	1
	Fourth order	398	0.133	0.34	0	1
	Fifth order	398	0.085	0.28	0	1

Variable		Obs	Mean	Std.Dev.	Min	Max
Facility distance	Above 5 km = 1 Otherwise = 0	398	0.239	0.427	0	1
Residence	Rural = 1 Otherwise = 0	398	0.92	0.272	0	1
ANC	Yes = 1 Otherwise = 0	398	0.972	0.164	0	1
Place of delivery	Health facility = 1 Otherwise = 0	398	0.872	0.335	0	1
Vaccine stock out	Yes = 1 Otherwise = 0	398	0.123	0.329	0	1

4.3 Diagnostic tests

4.3.1 Correlation matrix

The correlation matrix results indicate that immunization uptake is positively correlated to all model variables. However, the correlations are generally weak since they are all below 0.5. Looking at the associations among the independent variable, similar results for weak degree of association are reports as evidence in the correlation matrix table.

Table 4.2: Correlation matrix results

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
(1) fully vaccinated	1																		
(2) married	0.091	1																	
(3) primary	0.095	0.07	1																
(4) secondary	0.115	-0.059	-0.679	1															
(5) college	0.008	0.032	-0.341	-0.374	1														
(6) Skilled	0.002	0.033	-0.036	-0.008	0.073	1													
(7) knowledge	0.088	0.108	-0.099	0.038	0.095	0.046	1												
(8) child sage	0.187	-0.098	0.073	-0.065	-0.054	-0.037	-0.028	1											
(9) child gender	0.01	-0.014	0.055	-0.035	-0.035	0.135	-0.005	0.086	1										
(10) order1	0.046	-0.384	-0.262	0.218	0.094	-0.124	-0.111	0.033	-0.081	1									
(11) order2	0.063	0.116	-0.063	0.033	0.04	0.104	0.066	-0.019	0.04	-0.422	1								
(12) order3	0.003	0.122	0.052	-0.057	0.032	0.006	-0.065	-0.058	-0.032	-0.359	-0.255	1							
(13) order4	0.012	0.163	0.179	-0.114	-0.109	0.046	0.131	-0.048	0.064	-0.302	-0.215	-0.183	1						
(14) Distance	0.047	0.011	0.045	-0.019	-0.033	-0.088	-0.077	0.076	0.058	-0.041	-0.027	0.062	-0.011	1					
(15) residence	0.064	-0.055	0.042	0.087	-0.201	-0.106	-0.121	-0.039	0.01	-0.04	0.096	-0.128	0.007	0.014	1				
(16) ANC	0.05	0.088	-0.025	-0.04	0.073	0.111	0.051	0.021	0.01	-0.092	0.056	0.079	-0.069	0.058	-0.05	1			
(17) place of delivery	0.035	-0.041	-0.101	0.073	0.043	-0.024	-0.018	-0.076	0.026	0.077	-0.022	-0.096	0.04	-0.156	0.053	0.119	1		
(18) vaccine stock out	0.047	-0.002	0.02	-0.03	-0.016	-0.032	0.028	0.079	0.08	-0.067	-0.024	0.025	0.011	-0.012	0.083	0.017	-0.062	1	

4.3.2 Multicollinearity test

Table 4.3: Multicollinearity test results

Variable	VIF	1/VIF
Secondary	8.87	0.112704
Primary	8.13	0.123048
College	5.52	0.181023
First birth order	4.48	0.223094
Second birth order	3.22	0.310449
Third birth order	2.87	0.348898
Fourth birth order	2.32	0.430502
Married	1.24	0.803445
Residence - rural	1.12	0.891193
Knowledge of vaccines	1.10	0.911131
Place of delivery	1.09	0.915315
Skilled occupation	1.09	0.917516
ANC attendance	1.08	0.929585
Child's age	1.07	0.937700
Facility distance	1.06	0.938996
Child sex	1.05	0.949858
Vaccine stock out	1.04	0.95927
Mean VIF	2.73	

The mean variance inflation factor was the model was estimated to be 2.73. This is below the threshold of 10 implying absence of multicollinearity in the model.

4.3.3 Test for heteroscedasticity

Table 4.4: Test for heteroscedasticity results

Fully vaccinated	Coef.	St.Err.	t-value	p-value	95% Conf Interval		Sig
Married	1.095	0.145	7.55	0.000	0.811	1.379	***
Secondary	0.000	0.001	-0.11	0.917	-0.001	0.001	
Primary	0.000	0.001	-0.11	0.916	-0.003	0.002	
College	0.000	0.001	-0.11	0.916	-0.002	0.002	
First birth order	0.000	0.000	-0.10	0.917	0.000	0.000	
Second birth order	0.000	0.001	0.11	0.916	-0.001	0.002	
Third birth order	1.769	0.697	2.54	0.011	0.404	3.135	**
Fourth birth order	0.000	0.000	-0.10	0.917	0.000	0.000	
Married	0.000	0.001	0.11	0.916	-0.002	0.002	
Residence - rural	0.000	0.001	0.11	0.916	-0.002	0.002	
Knowledge of vaccines	0.000	0.001	0.11	0.916	-0.002	0.002	
Place of delivery	0.000	0.001	0.11	0.916	-0.001	0.001	
Skilled occupation	0.000	0.000	-0.11	0.917	-0.001	0.000	
ANC attendance	0.000	0.001	0.11	0.916	-0.001	0.001	
Child's age	0.000	0.010	0.05	0.960	-0.018	0.019	
Facility distance	0.000	0.000	-0.03	0.976	0.000	0.000	
Child sex	0.000	0.000	0.10	0.920	0.000	0.000	
Vaccine stock out	-1.096	0.145	-7.54	0.000	-1.381	-0.811	***
Insigma2	-9.095	9.5123	-0.96	0.339	-27.739	9.548	
Likelihood-ratio test of Insigma2 = 0 : chi2(1) = 0.079 Prob > chi2 = 0.6247							

To test for heteroscedasticity, the heteroscedastic probit model was estimated. From the model, the chi2 statistic was found to be 0.079 with the respective probability being 0.6247. the probability of the statistic was found to be greater than 5 percent significance level. Therefore, testing for heteroscedasticity at 5 percent, we find no evidence for heteroskedasticity problem in our model

4.4 Regression Results

Regarding the reference categories, for marital status, not married was set as the benchmark dummy category. Regarding caregiver's education level, no education was set as the benchmark dummy category. Unskilled occupation was set as the benchmark dummy category for the caregiver's occupation. Lack of knowledge on vaccines was set as the benchmark dummy category for knowledge on vaccines variable.

Regarding child characteristics, age above 12 months, female gender, and fifth birth order were set as the reference categories for child age, child gender and childbirth order variables. Regarding environmental or health system characteristics, distance less than 5 kilometers from the nearest health facility, urban residence, ANC non-attendance, home delivery and absence of vaccines stock outs were set as benchmark dummy categories for distance to health facility, residence, ANC attendance, place of delivery and vaccines stock outs respectively.

Table 4.5 Probit Model Results

Fully vaccinated	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]		Sig
Age	-0.007	0.012	-0.63	0.528	-0.030	0.016	
Married	0.461	0.192	2.40	0.016	0.084	0.838	**
Primary	0.435	0.408	1.07	0.286	-1.234	0.364	
Secondary	0.959	0.424	2.26	0.024	-1.790	-0.128	**
College	0.740	0.454	1.63	0.103	-1.630	0.149	
Occupation - skilled	0.090	0.172	0.53	0.599	-0.246	0.427	
Knowledge of vaccines	0.396	0.193	2.06	0.040	0.019	0.774	**
Child age	2.150	0.654	3.29	0.001	0.868	3.432	***
Child sex	-0.024	0.153	-0.16	0.876	-0.324	0.277	
First birth order	0.791	0.371	2.13	0.033	0.064	1.518	**
Second birth order	0.791	0.347	2.28	0.023	0.111	1.472	**
Third birth order	0.758	0.358	2.12	0.034	0.057	1.459	**
Fourth birth order	0.527	0.354	1.49	0.136	-0.166	1.220	
Facility distance	-0.191	0.185	-1.03	0.302	-0.555	0.172	
Residence - rural	0.588	0.334	1.76	0.079	-0.067	1.243	*
ANC attendance	0.299	0.551	0.54	0.587	-0.781	1.380	
Place of delivery	0.305	0.248	1.23	0.219	-0.181	0.790	

Vaccine stock out	0.153	0.220	0.69	0.488	-0.279	0.584	
Constant	-2.390	0.903	-2.65	0.008	-4.160	-0.619	***
Mean dependent var	0.214		SD dependent var		0.410		
Pseudo r-squared	0.095		Number of obs		398.000		
Chi-square	39.407		Prob > chi2		0.003		
Akaike crit. (AIC)	411.435		Bayesian crit. (BIC)		487.177		
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$							

From the results of the probit model in table 4.2, the results reveal that the uptake of immunization decreases with the increase in the caregiver's age. Therefore, children under the care of the older caregivers are less likely to be fully vaccinated. Therefore, the younger care givers are more likely to be cautious to avoid missing the immunization schedule. Regarding the marital status of the care giver, the probit model results reveal that married care givers are more likely to have their children fully immunized compared to unmarried care givers. This could point towards the influence of a spouse in adhering to vaccination schedule. Educated caregivers were found to have a higher likelihood of having the children vaccinated compared to the children of parents who have no formal education at all. This implies that the uptake of immunization increases with the parent's literacy level.

Regarding occupation type, the findings posit that engagement in skilled occupation was found to increase uptake of immunization among the households compared to engagement in semi and unskilled occupations. Further, the possession of the knowledge in vaccines was found to increase the likelihood of having the child being fully vaccinated compared to lack of knowledge on vaccines. A review on the child characteristics posits that adherence to full vaccination was found to increase with lower child's age. According to the findings, children below 12 months age were found to have a higher likelihood of being fully vaccinated compared to children above 12-months age. This could allude to the fact that majority of the key vaccines are for children under 12-months age. In terms of child gender, the regression model results posit that male children are less likely to be fully vaccinated compared to female children.

The child birth order was found to increase the likelihood of the child being fully immunized. However, the results indicate that lower birth order children are more likely to be fully vaccinated

compared to higher birth order children. This could allude to the fact that lower birth order corresponds with low age which positively influences immunization uptake given the key vaccines are generally scheduled for children under 12-months age. Regarding environmental or health system characteristics, distance was found to have a negative effect on immunization uptake. Living far away from the nearest health facility was found to have a negative effect on the uptake of the immunization of the sampled households. This finding could be supported by the fact that the longer the distance to the nearest health facility the higher the cost of seeking for immunization services due to high transport cost to and from the health facility. With regards to residence, the rural residence was found to increase the likelihood of seeking for immunization services among the households compared to urban residence. This could perhaps be informed by the setting of the study which was mainly in the rural areas given that the larger proportion of the household sampled was from a rural setting.

Women who had a visit to a health facility in search for the ANC services were found to have a higher likelihood of seeking for vaccination of their children compared to women who had never sought for the ANC services. This could be explained by the fact that women who had sought for the ANC services are more likely to be enlightened on the importance of adhering to the child immunization schedule upon delivery hence are more likely to have their children fully vaccinated. Similar findings were reported for place of delivery whereby facility – based delivery was found to increase the likelihood of immunization uptake compared to home delivery. Women who delivered in health facility are more likely to be enlightened on the importance of adhering to the child immunization schedule upon delivery by seeking for postnatal services hence are more likely to have their children fully vaccinated.

Lastly, vaccine stock outs were found to increase the likelihood of children being fully vaccinated compared to absence of vaccine stock outs. This implies that caregivers are likely to be more proactive in the event of vaccines stock outs hence more likely to seek for full immunization of their children early enough to avoid the bad eventuality of missing vaccination arising from vaccines stock outs. Therefore, households will seek for the immunization services promptly to avoid missing vaccination should a stock out emerge. Therefore, possibility and even occurrence of vaccines stock outs is likely to make households proactive in seeking for vaccines from other nearest facilities hence the positive effect.

To examine the magnitude of the effect of independent variables on dependent variable, the marginal effects of the model were computed. These were computed from the fitted regression model.

Table 4.6 Marginal effects results

Variable	dy/dx	Std.Err.	t-value	P>z	95% Conf Interval	
Age	-0.002	0.003	-0.630	0.527	-0.008	0.004
Married	0.117	0.044	2.640	0.008	0.030	0.203
Primary	0.114	0.102	1.120	0.262	-0.314	0.085
Secondary	0.246	0.101	2.440	0.015	-0.444	-0.049
College	0.159	0.073	2.190	0.029	-0.302	-0.017
Occupation - skilled	0.025	0.049	0.520	0.605	-0.070	0.120
Knowledge of vaccines	0.099	0.043	2.290	0.022	0.014	0.184
Child age	0.710	0.120	5.920	0.000	0.475	0.945
Child sex	-0.007	0.042	-0.160	0.876	-0.089	0.076
First birth order	0.234	0.114	2.040	0.041	0.009	0.458
Second birth order	0.252	0.121	2.080	0.037	0.015	0.489
Third birth order	0.246	0.129	1.910	0.056	-0.006	0.498
Fourth birth order	0.167	0.124	1.340	0.179	-0.077	0.411
Facility distance	-0.050	0.046	-1.080	0.278	-0.141	0.041
Residence – rural	0.127	0.053	2.380	0.017	0.022	0.232
ANC attendance	0.072	0.114	0.630	0.527	-0.151	0.296
Place of delivery	0.075	0.055	1.380	0.167	-0.031	0.182
Vaccine missed out	0.044	0.066	0.660	0.507	-0.086	0.174

4.5 Discussion of Results

The study sought to investigate the determinants of uptake of immunization services among children aged below 12 months in Aldai Sub-County, Nandi County. The Kenyan Government has continued to invest into immunization by ensuring all the government health become immunising facilities to ensure every Kenyan child has access to immunization without having to pay a single cent to get the services.

The results revealed that adherence to full vaccination among the sampled caregivers is quite low. From the results, only 21.4 percent of the 398 sample households reported having fully vaccinated

their children aged below 12 months in Aldai sub-county, Nandi County. This represents very low adherence to full children vaccination as compared to KHIS results which indicated 75.6% of the children were fully vaccinated.

The uptake of immunization was found to decrease with the increase in the caregiver's age. Therefore, children under the care of the older caregivers are less likely to be fully vaccinated by 0.2 percent holding other factors constant. However, comparing the z statistic and the respective p value we find that the p – value is less than the z statistic in absolute terms implying that effect of caregiver's age on the uptake of immunization is insignificant at 5 percent significance level. Further, this is evidenced by the p – value which is greater than the 5 percent significance level.

Regarding the marital status of the care giver, the probit model results reveal that married care givers are more likely to have their children fully immunized compared to unmarried care givers by 11.7 percent holding other factors constant. The effect of marital status was found to be significant at 5 percent significance level. This significant effect of marital status imply that married caregivers are more likely to fully vaccinate their children who are below 12 months compared to unmarried caregivers. This could be informed by the fact that the spouse might have influence in ensuring that the immunization schedule is fully adhered to. This could be through possibly reminding the spouse on when the vaccination is due, providing financial support to pay for possible costs that are likely to be linked to seeking for immunization services. This could explain why married caregivers are more likely to fully vaccinate their children compared to unmarried caregivers.

Educated caregivers were found to have a higher likelihood of having the children vaccinated compared to the children of parents who have no formal education at all. This implies that the uptake of immunization increases with the parent's literacy level. Caregivers with primary, secondary and tertiary education were found to have a higher likelihood of ensuring their children are fully vaccinated by 11.4 percent, 24.6 percent and 15.9 percent respectively holding other factors constant. However, only the effect of secondary and tertiary education was found to be significant at 5 percent significance level. Caregivers with secondary and college education are more likely to have better understanding of vaccines given their higher literacy levels. Further, caregivers with higher education levels are more likely to have better income levels hence more

capable of meeting costs associated with seeking for immunization services. on the other hand, caregivers with no education are likely to have either little or no knowledge of vaccines and their importance hence are likely to undertake full immunization of their children.

Regarding occupation type, the findings posit that engagement in skilled occupation was found to increase uptake of immunization among the households compared to engagement in semi and unskilled occupations by 2.5 percent holding other factors constant. The effect was however found to be insignificant at 5 percent significance level. Further, the possession of the knowledge in vaccines was found to increase the likelihood of having the child being fully vaccinated compared to lack of knowledge on vaccines by 9.9 percent holding other factors constant. The effect of knowledge in vaccines was found to be significant at 5 percent significance level. Caregivers' knowledge about the vaccines implies that they are aware of the benefits of the vaccines in boosting child's immunity given that they are more enlightened. This explains the significant effect knowledge on vaccines has on vaccines uptake.

A review on the child characteristics posits that adherence to full vaccination was found to increase with lower child's age. According to the findings, children below 12 months age were found to have a higher likelihood of being fully vaccinated compared to children above 12-months old by 71 percent holding other factors constant with the effect being significant at 5 percent significance level. The significant effect of child age as a determinant of vaccines uptake could be explained by the fact that the key vaccines for children are mainly scheduled for 12 months and below. In addition, its during the low age perhaps 12 month and below that the child's immunity is highly low hence the caregiver will be more cautious to ensure that the child undertakes all the recommended vaccines. In addition, during the first 12 months majority of the caregivers are more likely to seek for post-natal services hence are more likely to be reminded on when the child vaccination falls due thus explaining the significance effect of below 12 months age as opposed to above 12 months.

In terms of child gender, the regression model results posit that male children are less likely to be fully vaccinated compared to female children by 0.7 percent holding other factors constant. However, the effect was found to be insignificant at 5 percent significance level. The child birth order was found to increase the likelihood of the child being fully immunized. However, the results

indicate that lower birth order children are more likely to be fully vaccinated compared to higher birth order children. This could allude to the fact that lower birth order corresponds with low age which positive influences immunization uptake given the key vaccines are generally scheduled for children under 12-months age.

First, second, third and fourth birth order were found to have a higher likelihood of the child being fully immunized compared to fifth birth order by 23.4, 25.2, 24.6 and 16.7 percent respectively other factors constant. The effect of the third and fourth birth order was however found to be insignificant at 5% significance level. The results indicate that lower birth order is associated with a higher probability of being age-appropriately immunized compared to higher birth order children. This could be explained by the fact that lower birth order are more vulnerable to infections incase of lack of vaccination. I addition, this could be explained by the fact that the caregiver overtime has gained experience from previous birth orders and realized the importance of undertaking full vaccination of the children. This explains why they are more likely to vaccinate the younger children.

Regarding environmental or health system characteristics, distance was found to have a negative effect on immunization uptake by 5 percent *ceteris paribus*. Living far away from the nearest health facility was found to have a negative effect on the uptake of the immunization of the sampled households. However, the effect was found to be insignificant at 5 percent significance level. The rural residence was found to increase the likelihood of seeking for immunization services among the households compared to urban residence by 12.7 percent holding other factors constant. This could perhaps be informed by the setting of the study which was mainly in the rural areas given that the larger proportion of the household sampled was from a rural setting. The effect was significant at 5 percent significance level. In addition, the significant effect of rural residence in promoting vaccines uptake could be explained by the fact that upon devolution of the healthcare services, counties have heavily invested in health infrastructures and systems in the rural areas that had lagged behind for long time during the centralized governance system. In addition, given that past history of low healthcare seeking behaviour among the rural residents, the improvement in the health infrastructures and systems in the rural areas could have spurred uptake of the healthcare service provided by the county. This could explain the significance of rural residence in promoting vaccines uptake among rural households.

Women who had a visit to a health facility in search for the ANC services were found to have a higher likelihood of seeking for vaccination of their children compared to women who had never sought for the ANC services by 7.2 percent holding other factors constant. However, the effect was insignificant at 5 percent significance level. This could be explained by the fact that women who had sought for the ANC services are more likely to be enlightened on the importance of adhering to the child immunization schedule upon delivery hence are more likely to have their children fully vaccinated. Similar findings were reported for place of delivery whereby facility – based delivery was found to increase the likelihood of immunization uptake compared to home delivery by 7.5 percent holding other factors constant. However, the effect was insignificant at 5 percent significance level. Lastly, vaccine stock outs was found to increase the likelihood of children being fully vaccinated compared to absence of vaccine stock outs by 4.4 percent holding other factors constant. However, the effect was insignificant at 5 percent significance level.

Regarding the marital status of the care giver, the probit model results reveal that married care givers are more likely to have their children fully immunized compared to unmarried care givers. This could point towards the influence of a spouse in adhering to vaccination schedule. Similar findings are reported by Jonathan (2018) who found that married women have a higher likelihood of compliance to the immunization schedule thus affected immunization uptake positively among children below age of 2 years at Nanyongera Health Centre, Tororo District of Uganda.

Educated caregivers were found to have a higher likelihood of having the children vaccinated compared to the children of parents who have no formal education at all. This implies that the uptake of immunization increases with the parent’s literacy level. Similar findings are reported by Okoro (2015) who examined the influence of sociodemographic factors on immunization of children in Enugu, Nigeria found out that mother’s education status had a significant impact on immunization completion with mothers who had lower academic credentials tending to register low immunization uptake as opposed to mothers with higher academics.

In addition, (Girmay, 2019) found that mothers who had attained post primary education had a 2.39 times high chance of having their children complete immunization as compared to those with low levels of education in Ethiopia. Further, Phimmasane (2020), while seeking to find factors affecting compliance with measles vaccination in Lao using cross-sectional descriptive study

established that having a father with high academic status increased chances of compliance with vaccination.

Regarding occupation type, the findings posit that engagement in skilled occupation was found to increase uptake of immunization among the households compared to engagement in semi and unskilled occupations. Similarly, In China, (Ke and Zheng, 2014) examined childhood immunization and risk factors. The cross-sectional study found that mother's occupation is likely to have an impact as their children receive the recommended childhood vaccines thus a positive predictor of immunization uptake. Women in skilled occupations are likely to have higher income levels are more likely to seek for immunization services including paying for non – free vaccines.

However, the findings are in contrast with Duru (2016) who found that in Nigeria mother's occupation had no significant association immunization uptake among children under 5 years with those with occupation reporting no different results from those without. In addition, Aalemi (2020) in the analysis of Afghanistan 2015 Demographic and health survey to establish factors influencing vaccination coverage among children aged 12-23 months found out that having a father who had some professional occupation increased the chances of having the child vaccinated with those who had fathers in a professional occupation scoring 3.8 times higher chances of being vaccinated.

Further, the possession of the knowledge in vaccines was found to increase the likelihood of having the child being fully vaccinated compared to lack of knowledge on vaccines. The study findings agree with Otubor (2015) who found that mother's understanding of vaccination contributes to immunization in Jos North, Nigeria whereby mothers who possess desired levels of understanding on vaccines were found to have higher tendency of having their children complete immunization with 89.6% of the 232 respondents in the study having desirable levels of knowledge on immunization. Further, Olumiya (2008) found that knowledge on immunization as a precursor to the uptake of immunization of children in rural areas of Nigeria which revealed that mothers with adequate knowledge on immunization tend to have their children complete the prescribed vaccines as compared to those with less or no knowledge with 87% of the mothers interviewed having adequate knowledge on immunization.

A review on the child characteristics posits that adherence to full vaccination was found to increase with lower child's age. According to the findings, children below 12 months age were found to have a higher likelihood of being fully vaccinated compared to children above 12-months age. This could allude to the fact that majority of the key vaccines are for children under 12-months age. In terms of child gender, the regression model results posit that male children are less likely to be fully vaccinated compared to female children. However, the findings disagree with Oladokun, Adedokun and Lawoyin (2010) who found that that a boy child was given priority when it came to immunization thus having a three times likelihood of being vaccinated than a girl child in Ibadan, Nigeria.

The childbirth order was found to increase the likelihood of the child being fully immunized. However, the results indicate that lower birth order children are more likely to be fully vaccinated compared to higher birth order children. This could allude to the fact that lower birth order corresponds with low age which positive influences immunization uptake given the key vaccines are generally scheduled for children under 12-months age. Similar findings were reported by Mukungwa (2015) who examined factors associated with full immunization coverage among children aged 12-23 months in Zimbabwe and found that 69% of first birth order are more likely to complete their prescribed vaccines as compared to 59% of children born in the position of number five to six and 45% of children in the 6th and above position. This implies that as more children are born in the family the uptake of vaccination dwindles. Similarly, Herliana and Douiri (2017) found that children born after the first child had reduced likelihood of receiving vaccination with the chances of vaccination diminishing as more children are born into a family.

Regarding environmental or health system characteristics, distance was found to have a negative effect on immunization uptake. Living far away from the nearest health facility was found to have a negative effect on the uptake of the immunization of the sampled households. This finding could be supported by the fact that the longer the distance to the nearest health facility the higher the cost of seeking for immunization services due to high transport cost to and from the health facility. Similarly, In India, Rup (2008) while seeking to determine what affects coverage of immunization in relation to children in a cross-sectional study in Assam India found that children born in families residing within a 2 kilometer radius tend to comply with the immunization schedule unlike their peers living outside the 2 kilometer. In addition, in Sudan, Ibnouf (2007) revealed that having to

walk to the nearest immunizing facility had a strong relationship with the up-to-date adherence to the immunization schedule of the child with mothers who walked for 30 minutes or less to the health facility reporting a 3.4 times higher likelihood of having their children comply with the vaccine calendar as opposed to those out of the less than 30 minutes' walk.

The rural residence was found to increase the likelihood of seeking for immunization services among the households compared to urban residence. This could perhaps be informed by the setting of the study which was mainly in the rural areas given that the larger proportion of the household sampled was from a rural setting. However, the findings disagree with Olumiya (2008) who examined what leads to children partially receiving immunization services in Nigeria and found that residence is a significant contributor to immunization uptake. The study found that children born in urban areas had improved chances of being vaccinated than their counterparts who resided out of the urban set-up. Herliana and Douiri (2017) in cross-sectional research in India that sought to establish the determinants of immunization coverage in children of 12-59 months of age showing that geographical location was one of a significant contributor to immunization coverage with more children living in urban areas receiving their vaccines as prescribed than those living in rural areas.

Women who had a visit to a health facility in search for the ANC services were found to have a higher likelihood of seeking for vaccination of their children compared to women who had never sought for the ANC services. The results agree with Aalemi (2020) in Afghanistan who examined what contributes to vaccination of young ones between the age of 12 and 23 months in Afghanistan found out that children born to mothers who made at least 3 visits had 70% higher chance of being immunized than their counterparts born to mothers who had no antenatal care visit during their pregnancy period. Similar results are reported by Mukungwa (2015) in Zimbabwe.

Further, Etana (2012) in a cross-sectional community study examined vaccination in Central Ethiopia among 12 to 23 months old children. The study found that antenatal care follow-up, birth in a hospital, mother's knowledge on immunization compliance significantly affected uptake and completion of immunization. Similar findings were reported for place of delivery whereby facility – based delivery was found to increase the likelihood of immunization uptake compared to home delivery. Women who delivered in health facility are more likely to be enlightened on the

importance of adhering to the child immunization schedule upon delivery by seeking for postnatal services hence are more likely to have their children fully vaccinated.

Lastly, vaccine stock outs were found to increase the likelihood of children being fully vaccinated compared to absence of vaccine stock outs. This implies that caregivers are likely to be more proactive in the event of vaccines stock outs hence more likely to seek for full immunization of their children early enough to avoid the bad eventuality of missing vaccination arising from vaccines stock outs. However, Lyndon (2017) asserts that vaccine stock-outs has the potential of discouraging caregivers from taking their children for immunization services thus affecting uptake of immunization services. Further, Babirye (2012) while conducting a cross sectional study to assess how timeliness of vaccines affects vaccination services in Kampala Uganda found out that inadequate supply of vaccines to immunizing facilities had a significant impact on uptake of vaccination.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter covers the study summary, conclusions drawn from the research findings and recommendations.

5.2 Summary

The study sought to examine the factors that influence uptake of immunization services for children below 12 months in Aldai Sub-County, Nandi County in Kenya. Specifically, the study sought to determine the pattern of immunization services uptake for children below 12 months in Aldai Sub-County. Secondly, the study sought to examine the factors that influence uptake of immunization services for children below 12 months in Aldai Sub-County.

The undertaking of the study was motivated by unanswered questions which this study seeks to provide answers to. Kenya as a country has continued to put in strategies that have been adopted by 47 counties to boost uptake of immunization services and ensure every child gets protection against vaccine preventable diseases. These strategies include: Integrated outreach programs, mass immunization campaigns, increase in number of vaccinating facilities by making sure all government facilities and private facilities stock and offer vaccination services, media campaign on vaccination; advocacy, communication and social mobilization activities toward promoting vaccination, community health strategy ensuring every household is attached to a community health volunteer. Despite these efforts the country has continued to register low immunization uptake falling behind the WHO target of 90% with the current uptake standing at 83.2% (KHIS, 2021).

It further notable that achievements by counties in uptake of immunization services with Nandi County uptake being at 83.1% vary across the sub-counties and immunizing facilities with Aldai Sub-County registering the lowest uptake of 75.6% and Nandi Hills Sub-County registering the highest uptake of 94.9% (KHIS, 2021) indicating discrepancies in immunization uptake within the same country and county and thus indicating that a substantial number of children in Aldai Sub-County are still exposed to the dangers caused by vaccine preventable diseases including death and disability prompting this study that sought to unravel the determinants of immunization uptake

among children below 12 months. For this reason, this study was undertaken in efforts towards contributing to addressing this challenge of immunization in Aldai Sub-County leave alone Nandi County.

The study relied on the probit model in modelling the vaccination services uptake. The uptake of immunization services denoted as Y is binary this study therefore employed a binary response model and therefore had only 2 possible outcomes (Uptake and Non-uptake of immunization services) which was denoted as 1 and 0. An array of the independent variables was adopted informed by empirical literature review broadly categorized into parental, characteristics, child characteristics and environmental/health system factors. Parental characteristics that were used as predictor variables included: age, marital status, education level of the caregiver, occupation, knowledge of immunization as a prevention tool for vaccine preventable diseases, perceptions and attitude of the caregiver on the service. For child characteristics the child's age, gender and birth order was used. The environmental/health system factors that were used as predictor variables include distance to the health facility, residence of the caregiver, antenatal care visit, hospital delivery, vaccine stock-outs and shortage. The study relied on the primary data collected from the sampled households. In total 396 households were sampled for the study. Data was collected using questionnaires.

5.3 Conclusions

The study found that parental, child and environmental/health system factors are crucial predictors of immunization uptake among under 12 months children in Aldai Sub-County, Nandi County. The study findings reveal that the uptake of immunization decreases with the increase in the caregiver's age. Therefore, children under the care of the older caregivers are less likely to be fully vaccinated. Therefore, the younger care givers are more likely to be cautious to avoid missing the immunization schedule.

Regarding the marital status of the care giver, the probit model results reveal that married care givers are more likely to have their children fully immunized compared to unmarried care givers. This could point towards the influence of a spouse in adhering to vaccination schedule. Educated caregivers were found to have a higher likelihood of having the children vaccinated compared to the children of parents who have no formal education at all. This implies that the uptake of

immunization increases with the parent's literacy level. Regarding occupation type, the findings posit that engagement in skilled occupation was found to increase uptake of immunization among the households compared to engagement in semi and unskilled occupations. Further, the possession of the knowledge in vaccines was found to increase the likelihood of having the child being fully vaccinated compared to lack of knowledge on vaccines.

A review on the child characteristics posits that adherence to full vaccination was found to increase with lower child's age. According to the findings, children below 12 months age were found to have a higher likelihood of being fully vaccinated compared to children above 12-months age. This could allude to the fact that majority of the key vaccines are for children under 12-months age. In terms of child gender, the regression model results posit that male children are less likely to be fully vaccinated compared to female children. The child birth order was found to increase the likelihood of the child being fully immunized. However, the results indicate that lower birth order children are more likely to be fully vaccinated compared to higher birth order children. This could allude to the fact that lower birth order corresponds with low age which positive influences immunization uptake given the key vaccines are generally scheduled for children under 12-months age.

Regarding environmental or health system characteristics, distance was found to have a negative effect on immunization uptake. Living far away from the nearest health facility was found to have a negative effect on the uptake of the immunization of the sampled households. This finding could be supported by the fact that the longer the distance to the nearest health facility the higher the cost of seeking for immunization services due to high transport cost to and from the health facility. The rural residence was found to increase the likelihood of seeking for immunization services among the households compared to urban residence. This could perhaps be informed by the setting of the study which was mainly in the rural areas given that the larger proportion of the household sampled was from a rural setting.

Women who had a visit to a health facility in search for the ANC services were found to have a higher likelihood of seeking for vaccination of their children compared to women who had never sought for the ANC services. This could be explained by the fact that women who had sought for the ANC services are more likely to be enlightened on the importance of adhering to the child

immunization schedule upon delivery hence are more likely to have their children fully vaccinated. Similar findings were reported for place of delivery whereby facility – based delivery was found to increase the likelihood of immunization uptake compared to home delivery. Women who delivered in health facility are more likely to be enlightened on the importance of adhering to the child immunization schedule upon delivery by seeking for postnatal services hence are more likely to have their children fully vaccinated.

Lastly, vaccine stock outs were found to increase the likelihood of children being fully vaccinated compared to absence of vaccine stock outs. This implies that caregivers are likely to be more proactive in the event of vaccines stock outs hence more likely to seek for full immunization of their children early enough to avoid the bad eventuality of missing vaccination arising from vaccines stock outs. Therefore, households will seek for the immunization services promptly to avoid missing vaccination should a stock out emerge. Therefore, possibility and even occurrence of vaccines stock outs is likely to make households proactive in seeking for vaccines from other nearest facilities hence the positive effect.

5.4 Policy Recommendations

Based on the study findings, several policy pronouncements are made. Regarding literacy levels of the mothers and caregivers, there is need for the County government to sensitise the mothers and caregivers on the benefits of undertaking full immunization of the children. Such sensitization should be aimed at not only ensuring compliance but also the adherence to the immunization schedule for children. To ensure effectiveness of the sensitization, its crucial for the county government to engage county health officers in the rural areas and target women groups as the sensitization channels.

Secondly, is the need to enhance education programmes on the need for and importance of vaccines. This recommendation is based on the finding that knowledge on vaccine has a positive and significant effect on the uptake of vaccines. The County government need to plan for sensitization forums and health campaigns among the household mostly targeting the expectants and household with young children on the importance of adhering to the child immunization schedule issued during delivery.

Regarding the child age, the study found that child below 12 months are more likely to be fully vaccinated compared to children who are above 12 months. Therefore, there is need for the county government to educate the mothers and caregivers on the need to adhere to immunization of children across various ages. This would be crucial in ensuring that there is no much disparity or inequality in child immunization across age groups.

Regarding the birth order, the study established that lower birth order children are more likely to be fully vaccinated compared to higher birth order children. Therefore, there is need for the county government to educate the mothers and caregivers on the need to adhere to full immunization of all children across the birth orders. This would be crucial in ensuring that there is no much disparity or inequality in child immunization across birth order.

Regarding the environmental or health system characteristics, expanding the health infrastructure through construction of more health facilities geared toward promoting maternal health is a noble undertaking especially in the rural areas. In addition, the County could consider rolling out massive vaccination coupled with the tracking of the mothers with children under 12 months whereby the county health officers could trace them at their respective areas of residence. In this case, investment in a robust health record system to enable such tracking is key. Expansion of the healthcare services in the rural areas would be helpful in enhancing healthcare access among the rural dwellers.

5.5 Limitations of the Study

The study focused on Aldai Sub-County, Nandi County. Therefore, the study is likely to have suffered from data scarcity from the sampled households. Therefore, the findings cannot be generalized to all other counties and the entire country at large. In addition, the study findings could also fall short of being generalized to the larger Nandi County.

5.6 Areas for further Study

Similar studies across different counties would be worthwhile undertaking. Such studies could be key in informing cross – County analysis. In addition, future studies could consider diversifying the unit of analysis to include under 12 months, under 24 months and under 5 years and examine how uptake of immunization varies across children ages in Kenya. This would be key in eliciting

findings on which age group tends to be fully vaccinated as per the health guidelines and which age group fall short of immunization guideline adherence. This would inform policy pronouncement toward promoting adherence to immunization at various age groups.

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Caregiver questionnaire on determinants of uptake of immunization services among children below 12 months in Aldai Sub-County

SECTION 1: IDENTIFICATION

Health facility name:

Date of interview:

Time of Interview:

SECTION 2: CONSENT FORM.

My name is Daniel Kemboi, University of Nairobi student undertaking research for my Master of Science in Health Economics. My research is entitled “Determinants of uptake of immunization services among children below 12 months in Aldai Sub-County, Nandi County”. The choice to participate in the study as a respondent is optional. I wish to guarantee you that your responses will remain confidential and no information aimed at identifying who you are will be taken

Do you wish to proceed with the interview? Yes [] No []

Respondent’s signature ----- Date: -----

(If the respondent is willing to participate in the study, Kindly proceed with interview).

SECTION 1: PARENTAL AND CHILD CHARACTERISTICS				
001	What is your age	Age in complete years years	
002	What is your marital status?	Single	[]	
		Married	[]	
		Widowed	[]	
		Divorced/separated	[]	
003	What level of education have you attained	No education	[]	
		Primary education	[]	
		Secondary education	[]	
		Tertiary/college education	[]	

004	What is your occupation?	Farmer Salaried Casual worker Retired Trade/self employed Not employed	[] [] [] [] [] []	
005	What type of job are you involved in?	Skilled Semi-skilled Not employed	[] [] []	
006	Where do you currently live? Probe to determine and clarify whether rural or urban	Urban Rural	[] []	
007	If married, what is your partner's age?	 years	
008	What is your partner's level of education?	No education Primary education Secondary education Tertiary/college education	[] [] [] []	
009	What is your partner's occupation?	Farmer Salaried Casual worker Retired Trade/self employed Not employed	[] [] [] [] [] []	
010	What type of job is your partner involved in?	Skilled Semi-skilled Not employed	[] [] []	
011	How old is your child?	0-12 months Above 12 months	[] []	

012	What is the birth order of this child? Inquire the name and it	1 st 2 nd 3 rd 4 th Above 4 th	[] [] [] [] []	
013	What is the sex of this child? (use the name)	Male Female	[] []	
014	Do you know the vaccines that your child is supposed to receive?	Yes No	[] []	If yes proceed to question 015
015	How many of these vaccines have this child received so far?	Indicate the number as given		
016	What diseases are these vaccines meant to prevent children from?	Indicate as answered		
017	What is your perception on vaccination of children against these diseases?			
SECTION 2: ENVIRONMENTAL/HEALTH SYSTEM VARIABLES				

018	Did you attend antenatal clinics during your pregnancy	Yes No	[] []	
019	How many visits did you attend?	1 st visit 2 nd visit 3 rd visit 4 th visit Above 4 th visit	[] [] [] [] []	
020	Where did you deliver this child?	Hospital/health facility Home	[] []	
021	During your visits for your child's immunization have you ever missed out on having your child get the vaccine?	Yes No	[] []	
022	What was the reason for missing the vaccine?	Vaccine is out of stock Any other reason.....	[] []	
023	How far is this facility from your home? Give approximate distance and time taken to reach the facility?	Within 5 km Above 5 km	[] []	
024	How will you rate the vaccination services offered to	Excellent Good Satisfactory	[] [] []	

	your child in this facility?	Poor Very poor	[] []	
SECTION 3: IMMUNIZATION STATUS OF THE CHILD				
025	Please tell me if this child has received the following vaccines			
025A	BCG (an injection on the arm that leaves a scar)	Yes No Don't know	[] [] []	
025B	Polio vaccine (drops in the mouth)	Yes No Don't know	[] [] []	
025C	Pentavalent vaccine (an injection on the thigh)	Yes No Don't know	[] [] []	
025D	How many pentavalent vaccines has the child received	Indicate number		
025E	Measles vaccine at 9 months (shot in the right upper arm)	Yes No Don't know	[] [] []	
026	Do you have a mother child booklet for this child? If yes, can I have a look at it?	Yes No	[] []	
027	If allowed to look at it confirm the child's vaccination status	Fully immunized (1 st measles vaccine at 9 months or above) Partially immunized (has received some vaccines but not 1 st measles)	[] [] []	

		Unimmunized (has received no vaccine)		
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