IMMUNIZATION AND VITAMIN A SUPPLEMENTATION COVERAGE AND ASSOCIATED FACTORS AMONG CHILDREN AGED 12-23 MONTHS IN MWALUPHAMBA SUB-COUNTY, KWALE COUNTY

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Immunization and Vitamin a Supplementation Coverage and Associated Factors among Children Aged 12-23 Months In Mwaluphamba Sub-County, Kwale County

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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This Thesis has been submitted for examination with our approval as University Supervisors

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DEDICATION

I dedicate this work to my parents Mr Paul Gitau Muchina and Mrs Regina Muthoni Gitau. My husband Godfrey, daughter Jenny and my brothers and sisters for their love, encouragement and support during my studies. May God bless you abundantly.

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ABBREVIATIONS AND ACRONYMS

AIDS Acquired immunodeficiency syndrome

BCG Bacille Calmette-Guérin

DVI Division of Vaccines and Immunisations

DPT Diphtheria, Pertussis and Tetanus

DLTLD Division of Leprosy, Tuberculosis and Lung Diseases

EPI Expanded program on Immunization

ERC Ethical Review Committee

GOK Government of Kenya

GAVI Global Alliance for Vaccine and Immunization

HDSS Health Demographic Surveillance Site

HBV Hepatitis B Virus

Hep Hepatitis B vaccine

HBeAg Hepatitis B e Antigen

Hib Haemophilus Influenza Type B vaccine

IgG Immunoglobulin G

IgM Immunoglobulin M

IPV Inactivated Polio Vaccine

KEPI Kenya Expanded Program on Immunization

KDHS Kenya Demographic and Health Survey

KNBS Kenya National Bureau of Statistics

KK Kwale-Kinango

MDG Millennium Development Goal

MOH Ministry of Health

MCH Mother and Child Health

Mtb Mycobacteria *tuberculosis*

MOPS Ministry of Public Health and Sanitation

WHA World Health Assembly

NID National Immunization Day

NNT Neonatal Tetanus

NUITM Nagasaki University Institute of Tropical Medicine

OPV Oral Polio Vaccine

SIAs Supplemental Immunisation Activities

SPSS Statistical Package for the Social Sciences

TB Tuberculosis

TT Tetanus Toxoid

UNICEF United Nations Children Emergency Fund

VAS Vitamin A supplementation

VAD Vitamin A Deficiency

VPD Vaccine Preventable Diseases

WB World Bank

W H O World Health Organisation

WPV Wild Polio Virus

ABSTRACT

Childhood immunization is regarded as key to preventive and promotive health care in any community. Low immunization coverage is indicative of poor health status in children under-five years. Vitamin A supplementation is also important in strengthening the immune system as well as preventing blindness in children under-five years. In Kenya, about three quarters of children aged between 12-23 months are reported to receive all recommended vaccinations while more than half of them receive Vitamin A Supplements. However, there exist variation within provinces/Counties on the coverage of both immunization and Vitamin A Supplementation. The study was a cross-sectional study conducted at the household level to assess the immunization and vitamin A supplementation and associated factors among children aged 12-23 months in Mwaluphamba Sub-County Kwale County. The primary sampling units were households within Health Demographic Surveillance Site. A total of 285 households were sampled. A structured questionnaire was used to capture socio demographic, socio economic and health provision characteristic. Data analysis was done using SPSS software version 20 and p-value was set at < 0.05. Coverage for individual immunizations were BCG 99%, OPV3 31.6%, Pentavalent three 83.2% and Measles 67.8%. Polio vaccination coverage was significantly associated with level of education ($p=0.035$), type of employment ($p=0.002$), distance to health facility ($p=0.031$), time taken to health facility ($p=0.008$), place of last delivery ($p<0.001$) and facilitator during delivery ($P<0.001$). Pentavalent vaccination coverage had significant association with gender of the child ($p=0.030$), place of delivery ($p=0.047$), type of facilitator during delivery ($p=0.034$) and time ($p=0.013$). Measles vaccination coverage had significant association with place of last delivery ($p=0.006$) and type of facilitator during delivery ($p=0.003$). First dose of VAS coverage was significantly associated with by gender of the child ($p=0.034$), religion of the respondents ($p=0.047$), place of last delivery ($p<0.001$) and delivery assistant. ($p=0.019$). Second dose of VAS had significant association with age of the respondent ($p=0.009$), place of last delivery ($p=0.001$) and type of facilitator during delivery ($p=0.036$). Immunization coverage was lower than 77% reported in KDHS 2014 and the 80% recommended by WHO. The dropout rate between those who received BCG at birth and those who received measles vaccine at 9 months was high 31.2%. There was discrepancies in coverage of OPV3 and third dose of pentavalent vaccines which are given concurrently where polio vaccine (31.6%) was lower than pentavalent vaccine (83.2%). Vitamin A coverage at first dose was 45% while at second dose was 29.5%. Effective vaccination outreach services need to be put in place to target those who miss out on receiving vaccinations during immunization days. More efforts to be put in place in improving delivery rates in health facilities and with assistance by health workers, as these are positively associated with higher vaccination coverage. Health education and sensitization on the importance of child vaccinations and Vitamin A supplements should be provided in the study area.

CHAPTER ONE

INTRODUCTION

1.1Background Information

The World Bank (WB) has classified immunization as a cost-effective and life-saving intervention to reduce morbidity and mortality among infants (Gordis, 2000). Immunization works by stimulation of the body's own immune response (by administration of a vaccine) which is referred to as active immunization or through passive immunization which is temporary immunity brought about by the transfer of pre-formed antibody, or specifically sensitized lymphocytes, from an immune individual to a non-immune individual – the latter thus becoming immune without necessarily having had contact with the corresponding antigen(s). In 2015, World Health Organisation (WHO) report estimated that childhood immunization averts two to three million deaths every year and 1.5 million deaths could be prevented if global immunization improves (UNICEF, 2015).

Efforts to have universal immunization in the 1980s saw accelerated immunization coverage reaching 70% globally for the pentavalent and measles vaccines by end of 1990. However there has been stagnation in immunization coverage leading to deaths due to preventable diseases globally. Latest WHO immunization coverage report stated that 19.4 million infants worldwide are still missing out on basic vaccines (UNICEF, 2015). Majority of these infants are those who live mainly in disadvantaged rural communities hence they are not reached by routine immunization services. These significant variations in coverage exist between and within regions and countries. Unless this gap is closed more children under five

years of age will continue to die annually from preventable diseases for which vaccines are available.

In today's increasingly interdependent world, acting together against vaccine-preventable diseases of public health importance and preparing for the possible emergence of diseases with pandemic potential will contribute significantly to improving global health and security. Immunization and the other linked health interventions that can be easily implemented with immunization to the benefit of both, will contribute significantly to the reduction of infant mortality rates and consequently attain the Sustainable Development Goal (SDGs) number three that target on ending preventable deaths of new-borns and children under five years of age by 2030.

The use of immunization services however requires acceptability from the target community. This means that for immunization services to be used there must be a clear understanding of the benefits of vaccination among community members, a readiness for providing vaccination by the health services, and interventions to overcome access barriers to immunization services (Kidane *et al.*, 2003; Ndiritu *et al.*, 2006; Torun *et al.*, 2006).

In many developing countries, immunization services do not reach the poorest and most excluded populations. Even when services are available, a substantial number of caregivers still fail to complete the immunization schedule (Waisbord *et al.*, 2005). In Sub -Saharan Africa, immunizations are typically provided in the health clinics and hospital outpatient facilities that comprise the backbone of countries'

regular health services. Nonetheless, when health services are weak like in most of Sub-Saharan Africa Countries, many children are not reached due to under investments in national immunization programmes, vaccines stock-outs and disease outbreaks (UNICEF, 2015). Three out of six countries (Ethiopia, Nigeria and Democratic Republic of Congo) have the most unvaccinated children in Africa. GVAP highlights the need to identify barriers to vaccine delivery and to ensure accountability through annual reporting of actions taken to improve immunization programs for countries experiencing stagnation in coverage. These missed opportunities adversely affect not only children who are left unprotected, but also future generations of other children (Subaiya *et al*., 2015). Identifying barriers to vaccine delivery and ensuring accountability through annual reporting are some of the actions that need to be taken to improve immunization program

World Health Organisation considers that a child is fully vaccinated if he/she has received one dose of Bacterium of Calmette Guerin (BCG), three doses each of Diphtheria Pertussis and Tetanus (DPT), polio, and one dose of measles vaccine. Bacterium of Calmette Guerin should be given at birth or at first clinic contact; it protects against tuberculosis. DPT protects against diphtheria, pertussis, and tetanus. DPT and polio require three vaccinations at approximately 6, 10 and 14 weeks of age. Measles should be given at or soon after reaching nine months of age. The WHO recommends that children receive the complete schedule of vaccinations before 12 months of age (WHO, 2009a).

The Government of Kenya provides vaccines for the vaccine preventable diseases free of charge through Division for Vaccine and Immunisations (DVI). Diseases

which have been targeted includes, Tuberculosis, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B and Haemophilus *Influenza* type b. Pneumococcal pneumonia and Rotavirus have also been introduced. According to a report by Kenya Demographic Health Survey (KDHS), the Proportion of children aged two years and below that are reported to have received all basic vaccinations in Kenya is 79%. However, this proportion varies from 55% in the North Eastern Province which had the lowest to 93.3% in the Central Province with the highest (KDHS, 2014). This geographical disparity in coverage reflects the variation in the influence of determinants of immunizations across the different provinces in Kenya. Coast Province immunization coverage was 80.5% while children aged between 12-23 months who had received Vitamin A supplement was low at 72% (KDHS, 2014).

1.2 Statement of the Problem

Partial immunization coverage against vaccine preventable diseases is a significant public health problem especially in rural areas in Kenya. Assessing immunization coverage assists in evaluating progress in achieving programme objectives and in improving service delivery. In addition, assessing immunization coverage provides evidence of progress towards achieving vaccination targets. Such positive evidence is required for continuing support from donor-supported initiatives like the Global Alliance for Vaccines and Immunizations **(**Brugha *et al., 2*002).

Kwale County has some of the worst socioeconomic and health indicators in Kenya. Child malnutrition remains a serious public health problem in the area where stunting prevalence has been estimated to be 44.7%. Health centres in

Kinango and Samburu have also reported 50% cases of underweight (Ministry of Agriculture, 2004). Reports according to KDHS 2014 confirms this findings that Coast region had the highest levels of stunting at 31 percent (KDHS 2014). Studies have shown that malnutrition makes children vulnerable to preventable diseases leading to high morbidity. Study conducted in the study area reported immunization status as a significant predictor of children's linear growth. In addition, immunized children were less likely to be malnourished compared to non-immunised children (Adeladza, 2009).

Vitamin A supplementation (VAS) is one of the most cost-effective child survival strategies in areas where Vitamin A deficiency (VAD) exists. Strong evidence shows that in settings where VAD is prevalent, twice-yearly receipt of VAS by at least 80% of children ages 6–59 months reduces the risk of mortality from measles by an average of 50%, from diarrhoea by an average of 40%, and from all causes by 24% (Imdad *et al*., 2010). Generally, the coverage is low in most parts of the world with only 75% of children in Sub-Saharan Africa and 46% of children in South Asia receiving at least one dose of vitamin A annually (UNICEF, 2004).

1.3 Justification of Study

Kwale County has several challenges which includes poor infrastructure development, low agricultural production due to land tenure problems and yearly droughts due to rainfall inadequacy particularly in Kinango, Matuga and Samburu Constituencies (Kwale County Government, 2016). Medical facilities in Kwale County are inadequate in terms of the number of health centres and the service provided to the local population. People travel long distances for treatment, with the average distance to the nearest health facility being 7 kilometres. This coupled with poor road network, force many to forgo treatment. Over the years skewed budget allocation has resulted in disproportionate availability of health facilities and health services. Even with the few facilities available in the County, they are largely under-resourced and inaccessible to many people (Kwale County Government, 2016). To ensure morbidity and mortality due to preventable diseases are averted an assessment of immunization and Vitamin A supplementation coverage levels among children aged 12-23 months and associated factors is needed which will hence inform the County on strategies to put in place in up scaling immunization and Vitamin A supplementation coverage.

This age group was chosen as per the recommendations of WHO immunization cluster survey reference manual where the final primary immunization is at 9 months of age; (WHO, 2005b) and also this is the youngest cohort who have reached the age by which they should be fully vaccinated. About 51% of the study population was reported to have stunted growth (Adeladza, 2009). Limited

information is available on the immunization and vitamin A supplementation coverage in the study area.

1.4 Research Questions

1. What is the immunization coverage among children aged 12-23 months in Mwaluphamba Sub-County, Kwale County?
2. What is the Vitamin A Supplementation coverage status among children aged 12-23 months in Mwaluphamba Sub-County, Kwale County?
3. What are the factors associated with immunization among children aged 12-23 months in Mwaluaphamba Sub- County, Kwale County?
4. What are the factors associated with Vitamin A supplementation among children aged 12-23 months in Mwaluaphamba Sub-County, Kwale County?

1.5 Objectives

1.5.1 General Objective

To determine Immunization and Vitamin A supplementation coverage and associated factors among children aged 12-23 months in Mwaluphamba Sub-County, Kwale County.

1.5.2 Specific Objectives

1. To determine immunization uptake among children aged 12-23 months in Mwaluphamba Sub-County, Kwale County.
2. To determine Vitamin A supplementation uptake among children aged 12-23 months in Mwaluphamba Sub-County, Kwale County.

3. To establish factors associated with immunization uptake among aged between 12-23 months in Mwaluphamba Sub-County, Kwale County.
4. To establish factors associated with Vitamin A supplementation uptake among children 12-23 months in Mwaluphamba Sub-County, Kwale County.

CHAPTER TWO

LITERATURE REVIEW

2.1 Vaccination Overview

Immunization is a mechanism whereby an individual is made immune to an infectious disease simply by the administration of a vaccine which stimulates body's own immune system to protect the person against subsequent infection or disease (WHO, 2013a). It is recognized as one of the most cost effective interventions to prevent morbidity and mortality caused by infectious diseases, particularly in high endemic setting (Musgrove, 1993; WHO, 2005a). Vaccines prevent more than 2.5 million child deaths each year and it has been shown that children who receive all appropriate vaccinations by 9 months of age are less likely to die than those who do not (Rutherford *et al.,* 2009).

The immune system uses numerous tools to fight infection. Blood contains red blood cells, for carrying oxygen to tissues and organs, and white or immune cells, for fighting infection. These white cells consist primarily of B-lymphocytes, T-lymphocytes, and macrophages: When infections are detected, B-lymphocytes produce antibodies to attack them. *B lymphocytes* produce antibodies - proteins (gamma globulins) that recognize foreign substances (antigen) and attach themselves to them. B lymphocytes (or B cells) are each programmed to make one specific antibody. When a B cell comes across its triggering antigen it gives rise to many large cells known as plasma cells. Each plasma cell is essentially a factory for producing antibody. An antibody matches an antigen much like a key

matches a lock. Whenever the antibody and antigen interlock, the antibody marks the antigen for destruction. B lymphocytes are powerless to penetrate the cell so the job of attacking these target cells is left to T lymphocytes. Vaccines help develop immunity by imitating an infection. This type of infection, however, does not cause illness, but it does cause the immune system to produce T-lymphocytes and antibodies. However, it typically takes a few weeks for the body to produce T-lymphocytes and B-lymphocytes after vaccination. Therefore, it is possible that a person who was infected with a disease just before or just after vaccination could develop symptoms and get a disease, because the vaccine has not had enough time to provide protection (CDC, 2013)

Most vaccines are injected directly into muscle tissue where vaccine antigen disassociates from adjuvant. Vaccines containing aluminium adjutants (DPT, DT, TT, Td and hepatitis B vaccine) should be injected intramuscularly. The preferred site for intramuscular injection in infants and young children is the aspect of the upper thigh since it provides the largest muscular mass. In older children, the deltoid muscle has achieved sufficient size to offer a convenient site for intramuscular injection (WHO, 2009a)

2.2 History of Vaccination in Africa

Immunization began with Edward Jenner a Country doctor living in Berkeley (Gloucestershire) England, is considered the founder of vaccinology. In 1796 he performed the world's first vaccination (Baxby, 1981; Baxby, 2001). His affirmation that 'the cow-pox protects the human constitution from the infection

of smallpox' laid the foundation for modern vaccinology (Jenner, 1798). Inspired by Jenner's work, Louis Pasture worked on attenuation of viruses and preventive inoculation of viruses other than small pox. Elimination of poliomyelitis and Measles in many regions further demonstrated that vaccines were among the most powerful public health tools.

In 1974, the Expanded Programme of Immunization (EPI) was established by the WHO as a means to continue the great success that had been achieved earlier with the eradication of smallpox by ensuring all children in all Countries benefit from life- saving immunizations. The initiative was to tackle six diseases which are tuberculosis, diphtheria, tetanus, pertussis, polio, and measles. WHO later recommended that yellow fever, hepatitis B and Haemophilus type B vaccines be added to the national immunization programs (WHO, 2009a)

Global data shows that infants less than one year of age immunized with DPT, (three doses of the combined vaccine against diphtheria, pertussis and tetanus) increased from 20% in 1980 to 79% in 2006. The percentage of children immunized with three doses of polio vaccine in 2006 rose from 22% in 1980 to 80%. Measles coverage increased from 16% in 1980 to 80% in 2006. However, these increases are still falling short of the 2010 target of 90% set by WHO/UNICEF Global Immunization Vision and Strategy. It is argued that further increases in coverage of DPT, Polio and Measles would save millions of infant lives (WHO, 2013b).

Despite the successes of immunization programs worldwide, global estimates of (Vaccine Preventable Diseases) VPD mortality and DTP3 coverage underscore that available vaccines are not being used to their fullest potential in most disadvantaged and remote communities. Challenges include sustaining current vaccination coverage levels, extending vaccination to unreached populations and persons beyond infancy, and introducing new vaccines and technologies. Immunization coverage in low-income countries remains significantly below the levels in middle and high-income countries. (World Bank, 2009); (CDC, 2006)

Though immunization goals to protect the worlds' children were established in 1974 by World Health Assembly, most African countries started their immunization programs during the first half of the decade. Some of the countries conducted their immunization services with a minimum set up. Immunization fails to reach about 20% of children born in a year which amounts to 24 million globally, of which majority reside in developing countries. This shows that the children of developing countries are still far from the reach of vaccination (WHO, 2014).

Since 1995, immunization coverage rates have generally been stagnant or on a decline, with important variation by geographic area and between countries within the region (Msambichaka, 2000). Inequalities in regional immunization coverage rates and even countries with high national coverage rates and demonstrable improvements in coverage continue to show socio-economic disparities in coverage (Buton *et al.*, 2009; Uddin *et al.*, 2010).

A substantial number of studies have documented cases of inadequate immunization coverage and challenges in Sub-Saharan Africa. Among the 29 sub-Saharan countries surveyed, full childhood immunization coverage varies widely from only 11% of children of ages 12 -23 Months in Chad to 78% in Zambia. In some countries, missing the third dose of vaccine in the DPT and Polio series is the reason that complete immunization levels are low (WHO /UNICEF, 2005). To improve the situation, factors contributing to incomplete immunizations need to be well understood

2.3 Immunization Coverage in Kenya

Kenya Expanded Program on Immunization (KEPI) has increased immunization of the target population since its inception in 1980 by achieving and maintaining coverage of over 75% by the early 1990. The Ministry of Health has applied strategies to increase immunization coverage in Kenya. According to KDHS 2014 survey reports the number of children who received BCG vaccination was 97%, those who received the third dose of DPT-HepB-Hib was 90%, those who received third dose of polio vaccine was 98% and measles was at 87% (KDHS, 2014).

National immunization coverage was 79% with only 2% of children who had not received any vaccinations. Coverage was highest in the Central Province with 90% and lowest in the North Eastern region, where only 51% of children were fully immunised. In North Eastern 11% had not received any of the recommended

immunisations, as compared with 2 percent or less in the other regions (KDHS, 2014).

The difference in immunization coverage in various parts of the country is a clear indication that there exists disparities accessing immunization services in various regions in the Country. This regional disparities has contributed to the remerging of vaccine preventable diseases like measles and polio. Although polio had been declared not a threat to children in Kenya years ago, recent reports indicate that the disease is now a real threat (Reynods *et al.*, 2007). This calls for the need for new approaches to ensure immunization coverage reaches recommended rate by WHO of 90% across all the Counties if the Country is to achieve SDGs on ending preventable deaths of new-borns and children under five years and universal access to primary health care. The table **2.1** below illustrates the schedule followed during routine children immunization in Kenya. Vitamin A Supplementation has been included in the schedule to ensure effective delivery of vitamin A supplementation.

Table 2.1: Routine Immunization Schedule for Children under one Year

Vaccine	Age of administration	Indicate by "x" if given in:		
		Entire country	Only part of the country	Comments
BCG	At birth	X		
OPV	At birth, 6 weeks, 10 weeks, and 14 weeks.	X		
DPT-HepB-Hib (Pentavalent)	6weeks, 10 weeks, and 14 weeks	X		
Measles	9 months	X		
Yellow Fever	9 months		X	Baringo, Keiyo, Koibatek and Marakwet) at high risk of yellow fever disease. Follow up SIAs planned for 2012
TeT	Pregnant women	X		
Vitamin A	6 months interval	X		To be integrated with measles/OPV SIAs

Source: Ministry of Public Health and sanitation (Division of Vaccines and Immunization Comprehensive Multi Year Plan 2013-2017)

2.4 Vaccines Classification

A vaccine is a biological preparation that provides active acquired immunity to a particular disease. There are two basic types of vaccines: live attenuated and inactivated. The characteristics of live and inactivated vaccines are different, and

these characteristics determine how the vaccine is used. Both types work by exposing human system to a pathogen and mimicking it so that the future cases of exposure and adaptive immune response is triggered and the person avoids disease (Siegrist, 2008).

2.4.1 Live (Attenuated) Vaccines

Live attenuated vaccines are produced by modifying a disease-producing ("wild") virus or bacterium in a laboratory. The resulting vaccine organism retains the ability to replicate (grow) and produce immunity, but usually does not cause illness (Siegrist, 2008). Conventional vaccines have been based on live attenuated pathogens, and contain laboratory-weakened versions of the original pathogen. The advantage of this type of vaccine is that both a strong cellular and an antibody response are produced. Usually, long-term protection is also achieved, and a single inoculation is often sufficient. Furthermore, since live vaccines are often attenuated (made less pathogenic) by passage in animal or thermal mutation, they can revert to their pathogenic form and cause serious illness. It is for this reason, polio live (Sabin) vaccine, which was used for many years, has been replaced in many countries by the inactivated (Salk) vaccine (Clem, 2011).

Currently available live attenuated viral vaccines are measles, mumps, rubella, vaccinia, oral polio, varicella, zoster (which contains the same virus as varicella vaccine but in much higher amount), yellow fever, rotavirus, and influenza (intranasal). Live attenuated bacterial vaccines are Bacilli Calmette-Guérin (BCG) and oral typhoid vaccine (CDC, 2013)

2.4.2 Inactivated (Killed) Vaccines

Inactivated vaccines are produced by growing the bacterium or virus in culture media, then inactivating it with heat and/or chemicals (usually formalin) to reduce infectivity. Inactivated vaccines can be composed of either whole viruses or bacteria, or fractions of either. Fractional vaccines are either protein-based or polysaccharide-based. Protein-based vaccines include toxoids (inactivated bacterial toxin) and subunit products. Most polysaccharide-based vaccines are composed of pure cell wall polysaccharide from bacteria. Conjugate polysaccharide vaccines contain polysaccharide that is chemically linked to a protein. This linkage makes the polysaccharide a more potent vaccine. The main advantage of killed or inactivated vaccines over attenuated vaccines is safety. Since these vaccines are based on killed/inactivated pathogens, the concerns regarding reverting back to virulence are obviated (Petrovsky *et al.*, 2004; Siegrist 2008)

Inactivated vaccines always require multiple doses. In general, the first dose does not produce protective immunity, but only "primes" the immune system. A protective immune response develops after the second or third dose. In contrast to live vaccines, in which the immune response closely resembles natural infection, the immune response to an inactivated vaccine is mostly humoral, little or no cellular immunity results. Antibody titers against inactivated antigens diminish with time. As a result, some inactivated vaccines may require periodic supplemental doses to increase, or "boost," antibody titers. Currently available inactivated vaccines are limited to inactivated whole viral vaccines (influenza,

polio, rabies, and hepatitis A). Whole inactivated bacterial vaccines include pertussis, typhoid, cholera, and plague (CDC, 2013)

2.5 Type of Vaccines

According to WHO, children are supposed to receive a number of vaccines by the time they reach one year. This is in response to avert preventable deaths caused by infectious diseases like Tuberculosis, Pertussis, Diphtheria, Tetanus, Haemophilus Influenza type B, Hepatitis B, Poliomyelitis, and Measles. Vitamin A supplementation is also incorporated in the immunization schedule where children are supposed to receive the supplements from the age of six months up to five years. The performance of immunization program is determined by the coverage of the pentavalent vaccine which is a combined dose of diphtheria-whooping cough- tetanus-Haemophilus influenza type B and Hepatitis B. Failure to completely immunize children within the required time can lead to disease outbreaks, resulting in death and disability. In Kenya, repeated outbreaks have been reported in different parts of the country. These outbreaks are an indication that despite improved immunization coverage in the country, not all children are protected through routine immunization programmes (WHO, 2006)

2.5.1 Bacterium of Calmette Guerin (BCG) Vaccine

Tuberculosis (TB) is a bacterial infection caused by *Mycobacterium tuberculosis*. It is transmitted through respiratory droplets, and it's highly contagious. Studies have shown that 25 to 50% infection rate are those in close contact with infected individuals (Smith *et al*., 1999). Tuberculosis causes nearly 2 million to 3 million

deaths annually, and is believed that another 8 million people are infected with the bacterium each year. In much of the world the TB incidence rates continue to grow, especially in Sub-Saharan Africa, despite the widespread use of the *Bacille Calmette-Guérin* (BCG) vaccine (Cantwell *et al*., 1996).

In Africa, co-infections of human immunodeficiency virus (HIV) and TB have led to increases in the incidence rate of TB by approximately 20 percent (Smith *et al.*, 1999). Emerging mycobacterial drug resistance is further complicating the situation. After decades of steady decline, the incidence of TB is also increasing in industrialized countries, mainly as the result of outbreaks in particularly vulnerable groups.

The Bacille Calmette–Guérin (BCG) vaccine has existed for 80 years and is one of the most widely used of all current vaccines, reaching >80% of neonates and infants in countries where it is part of the national childhood immunization programme (WHO, 2004). The vaccine is a live attenuated bacterial vaccine most commonly administered intradermally at birth to prevent tuberculosis. The effectiveness of the BCG vaccine against TB has been debated, with a range estimated from 0 to 80 % (Fine, 2000). The real impact of BCG may have been confounded by many other improvements in public health that could have contributed to the decrease in disease burden associated with tuberculosis (Smith *et al*., 1999)

In Kenya the notification rate of all forms of TB over the past 5 years has been increasing by an average of 14%. Reported cases of Tuberculosis have risen from 10,000 in the 1980s to over 100,000 in 2004. The increase has been driven mostly

by the high prevalence of HIV in the population. It is estimated that up to 60% of TB patients are co-infected with HIV in Kenya (Ministry of Health, Kenya, 2003.) A survey conducted in Kenyan Districts which included, Elgeyo Marakwet, Kakamega, Kilifi, Kisii, Kitui, Siagya, Kwale, Meru, Muranga, Nakuru, Nairobi, and South Nyanza to assess the coverage of BCG scar among primary school children recorded that South Nyanza district experienced the greatest improvement in BCG coverage between the 2 surveys, while Kilifi district experienced the greatest decline in coverage. The greatest upward trend was observed in the Western and Rift Valley provinces, while the greatest downward trend was observed in the Coast and Eastern provinces. (Bosman *et al.*, 1998).

2.5.2. Polio Vaccine

Poliomyelitis (polio) is a highly infectious viral disease, which mainly affects young children. There are three type of virus (1, 2 and 3). The virus is transmitted through contaminated food and water, and multiplies in the intestine, from where it can invade the nervous system. Many infected people have no symptoms, but do excrete the virus in their faeces, hence transmitting infection to others (Sutter *et al.*, 2005).

In a small proportion of cases, the disease causes paralysis, which is often permanent. In response to the World Health Assembly (WHA) declaration in 2012 that polio constitutes a global public health emergency, the Polio Eradication and Endgame Strategic Plan 2013-2018 was developed (WHO, 2013c). This plan includes the introduction of at least one dose of inactivated polio vaccine (IPV) into routine immunization schedule as a strategy to mitigate the potential risk of

re-emergence of type 2 polio following the withdrawal of Sabin type 2 strains from oral polio vaccine (OPV). Two different poliomyelitis vaccines are currently used to protect against disease. Oral poliovirus vaccine (OPV) is a live attenuated vaccine containing all three serotypes of the poliovirus and induces protection as high as 95 percent in individuals who receive three doses. Additional booster doses are necessary to achieve nearly 100 percent protection. Currently the WHO recommends that OPV be given at birth, 6, 10, and 14 weeks in polio endemic or recently endemic countries (Sutter *et al*., 2005).

In many developed countries this vaccine is now delivered in a series of national or subnational campaigns several times a year. The majority of developing countries throughout the world rely on OPV for vaccinating their population, a combined birth cohort of 127 million people (Sutter *et al*., 2005).

Global burden of polio virus was estimated to be >350,000 cases in 1988 with Wild Polio Virus (WPV) reported in 125 countries (Sutter *et al.*, 2008). After the use of vaccine since 1988 the incidence dropped by>99%. Despite the remarkable success, in 2014, Nigeria, Pakistan and Afghanistan remain endemic for transmission of WPV (WHO, 2014a).

Global efforts toward polio eradication have included vaccination campaigns and active surveillance. The annual incidence of paralytic polio was reduced from an estimated 350,000 in 1988 to about 1,000 in 2004 worldwide (Roper *et al*., 2007). Africa and South Asia are the last regions in the world where poliomyelitis is still endemic. False accusations of tainted vaccines by local leaders have led to a local

resurgence of poliomyelitis cases and consequent spread to other parts of Africa (Heymann *et al.*, 2004).

Kenya has remained free from Polio since 1984 till an outbreak of the disease in the neighbouring countries brought the disease back to the country. The first case in Kenya after a gap of 22years occurred at the refugee camp near the Kenya-Somalia border. The infected person was a three year old Somali girl. Another outbreak was detected in Rongo District in Kisumu in the year 2011 and mass campaign was carried out to eradicate and kick polio out of Kenya (WHO, 2011).

2.5.3 Diphtheria- Pertussis- Tetanus –Hepatitis B and Haemophilus influenza type B (Pentavalent Vaccine)

This vaccine is given as a combination of five vaccines to reduce the number of injections and encourage compliance to vaccination schedule. Infants schedule is single dose of 0.5ml doses given at 6, 10 and 14 weeks. Is an intramuscular injection into the antero-lateral aspect of the left thigh (Ministry of Health, 2013)

2.5.3.1 Diphtheria

Diphtheria is caused by toxin-producing strains of the bacterium Corynebacterium diphtheriae, which can be transmitted from person to person via respiratory droplets. Morbidity and mortality result from the bacterial toxin that may cause obstructive pseudo-membranes in the upper respiratory tract (croup) or damage to myocardium and other tissues. Devastating diphtheria epidemics affecting mainly children have been described from many countries throughout history. In countries endemic for diphtheria, the disease occurs mostly as sporadic cases or in

small out breaks (WHO, 2006). Incidence data in Africa is limited to case series and hospital based- based surveillance studies, where underreporting is likely, given that diphtheria is frequently reported as nonspecific upper respiratory infections (Rodrigues, 1991).

Death can result from severe cases in which swelling from pharyngeal and tracheal exudates obstruct the airway. Cutaneous diphtheria presents as skin lesions and causes far fewer complications and deaths among those infected. Although most infections with C. diphtheria are asymptomatic or run a relatively mild clinical course, high case fatality rates (>10%) have been reported even in recent outbreaks (WHO, 2006).

The EPI has traditionally recommended three doses of the combined diphtheria-tetanus pertussis (DPT) vaccine in the first year of life together with polio vaccine. Most developed countries give subsequent booster doses in childhood and diphtheria-tetanus boosters in adulthood. In Africa, the need for boosters is overcome by the natural immunity provided by the presence of *C. diphtheriae* in skin ulcers as well as asymptomatic carriage in the throat, which spreads the organism throughout the population. Carrier rates in Africa have been estimated to be as high as 9.3% in children in the general population (Geldermalsen *et al*., 1993).

The incidence of diphtheria reflects inadequate coverage of the national childhood immunization programme. Consequently, obstacles to optimal vaccine delivery must be recognised and measures taken to upscale immunization coverage. In countries that are rendered non-endemic through high immunization coverage, the

primary vaccination series of 3 doses should be extended by at least 1 booster dose (WHO, 2006). It is recommended that to further promote immunity against diphtheria, combined diphtheria toxoid and tetanus toxoid rather than tetanus toxoid alone should be used when tetanus prophylaxis is needed following injuries.

2.5.3.2 Pertussis

Pertussis, or whooping cough, is a highly contagious disease caused by the bacterium *Bordetella pertussis*, which is transmitted through respiratory excretions and occurs throughout the world. Most pertussis in developing countries occurs in school age children. In developed countries, mild or asymptomatic infections in adults are believed to be common sources of transmission to very young infants. Studies have shown that girls tend to have higher incidence rates of the disease than boys (Dragsted *et al*., 2004).

Each year there are an estimated 20 million to 40 million cases of pertussis and another 200,000 to 400,000 deaths attributed to the disease 90% of which occur in the developing world. The incidence rate of pertussis has declined drastically over the past half-century primarily because of the administration of the inactivated whole-cell pertussis vaccines. Due to neurological reactions associated with the whole-cell vaccines, new acellular vaccines have been developed. Either of these vaccines is usually administered with the diphtheria and tetanus toxoids (TTs). The whole-cell vaccine is cheaper than the acellular vaccine and is produced in many developing countries (Amirthalingam *et al*., 2014)

2.5.3.3 Tetanus

Tetanus is caused by an infection with the bacterium *Clostridium tetani*, which is commonly found in soil, saliva, dust, and manure. The bacteria generally enters through a break in the skin such as a cut or puncture wound by a contaminated object and it can grow in dirty wounds where produces a neurotoxin causing convulsions and eventual death. Neonatal tetanus (NNT), the most common form of tetanus in developing countries particularly in rural areas where deliveries are at home, is the result of contamination of the umbilical stump either by the use of non-sterile instruments after delivery or the application of animal dung to the cut cord, a custom in many cultures, especially among groups in Sub-Saharan Africa (Meegan *et al.*, 2001). Tetanus can be prevented by immunizing women of child bearing age with tetanus toxoid (TT) – containing vaccines. Neonatal Tetanus which causes an estimated 450,000 infant deaths is defined as tetanus in the first month of life. Another 40,000 maternal deaths are estimated to occur from tetanus acquired during delivery (Roper *et al*., 2007).

The disease is the only EPI vaccine preventable disease that is not communicable but acquired through environmental contamination.

2.5.3.4 Haemophilus Influenza Type B

Haemophilus influenza type b (Hib) causes 3 million episodes of serious disease among children each year, leading to half a million deaths. It's the leading cause of meningitis, septicaemia and pneumonia in young children (Peltola *et al.,* 2000). Hib vaccine has been licensed for use in infants since 1991. Most industrialized countries introduced the vaccine quickly into routine infant immunization services. This was justified by observed annual incidence rates of Hib meningitis between 20 and 69 cases per 100 000 children under five years old (WHO, 2002).

In Kilifi, Kenya, invasive *H. Influenza* disease is responsible for 5% of inpatient deaths among young children; Streptococcus pneumonia and malaria, by comparison, are responsible for 9% and 22% of deaths respectively (Berkley *et al.,* 2005). *Haemophilus* Immunization with Hib conjugate vaccine reduces the risk of invasive Hib disease in young children by more than 90%, it's therefore recommended for inclusion in all routine infant's immunization (Adegbola *et al.,* 2005)

In 2001, the Global Alliance for Vaccines and Immunization (GAVI) offered financial support to developing countries to introduce Hib conjugate, Hepatitis vaccine, and DPT as pentavelent vaccine into routine childhood immunization over 5 years. Administration of these new antigens was considered important as invasive Hib disease incidence peaks at 4 weeks and vaccination beginning at 6 weeks can prevent early Horizontal HBV infection (Vardas *et al.,* 1999).

It is therefore important to constantly assess the coverage level of this vaccine to ensure deaths due to *Haemophilus influenza* type b are averted. A Study conducted in Kilifi District Hospital found introduction of Hib vaccine into the routine childhood immunization program reduced Hib disease incidence among children younger than 5 years to 12% of its baseline level. This impact was not observed until the third year after vaccine introduction (Cowgill *et al.,* 2006). This calls for proper surveillance system for the vaccination programme and vaccination of large proportion of children aged between 12-23 months to provide evidence of the vaccine effectiveness

2.5.3.5 Hepatitis B Vaccine

Hepatitis B virus causes a life-threatening liver infection that often leads to chronic liver disease and puts people at high risk of death from cirrhosis of the liver and liver cancer. Hepatitis B virus infection is a major global health problem. Worldwide, an estimated two billion people have been infected with the hepatitis B virus (HBV), and more than 360 million have chronic (long-term) liver infections (WHO, 2005d). Humans are the only reservoir of Hepatitis B virus and it is transmitted by percutaneous and permucosal exposure to infected blood and other body fluids, mainly semen and vaginal fluid. A proportion of 7-40% of individuals with Hepatitis B virus may also carry the hepatitis B e antigen (HBeAg) which is associated with high infectivity. Unless vaccinated at birth, the majority of children who are born to mothers who are (HBeAg) -positive become chronically infected (Beasley *et al.,* 1983)

A vaccine against hepatitis B has been available since 1982. Hepatitis B vaccine is 95% effective in preventing HBV infection and its chronic consequences, and is the first vaccine against a major human cancer. The vaccine has an outstanding record of safety and effectiveness. Since 1982, over one billion doses of hepatitis B vaccine have been used worldwide. In many countries where 8% to 15% of children used to become chronically infected with HBV, vaccination has reduced the rate of chronic infection to less than 1% among immunized children (WHO, 2011).

Africa has the second largest number of chronic HBV carrier rate after Asia, with over 50 million people being lifetime carriers. It has been estimated that over 12 million people will die due to hepatitis B induced liver disease, representing a 25% risk among carriers (Kiire, 1996). Studies in Kenya showed HBsAg carrier rates of 5 - 30% (Bagashwe *et al.*, 1973). Hepatitis B vaccine can be given as a monovalent or as a fixed combination with other vaccines like Diphtheria-Pertussis-Tetanus (DPT), HIB, Hepatitis A and inactivated Polio. The immune responses and safety of these combinations of vaccines are comparable to those observed when vaccines are administered separately (Bavdekar *et al.*, 2007; Pichichero *et al.*, 2007).

2.5.4 Pneumococcal conjugate vaccine (PCV)

Pneumococcal conjugate vaccine (PCV) is used to protect infants and young children against disease caused by the bacterium Streptococcus pneumonia (Pneumococcus). A large proportion of the population “carries” the bacteria in the

back of the nose without any symptoms. In the year 2008, approximately 8.8 million deaths occurred worldwide in children less than five years and pneumococcal disease caused an estimated 521,000 of these deaths (Black *et al*., 2010 ; WHO,2008) There are currently three PCV vaccines available on the global market: Prevnar (called Prevenar in some countries), Synflorix (PCV-10) and Prevnar 13 (Overturf and Committee on Infectious Diseases., 2000). Trials of pneumococcal conjugate vaccines (PCV) conducted among infants have shown significant efficacy against invasive pneumococcal disease (IPD) (Klugman *et al*., 2003) and by early 2010 PCV had been introduced into routine immunization programmes in over 50 high- and middle-income countries (WHO, 2011; CDC,2008).The World Health Organization had also recommended the introduction of PCV into the immunization schedules in developing countries with high background rates of childhood mortality (WHO,2007).

By vaccinating certain individuals and reducing their carriage of the bacterium, the rest of the population can be given 'herd protection' by reducing transmission of the bacterium to unvaccinated individuals. This is the first time PCV10 has been shown to be effective in a low-income country (KEMRI Wellcome Trust). Therefore, if you vaccinate children, they will not transmit to the parents. Clinical trials revealed that the vaccine was also effective in children with HIV (Hammit *et al*., 2010)

Kenya was among the first African countries to introduce PCV in 2011, and the first low-income country to use the 10-valent vaccine. The 10 serotypes included in the vaccine account for at least 70% of pneumococcal disease in every region

of the world and have the potential to greatly reduce pneumococcal disease (KEMRI Wellcome Trust).

2.5.5. Measles Vaccine

Measles is a highly contagious respiratory infection caused by a virus. The highest fatality rates are generally among children under five years, and up to 20% in infants less than one year old (Atatah *et al.*, 2015). The number of deaths due to measles has been a subject of considerable controversy for the past several years, mostly because of the inability to specify accurately the cause of death in children infected by measles and other similar conditions (Jamison *et al.*, 2006).

Most children born to immune mothers are protected from the virus for the first six months of their lives from acquired maternal antibodies (Strebel *et al.*, 2004). Children affected by measles may suffer lifelong disabilities, including brain damage and blindness, pneumonia, bronchitis and diarrhoea. A highly effective vaccine has been available since the 1960s (Ludlow e*t al.*, 2015). The vaccine is a live attenuated vaccine that can be administered alone or in combination with rubella vaccine, or with mumps and rubella vaccines. It is administered as a single dose during the first year of life, usually at 9 months (but at 12-15 months in industrialized countries). In the absence of vaccination, measles is estimated to infect virtually the entire population with the exception of isolated communities (Black, 1976).

Nearly 95% of children vaccinated with at least one combination of the vaccine develop immunity. Large-scale urban and nationwide vaccination campaigns over

the last few years have reduced measles mortality to 250,000–500,000 deaths per year, most of which still occur in Sub-Saharan Africa (Miller, 2000).

Despite this, measles remains the leading cause of vaccine-preventable deaths in the world. During 2000-2015, measles vaccination prevented an estimated 20.3 million deaths. Global measles deaths have decreased by 79% from an estimated 651 600 in 2000 to 134 200 in 2015. In populations with high levels of malnutrition and a lack of adequate health care, up to 10% of measles cases result in death. Inequalities in access to vaccines within Countries mean that death and disability from measles is concentrated primarily among the poorest, most marginalized and remote people. Failure to deliver at least one dose of measles vaccine to all infants remains the primary reason for high measles mortality (WHO, 2016)

In Kenya it was reported that there exists great regional disparities with a low coverage of measles of about 22.6% in Kiambu and a high coverage of 56.5% in Kwale Districts (Muttunga *et al*., 1999). Research has also shown that severe measles is more likely to occur among poorly nourished young children, especially those with insufficient Vitamin A, or whose immune systems have been weakened by HIV/AIDS or other diseases (WHO, 2005c). Due to high infectivity, measures should be put in place to ensure all children are accessed during routine immunization. A study done in Kenya found out that measles supplemental immunization activity (SIA) improved both coverage and equity, achieving significantly higher coverage across all the provinces. This reduced the gap in immunity between rich and poor households (Vijayaraghavan *et al.*, 2007).

2.5.6 Yellow Fever Vaccine

Yellow fever (YF) is a viral haemorrhagic fever. The virus is the prototype of the family Flaviviridae, which currently contains over 70 viruses, of which most are arthropod-borne, including the dengue viruses. The virus is transmitted when a mosquito bites an infected human and then, after an extrinsic (in the mosquito) incubation period of 12-21 days, bites a susceptible human. Aedes Aegypti breeds readily in all types of domestic and peri-domestic collections of fresh water, including flower vases, water drums, tin cans, broken coconut shells, old tyres and gutters (Vainio *et al*., 1998).

Typically, the disease onset is abrupt, with fever, muscle pain, particularly backache, headache, shivering, loss of appetite, and nausea or vomiting. Congestion of the conjunctivae and face are common, as well as relative bradycardia in the presence of fever. The patient is usually viraemic during this period, which lasts for approximately 3–6 days (Monath, 2005)

Although quantifying the burden of YF disease is made difficult by the wide spectrum of severity, with non-specific symptoms, it is approximated 200,000 cases of yellow fever occur annually; 90% of them occur in Africa (WHO, 1992). A dramatic resurgence of yellow fever has occurred since the 1980s in both sub-Saharan Africa and South America, this resurgence has been associated with relatively low vaccine coverage in areas where outbreaks of the disease occurred, migration of susceptible individuals to forested regions where the disease is transmitted, and increasing urbanization of the disease (Filippis *et al*., 2001).

The vast majority of reported cases and deaths (>90%) occur in sub-Saharan Africa, where YF is a major public health problem occurring in epidemic patterns. In African endemic regions, natural immunity to YF is acquired with age, hence children are at highest risk (Monath, 2005).

There is no evidence to date that specific antiviral or other pharmacological therapies are effective against the YF virus. Preventive measures against YF is through vaccination of population at risk. WHO recommends that all endemic countries should introduce YF vaccine into their routine immunization programs.

2.6 Vitamin A

Vitamin A is a term used for retinoid, biologically active compounds that occur naturally in both plants and animals tissues (Ross, 2007). The two types of vitamin A available in the human diet are;

a) Preformed vitamin A (retinoic acid, retinal and retinol) found in foods from animal sources, including dairy products, fish, and meat (especially liver)
b) Provitamin A carotenoids found in dark green leafy vegetables, fruits, roots and tubers
c) Supplements

Both provitamin A and preformed vitamin A must be metabolized intracellularly to retinal and retinoic acid, the active forms of vitamin A to support Vitamin's important biological functions.

2.6.1 Role of Vitamin A

a) Immunity

Vitamin A is mostly known as anti-infective Vitamin since it's needed for usual function of immune system (Semba *et al*., 2001). Retinol and its metabolites are needed to maintain the integrity of skin and mucosal cells (cells that line the airways, digestive tract, and urinary tract) which functions as barrier and form the body's first line of defence against infection. Lymphocytes and other white blood cells requires Vitamin A and retinoic acid for their development (Semba, 1998).

b) Growth and Development

Vitamin A is also required in reproduction where retinol and retinoic acid are essential for embryonic development (Semba *et al*., 2001). In addition, retinol and retinoic acid have been found to regulate expression of growth hormone.

c) Reduction of Mortality

In areas where nutrients are inadequate, vitamin A supplements are known to reduce child mortality by approximately 30%. In malnourished population, large vitamin A supplements tend to reduce adverse effect of measles infection (Hussey *et al.*, 1990)

d) **Vision**

Vitamin A or retinol is needed in the formation of 11-cis-retinal which later binds to opsin receptors on rods cells to form visual pigment or rhodopsin. Rod cells with rhodopsin can detect very small amount of light making them important for

night vision. Inadequate retinol results in impaired dark adaptation known as night blindness (Ross, 1999). Supplements and fortification of food have been shown to be effective interventions. Supplement treatment for night blindness includes high doses of vitamin A (200,000 IU) in the form of retinyl palmitate to be taken by mouth, which is administered two to four times a year (Sommer *et al.*, 1980)

2.6.2 Vitamin A Supplementation

Vitamin A deficiency (VAD) is one of the three major micronutrients deficiencies in the world especially in developing countries. Severity of infections such as measles and diarrhoeal diseases in children is increased by VAD, it also slows recovery from illness. According to the recent WHO estimates, VAD has moderate to severe public health issues in 122 and 45 Countries in the world and in Africa respectively. Highest burden of VAD occurs in Africa and Asia with Africa contributing to more than one-third of childhood xerophlmia (WHO, 2009b).

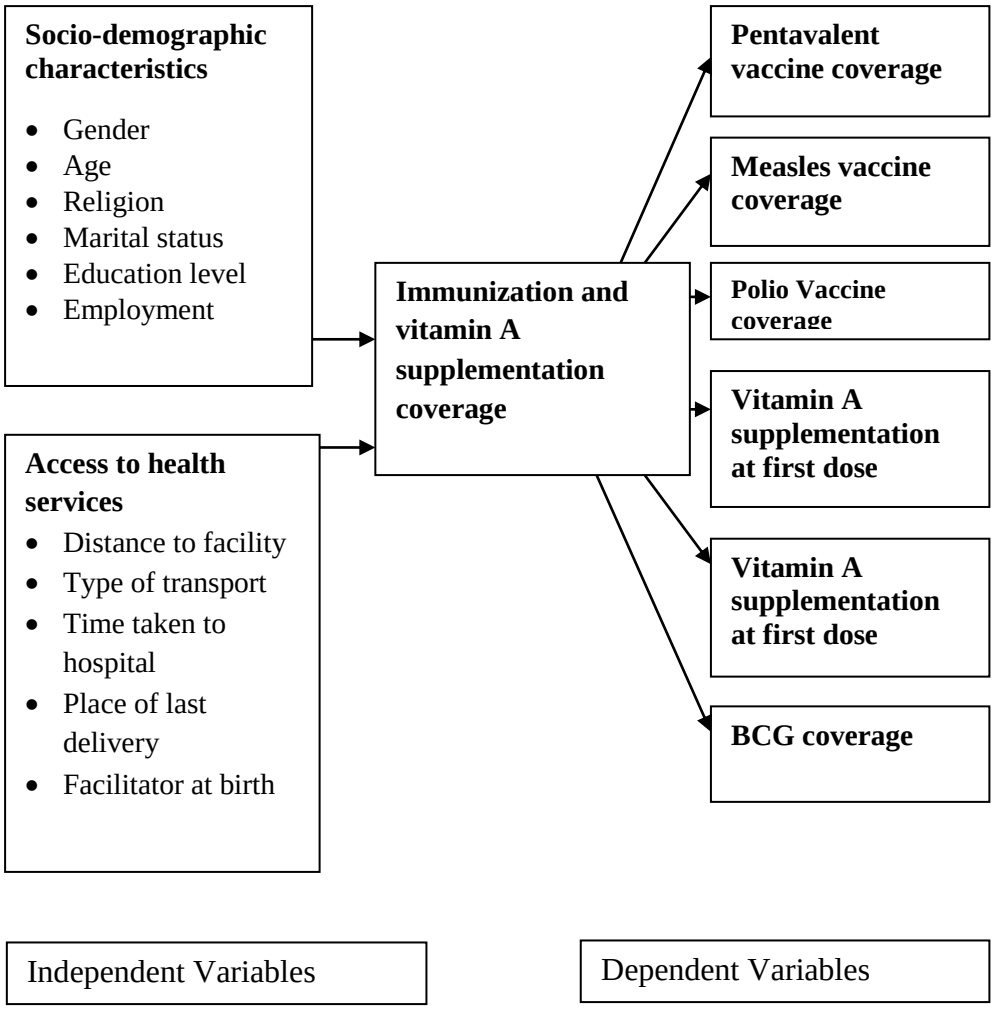
Vitamin A supplementation is recognized as one of the most cost-effective interventions for improving child survival and it is among the key interventions achievable at a large scale and that has proven potential to reduce the number of preventable child deaths each year. It is therefore a prerequisite for achieving MDG 4, particularly in countries with high under-five mortality and/or Vitamin A deficiency rates (WHO, 2009b)

Studies have shown that Vitamin A supplementation in children 6–59 months of age living in developing countries is associated with a reduced risk of all-cause

mortality by 30% and a reduced incidence of diarrhoea. The correction of VAD through supplementation may also improve humoral and cellular immune functions, including increases in B lymphocyte activation, proliferation and production of IgM and specific IgG, improvements in the T cell–helping response and cytokine synthesis, and enhancements in the function of natural killer cells and the monocyte/macrophage lineage ((Fawzi *et al.,* 1993; Semba, 1998; Imdad *et al.*, 2010).

A study conducted in Indonesia reported that high doses Vitamin A supplementation coverage improves linear growth of children with very low serum retinol and the effect is modified by age and breast-feeding. A similar study focusing on VAS and stunting found that receiving vitamin A supplement may be beneficial to growth of young children in Kenya. However, though freely offered through immunization services to children 6-59 months, some children do not receive it, particularly after completing the immunization schedule (Kimani *et al.*, 2013).

According to results from (KDHS 2008-2009), 30% of children below five years were found to have received Vitamin A Supplements six months before the survey. In Coast Province the coverage level was 38.3%. In 2014 the percentage had increased to 72% with Kwale County having 86.6 % VAS coverage (KDHS, 2014). This coverage is above the recommended one which should be 80%. The integration of program delivery with immunization services dramatically improved the situation between 2001 and 2005. Prior to 1998, distribution had been limited to nutritional and maternal and child health clinics. Subsequently, Vitamin A began to be administered through routine and supplementary immunization activities in an increasing number of Countries (WHO/UNICEF, 2007).



2.7 Conceptual framework

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Design

The study was a descriptive cross-sectional study.

3.2 Study Site

Kwale County is located in the South Coast of Kenya. It borders the republic of Tanzania to the South East, and the following Counties; Taita Taveta to the West; Kilifi to the North; Mombasa to the North and Indian Ocean to the North East. Kwale County covers a total surface area of 8,270.2 square kilometres and accounts for 1.42 percent of Kenya's total surface area. Major towns include Ukunda, Msambweni, Kinango and Lunga. The County is populated by Digo and Duruma people who belong to Mijikenda ethnic community of coastal Kenya.

The study was nested in Health Demographic Surveillance System (HDSS) used by Nagasaki University Institute of Tropical Medicine (NUITM) project. This study was conducted at Mwaluphamba Sub-County where DSS has an established relationship with the community.

3.3 Study Population

Study population comprised of (1576) households in Mwaluphamba Sub-County in which mothers or caregivers of children aged 12-23 months were sampled. The participants had to meet the inclusion criteria of being residents and having children aged 12-23 months.

3.3.1 Inclusion Criteria

1. Mothers or caregivers of children aged 12-23 months who lived within Mwaluphamba Sub-County area and who consented to participate in the study.

3.3.2 Exclusion Criteria

1. Mothers or caregivers who had all the inclusion criteria but could not participate in the study due to chronic conditions.
2. Refusal to give informed consent.

3.4 Sampling Procedure and Sample Size Determination

3.4.1 Sample Size Determination

The sample size estimation was determined using fisher formula for cross-sectional designs: (Fisher *et al*., 1998)

$n = \frac{Z^2_{1-\alpha/2} P(1-P)}{d^2}$ X DEFF (Cochran, 1977) Where; n= Minimum required sample size

α= Level of significance (0.05)

$Z_{1-\alpha/2}$= Standard normal deviate at 95% CI (1.96)

P= Coast province full immunization status according to KDHS 2008/2009 (78%)

d=Absolute precision (Margin of error), (0.05)

DEFF=Design effect due to clustering (1.2)

Minimum required sample size was 264. Allowing for 10% non-response, the sample size was adjusted upwards to 290.

Using Fishers exact formula for finite population:

$$\frac{n}{1+\frac{n}{N}}$$

Where: n = 348 (Sample size) N=1576 (Population size)

Minimum Sample size was adjusted to **245**

3.4.2 Sampling Procedure

Study was conducted within the Demographic surveillance system sites established by the KEMRI- Nagasaki University Institute of Tropical Medicine (NUITM) project in Mwaluphamba Sub-County. The surveillance site is divided into enumeration areas/ clusters. The study adopted a two stage sampling method where four clusters within HDSS were randomly sampled. Probability proportionate to size (PPS) sampling method was used to allocate sample size per cluster as illustrated in **Table 3.1** In second stage, simple random sampling method was used to select the households

Table 3.1: Sampling Allocation for the Sample Size

Cluster	**Target population(number of households)**	**Sample population**
Cluster A	520	$\frac{520}{1576} * 245 = 81$
Cluster B	187	$\frac{187}{1576} * 245 = 29$
Cluster C	400	$\frac{400}{1576} * 245 = 62$
Cluster D	469	$\frac{469}{1576} * 245 = 73$

3.5 Data Management and Analysis

3.5.1 Data collection

Before starting the study, five research assistants who involved in collecting routine data for the Kwale HDSS were recruited based on their willingness and availability to assist in data collection. Four research assistant were each allocated a cluster and the remaining one was the team lead. They participated in one day training session run by the principle investigator to familiarize themselves with research procedures and data collection tools. After the training piloting study was done in Shimba Hills are for half a day. The data collections tools were revised accordingly based on the information collected during pilot study feedback.

Data collection was done through administering semi- structured questionnaires to mothers/ care takers of children aged between 12-23months using the pre-tested questionnaire. Care givers from qualifying households gave both verbal and signed consent before proceeding with the study. Data on socio- demographic, socio-economic and child's immunization history was collected. Vaccination card was used to record the most recent date of immunization. Various approaches were used to ensure quality control of the data collection exercise. Firstly, field editing of questionnaires was conducted by the researcher to ensure all errors were checked and corrected. Missing data were retrieved through call backs to the households. Secondly, the researcher and the team lead observed data collection by research assistants in few households per cluster at random to ensure adherence to research procedure and protocol.

The quantitative data from the field was coded and double entered into a computer database designed using MS-Access application. Files Back-up was done regularly to avoid any loss or tampering of data. Data cleaning and validation was performed in order to achieve a clean dataset that was then exported into a Statistical Package format (SPSS) version 20 for analysis. All the questionnaires omitted the participant's identification information as a way of protecting confidentiality; they were also stored in a lockable drawer to limit accessibility.

3.5.2 Data Entry and Analysis

Data was entered using SPSS statistical software. Data cleaning was done where exploratory data analysis techniques were used at the initial stage of analysis to uncover the structure of data and identify outliers or unusual entered values. Descriptive statistics such as frequencies were used to summarize categorical variables. Pearson's Chi-square was used to test for the strength of association between categorical variables. All exposure variables (Independent factors) were associated with the dependent variable (Immunization coverage and VAS Coverage) to determine which ones had significant association. Odds ratio, confidence interval and P-value were used to determine association between variables. Confidence Interval (CI) was set at 95% and was used to estimate the strength of association between independent variables and the dependent variable. The threshold for statistical significance was set at $P<0.05$. Significant risk factors of bivariate analyses ($P<0.05$) were used in multivariable regression models. This technique was used to explore the dependent variables while taking into account the effects of all variables. Potential confounders and effect modifiers were tested using binary logistic regression models on the dependent variables. Adjusted odds ratio (AOR) and 95%CI were used to estimate the strength of association.

3.6 Ethical Consideration

Ethical clearance was sought from relevant authorities. This study was submitted to the scientific steering committee (SSC) and ethical review committee (ERC) of Kenya Medical Research Institute (KEMRI) for approval. Consent was sought from parents/guardians of the children participating in the study. The interview

was confidential. The consent allowed the research team to access the child's clinic card to extract information on clinical background and date of birth. Parents/guardians of the children in the study were explained the purpose of the study and how it will be carried. Finally the parents/guardians were informed on the possible benefits and risks of the study. This form was attached to the consent explanation form which was in Kiswahili (Appendix 1).

CHAPTER FOUR

RESULTS

4.1 Socio- Demographics Characteristics of the Study Participants

A total of 298 children were sampled, with mean age of 16.7 ± 3.6 months ranging between 12 and 23 months. The highest proportion (53.7%; 160) of the children (Figure 4.1) was females. Most respondents were aged 20-29 years

As regard to socio- demographic characteristics of the respondents, majority (88.6%; 264) of the households was headed by their husbands while few (5.0%; 15) households were headed by wives. A high proportion (88.6%; 264) of the respondents were Muslims while a small proportion (11.45; 34) of the respondents were Christians.

Out of the 298 study respondents, majority (82.6%; 246) were married while a small proportion of the respondents were widowed equivalent to divorced/separated.

A high proportion (99.7%; 297) of the study respondents had attended school.

Out of 297 study respondents who had attended school, majority (96.3%; 286) had primary school as the highest education level. A small proportion (0.3%; 1) had technical education as the highest education level. Majority (43.6%; 130) of the respondents reported that they were unemployed/housewives while a small proportion (1.0%; 3) reported that they had a formal employment as presented in (Table 4.1.)

Table 4.1: Socio-demographic/economic Characteristics of the study respondents in Mwaluphamba Sub- County

Variables	N=298	%
Head of household		
Husband	264	88.6
Wife	15	5.0
Other	19	6.4
Age group of mothers/Caregivers		
15-19	37	12.4
20-24	91	30.5
25-29	72	24.2
30-34	54	18.1
35-39	34	11.9
40+	10	3.4
Religion of the participant		
Christian	34	11.4
Muslim	264	88.6
Marital status		
Single	18	6.0
Married	246	82.6
Divorced/Separated	17	5.7
Widowed	17	5.7
Highest level of education		
No formal Education	1	0.3
Primary	286	96.3
Secondary	10	3.4
Tertiary	1	0.3
Type of employment		
Formal employment	3	1.0
Casual	9	3.0
Self employed	44	14.8
Farming	112	37.6
Unemployed/housewives	130	43.6

4.2 Access to Health Services among the study respondents

Access to the health services in the area were assessed and presented in (Table 4.2)

Majority (55%; 164) of the respondents indicated that the distance to the health facility was less than 5km. A small proportion (6%; 18) of the respondents indicated that the distance to the health facility was more than 5km. Walking was the most common mode of transport to the nearest hospital with majority (89.6%; 267) of the respondents reporting that they walked to the nearest hospital.

Analysis on the time taken to the hospital revealed that majority (51.7%; 154) took approximately between 30 minutes to 1hour, (41.6%; 124) took between 1hour to 2 hours, (5%; 15) took more than 2hours and a small proportion (1.7%; 5) revealed that they take less than 30 minutes.

Table 4.2: Access to Health Services among the study respondents in Mwaluphamba Sub- County

Variables	N=298	%
Distance to the Facility		
Less than 5 km	164	55
5 km	116	38.9
More than 5 km	18	6
Type of transport to nearest hospital		
Foot	267	89.6
Bicycle	1	0.3
Matatu	11	3.7
Personal car	1	0.3
Motorbike	18	6
Time taken to the hospital		
Less than 30 minutes	5	1.7
30 minutes -1 hour	154	51.7
1- 2 hrs	124	41.6
more than 2 hrs	15	5
Place of your last delivery		
Health facility	101	33.9
Home	197	66.1
Facilitator		
Health worker	97	32.6
Traditional birth attendant	131	44
Relative	48	16.1
Self	22	7.4

Km=Kilometres, hrs. = Hours

4.3 Vaccination Coverage of the study participants

Vaccination coverage of the children was assessed and presented on (**Table 4.3)**

Out of 298 study respondents, majority (99.7%; 287) indicated that their children had received a Vaccine. A high proportion (99%; 295) indicated that their child had been given BCG vaccine as well as (99.3%; 296) who indicated that their child had received pentavalent vaccine.

A high proportion (98.7%; 294) indicated that their child had received a polio vaccine. Majority (98.7%; 294) indicated that their child had received dose one of polio, (98.0%; 292) received dose two of polio, (89.6%; 267) received dose three of polio and (31.5%; 94) received dose four of polio.

Out of 296 respondents whose child had received pentavalent vaccine, majority (99.3%; 296) revealed that their child had received dose one, (97.7%; 291) dose two and (83.2%; 248) dose three.

Measles vaccine coverage was relatively low compared with other vaccines with only (67.8%; 202) reporting to have immunized their child against measles.

However, majority (99.3%; 296) of the study respondents revealed that their child was immunized during national immunization campaigns.

Table 4.3: Vaccination Coverage of the study participants in Mwaluphamba Sub- County

Variables	N=298	%
Ownership of vaccination card		
Yes(seen)	166	55.7
Yes(not seen)	92	30.9
No	40	13.4
Vaccines received (Any)		
Yes	297	99.7
No	1	0.3
BCG vaccine given		
Yes	295	99
No	3	1
Pentavalent vaccine given		
Yes	296	99.3
No	2	0.7
Number of times pentavalent vaccine was given		
Dose one	296	99.3
Dose Two	291	97.7
Dose Three (Full dose)	248	83.2
Polio vaccine given		
Yes	294	98.7
No	4	1.3
Number of times polio vaccine given		
Dose one	294	98.7
Dose two	292	98
Dose three	267	89.6
Dose four(Full dose)	94	31.5
Measles vaccine		
Yes	202	67.8
No	96	32.2
Immunizations received during national immunization campaigns		
Yes	296	99.3
No	2	0.7

BCG= Bacille Calmette–Guérin

4.4 Bacille Calmette-Guérin Vaccine Coverage in Relation to Socio-Economic/Demographic Characteristics of the study respondents

None of the socio-demographic characteristic was significantly associated with BCG vaccination as shown in (Table 4.4)

Table 4.4: Bacille Calmette-Guérin Vaccine Coverage in Relation to Socio-Economic/Demographic Characteristics of the study respondents in Mwaluphamba Sub- County

	Given BCG Vaccine		Not given BCG Vaccine			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Gender of the child (X^2=2.10, df=1,P=0.999)								
Male	137	99.3	1	0.7	Ref			
Female	158	98.8	2	1.3	0.58	0.05	6.42	0.655
Age group of the participants (X^2=3.28, df= 5, P=0.743)								
15-19	37	100	0	0	NA	NA	NA	0.999
20-24	90	98.9	1	1.1	NA	NA	NA	0.999
25-29	71	98.6	1	1.4	NA	NA	NA	0.999
30-34	54	100	0	0	NA	NA	NA	0.999
35-39	33	97.1	1	2.9	NA	NA	NA	0.999
40+	10	100	0	0	Ref			
Head of household (X^2=7.40,df=2, P=0.843)								
Husband	261	98.9	3	1.1	Ref			
Wife	15	100	0	0	NA	NA	NA	0.999
Other	19	100	0	0	NA	NA	NA	0.999
Marital Status of the respondents (X^2=4.23, df=3 P=0.314)								
Single	18	100	0	0	NA	NA	NA	0.999
Married	2	0.8	244	99.2	7.63	0.66	88.64	0.105
Widow	0	0	17	100	NA	NA	NA	0.999
Divorced	1	5.9	16	94.1	Ref			
Religion of the participant (X^2=0.390, df=1, P=0.999)								
Christian	34	100	0	0	NA	NA	NA	0.999
Muslim	261	98.9	3	1.1	Ref			
School attendance of the respondents (X^2=0.01, df=1,P=0.999)								
No	1	100	0	0	NA	NA	NA	0.999
Yes	294	99	3	1	Ref			
Highest level of education of the respondents (X^2=3.50,df=2, P=0.999)								
Primary	284	99	3	1	Ref			
Secondary	10	100	0	0	NA	NA	NA	0.999
Tertiary	1	100	0	0	NA	NA	NA	0.999

NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval DF=Degrees of Freedom, OR= Odds Ratio, BCG= Bacille Calmette–Guérin

4.5 Bacille Calmette-Guérin Vaccine coverage in relation to access to health services by the study respondents.

Bacille Calmette-Guérin vaccination coverage was not significantly associated with any of access to health services factors as presented in (Table 4.5)

Table 4.5: Bacille Calmette-Guérin Vaccine coverage in relation to access to health services by the study respondents in Mwaluphamba Sub- County.

	Given BCG Vaccine		Not given BCG Vaccine			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Distance to the Facility (X^2=1.26, df=2, P=0.645)								
Less than 5 km	163	99.4	1	0.6	Ref			
5 km	114	98.3	2	1.7	0.35	0.03	3.9	0.393
More than 5 km	18	100	0	0	NA	NA	NA	0.999
Type of transport to nearest hospital (X^2=6.56, df=4, P=0.999)								
Foot	264	98.9	3	1.1	Ref			
Bicycle	1	100	0	0	NA	NA	NA	0.999
Matatu	11	100	0	0	NA	NA	NA	0.999
Personal car	1	100	0	0	NA	NA	NA	0.999
Motorbike	18	100	0	0	NA	NA	NA	0.999
Time taken to the hospital (X^2=5.28,df=3, P=0.189)								
< 30 mins	5	100	0	0	NA	NA	NA	NA
30 Mins-1hour	153	99.4	1	0.6	10.93	0.65	184.32	0.097
1- 2 hrs	123	99.2	1	0.8	8.79	0.52	148.34	0.132
> 2 hrs	14	93.3	1	6.7	Ref			
Place of delivery (X^2=1.56, df=1, P=0.553)								
Health facility	101	100	0	0	NA	NA	NA	0.999
Home	194	98.5	3	1.5	Ref			
Facilitator (X^2=9.54,df=3, P=0.677)								
Health worker	97	100	0	0	NA	NA	NA	0.999
Traditional birth att	131	100	0	0	NA	NA	NA	0.999
Relative	47	97.9	1	2.1	4.7	0.4	54.84	0.217
Self	20	90.9	2	9.1	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, BCG= Bacille Calmette-Guérin, hrs=Hours, OR=Odds Ratio, df=degree of Freedom, hrs.=Hours, KM=Kilometers

4.6 Polio Vaccine Coverage in Relation to Socio-Demographic/Economic Characteristics of the study respondents

There was a statistically significant association between polio vaccination coverage and highest level of education of the respondents (X^2=7.39, P=0.014). There was significantly higher proportion of children receiving polio vaccine among mothers/ care givers who had secondary education (66.7%; 6) as the highest level of education compared to those who had primary education (30.5%; 87) as the highest level of education. Child whose mother had secondary level of education was 4.55 [95% CI = 1.11 – 18.62, P=0.035] times more likely to receive polio compared to the one whose mother had primary education as the highest level of education.

There was also a statistically significant association between polio vaccination coverage and the type of employment of the respondents (X^2=12.22, P=0.013). There was high proportion of children receiving polio vaccine among mothers/ care givers who were self-employed (51.2%; 22) compared to those who were unemployed (25.0%; 32). Child whose mother was self-employed was 3.14 [95% CI = 1.53 – 6.45, P=0.002] times more likely to receive polio vaccine compared to the one whose mother was unemployed as shown in (**Table 4.6**)

Table 4.6: Polio Vaccine Coverage in Relation to Socio-Demographic/Economic Characteristics of the study respondents in Mwaluphamba Sub- County.

	Given Polio Vaccine		Not given Polio Vaccine			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Gender of the child (X^2=0.11,df=1, P=0.738)								
Male	42	30.9	94	69.1	1.09	0.66	1.78	0.738
Female	52	32.7	107	67.3	Ref			
Age group of the participants (X^2=4.16, df=4, P=0.526)								
15-19	7	19.4	29	80.6	0.64	0.22	1.86	0.413
20-24	33	36.7	57	63.3	1.54	0.70	3.40	0.279
25-29	24	33.8	47	66.2	1.36	0.59	3.10	0.462
30-34	18	33.3	36	66.7	1.33	0.55	3.18	0.517
35+	12	27.3	32	72.7	Ref			
Head of household (X^2=0.404,df=2, P=0.817)								
Husband	83	31.8	178	68.2	0.8	0.3	2.1	0.650
Wife	4	26.7	11	73.3	0.62	0.14	2.73	0.530
Other	7	36.8	12	63.2				
Marital Status (X2=7.32, df=3, P=0.602)								
Single	7	38.9	11	61.1	4.77	0.83	27.56	0.072
Married	83	34.2	160	65.8	3.89	0.87	17.42	0.076
Widow	2	11.8	15	88.2	1	0.12	8.06	0.072
Divorced	2	11.8	15	88.2	Ref			
Religion of the participant (X2=2.65, df=1, P=0.103)								
Christian	15	44.1	19	55.9	1.82	0.88	3.76	0.107
Muslim	79	30.3	182	69.7				
School attendance (X^2=2.14,df=1, P=0.143)								
Yes	93	31.6	201	68.4	Ref			
No	1	100	0	0	NA	NA	NA	NA
Highest level of education (X^2=7.39,df=2, P=0.014)								
Primary	87	30.5	198	69.5	Ref			
Secondary	6	66.7	3	33.3	4.55	1.11	18.62	**0.035**
Tertiary	1	100	0	0	NA	NA	NA	NA
Type of employment (X=12.22, df=4, P=0.013)								
Formal	2	66.7	1	33.3	6	0.53	68.4	0.149
Casual	2	22.2	7	77.8	0.86	0.17	4.34	0.852
Self employed	22	51.2	21	48.8	3.14	1.53	6.45	**0.002**
Farming	36	32.1	76	67.9	1.42	0.81	2.5	0.221
Unemployed	32	25	96	75	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, OR=Odds Ratio, DF=Degree of Freedom

4.7 Polio Vaccine Coverage in Relation to Access to Health Services by the study respondents

Four out of five health provision factors were significantly related to Polio immunization coverage as shown in (**Table 4.7)**.

There was a statistically significant association between polio immunization coverage and distance to health facility (X^2=7.31, P=0.026). There was high proportion of children receiving polio vaccine among families that lived less than 5 km from the health facility (38.3%; 62) compared to those who lived more than 5km (16.7%; 3). Children from families that lived less than 5 km from the health facility were 3.10 [95% CI = 1.62– 11.14, P=0.031] times more likely to receive polio vaccine compared to children from families that lived more than 5km from the health facility. Children from families that lived 5 km from the health facility were 1.69 [95% CI = 1.12– 6.24, P=0.042] times likely to receive polio vaccine compared to children from families that lived more than 5km from the health facility.

Time taken to the health facility was significantly associated to polio immunization coverage (X^2=17.30, P<0.001). There was a high proportion of children receiving polio vaccine among families that took 1 hour or less (40.7%; 67) to get to the health facility compared to those who took more than 1 hour to get to the health facility (21.7%; 30). Children from families that

took 1 hour or less to get to health facility were 2.48 [95% CI = 1.48 – 4.15, P<0.001] times likely to receive polio vaccine compared to children from families that took more than 1 hour to get to the health facility.

The association between polio immunization coverage and place of the last delivery was statistically significant (χ^2=79.30, P<0.001). A higher proportion of Polio vaccine coverage was observed among children whose mothers had their last delivery in the health facility (65.3%; 66) compared to those whose mothers had their last delivery at home (14.4%; 28). A child born in a health facility was 11.18 [95% CI = 6.30 – 19.83, P<0.001] times more likely to be receive polio vaccine compared to those who were born at home.

The facilitator during birth was also significantly associated with polio immunization coverage (χ^2=82.59, P<0.001). There was higher proportion of children receiving polio vaccine among mothers whose facilitator at time of delivery was a health worker (67.0%; 65) compared to those who facilitated themselves at time of delivery (9.1%; 2). Children born by mothers who sought health worker at time of delivery as the facilitator were 20.31 [95% CI = 4.47 – 92.31, P<0.001] times more likely to receive polio vaccine compared to children born by mothers who facilitated themselves.

Table 4.7: Polio Vaccine Coverage in Relation to Access to Health Services by the study respondents in Mwaluphamba Sub- County

	Given Polio Vaccine		Not given Polio Vaccine			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Distance to the Facility (X^2=7.31, df=2, P=0.026)								
Less than 5 km	62	38.3	100	61.7	3.1	1.62	11.14	**0.031**
5 km	29	25.2	86	74.8	1.69	1.12	6.24	**0.042**
More than 5 km	3	16.7	15	83.3	Ref			
Type of transport to nearest hospital (X^2=5.42,df=4, P=0.226)								
Foot	82	31.1	182	68.9	1.17	0.4	3.39	0.771
Bicycle	0	0	1	100	NA	NA	NA	NA
Matatu	6	54.5	5	45.5	3.12	0.65	15.03	0.156
Personal car	1	100	0	0	NA	NA	NA	NA
Motorbike	5	27.8	13	72.2	Ref			
Time taken to the hospital (X^2=17.30,df=1, P<0.001)								
1 hour or less	64	40.7	93	59.3	2.48	1.48	4.15	**<0.001**
more than 1 hour	30	21.7	108	78.3	Ref			
Place of last delivery (X^2=79.30, df=1,P<0.001)								
Health facility	66	65.3	35	34.7	11.18	6.3	19.83	**<0.001**
Home	28	14.4	166	85.6	Ref			
Facilitator (X^2=82.59, df=3, P<0.001)								
Health worker	65	67	32	33	20.31	4.47	92.31	**<0.001**
Traditional birth attendant	20	15.6	108	84.4	1.85	0.4	8.55	0.430
Relative	7	14.6	41	85.4	1.71	0.32	8.98	0.528
Self	2	9.1	20	90.9	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, OR=Odds Ratio, DM=Degrees of Freedom, KM=Kilometers

4.8 Predictors of Polio Vaccination Coverage among Children Aged between 12 to 23 Months in Mwaluphamba Sub- County, Kwale County

Binary logistic regression was used to identify variables predictive of full polio vaccine intake. Six factors associated to full polio vaccine intake (P<0.05) in bivariate analysis were considered for multivariable analysis. Four successive iterations were performed using backward conditional method retaining two factors as presented in (**Table 4.8)**

Adjusting for other factors, there was a significant association between full polio vaccine intake and distance to the health facility. Children from families that lived less than 5km from the health facility were 4.84 [95% CI: 1.15 – 20.27, P=0.031] times more likely to receive full polio vaccine dosage compared children from families that live more than 5km from the health facility.

The facilitator at time of delivery was also significantly associated with full polio vaccine intake. A child whose facilitator at time of delivery was health worker was 20.69[95% CI: 4.50 – 95.15, P<0.001] times more likely to receive full polio vaccine dosage compared to one born by woman who facilitated herself at time delivery.

Table 4.8: Predictors of Polio Vaccination Coverage among Children Aged between 12 to 23 Months in Mwaluphamba Sub-County, Kwale County

		95% C.I		
Indicator	**AOR**	**Lower**	**Upper**	**P-Value**
Distance to the health facility				
Less than 5 km	4.84	1.15	20.27	**0.031**
5 km	2.86	0.66	12.38	0.160
More than 5 km	Ref			
Facilitator				
Health worker	20.69	4.50	95.15	**<0.001**
Traditional birth attendant	1.79	0.39	8.36	0.456
Relative	1.68	0.32	8.90	0.545
Self	Ref			

AOR= Adjusted Odds Ratio, CI= Confidence Interval, P-Value = Probability value, KM=Kilometers

4.9 Pentavalent Vaccine Coverage in Relation to Socio-Demographic/Economic Characteristics of the study respondents

One out of eight socio demographic/economic characteristics of the respondents was significantly associated with pentavalent vaccination coverage as presented in (**Table 4.9**)

There was a statistically significant association between pentavalent vaccination coverage and gender of the child (X^2=4.60, P=0.032). A higher proportion of female children (88.1%; 140) received full dose of pentavalent vaccine compared to male children (78.8%; 108). A female child was 1.98 [95% CI = 1.05 – 3.72, P=0.034] times more likely to receive full dose of pentavalent compared to a male child.

Table 4.9: Pentavalent Vaccine Coverage in Relation to Socio Demographic/Economic Characteristics of the study respondents in Mwaluphamba Sub- County

	Given full dose of pentavalent					95% CI		
	Yes		No					
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Gender of the child (X^2=4.60, df=1,P=0.032)								
Female	140	88.1	19	11.9	1.98	1.05	3.72	**0.034**
Male	108	78.8	29	21.2	Ref			
Age group of the participants (X^2=2.89, df=4,P=0.718)								
15-19	29	80.6	7	19.4	1.22	0.41	3.61	0.721
20-24	75	83.3	15	16.7	1.47	0.59	3.61	0.398
25-29	63	87.5	9	12.5	2.05	0.76	5.55	0.148
30-34	47	87	7	13	1.97	0.68	5.71	0.204
35+	34	77.3	10	22.7	Ref			
Head of household (X^2=0.10, df=2,P=0.999)								
Husband	219	83.6	43	16.4	0.95	0.27	3.42	0.944
Wife	13	86.7	2	13.3	1.22	0.18	8.42	0.841
Other	16	84.2	3	15.8	Ref			
Marital Status (X^2=4.23, df=3,P=0.221)								
Single	17	94.4	1	5.6	7.08	0.73	68.61	0.091
Married	206	84.4	38	15.6	2.26	0.75	6.78	0.146
Divorced	13	76.5	4	23.5	1.35	0.29	6.26	0.698
Widow/Widower	12	70.6	5	29.4	Ref			
Religion of the participant (X^2=0.064, df=1, P=0.800)								
Christian	29	85.3	5	14.7	1.14	0.42	3.11	0.800
Muslim	219	83.6	43	16.4	Ref			
School attendance (X^2=0.19,df=1, P=0.659)								
No	1	100	0	0	NA	NA	NA	NA
Yes	247	83.7	48	16.3	Ref			
Highest level of education (X^2=1.63,df=2, P=0.477)								
Primary	240	84.2	45	15.8	Ref			
Secondary	7	70	3	30	0.44	0.11	1.76	0.244
Tertiary	1	100	0	0	NA	NA	NA	NA
Type of employment (X=0.51, df=4,P=0.476)								
Formal	2	66.7	1	33.3	0.51	0.04	5.84	0.588
Casual	7	77.8	2	22.2	0.89	0.17	4.55	0.891
Self employed	41	93.2	3	6.8	3.48	1	12.15	0.050
Farming	96	85.7	16	14.3	1.53	0.77	3.03	0.222
Unemployed	102	79.7	26	20.3	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, OR= Odds Ratio, DF=Degrees of Freedom

4.10 Pentavalent Vaccine Coverage in Association with Access to Health Services by mothers/ care givers

Three out of five health provision factors were significantly related to full dose of pentavalent vaccine coverage as shown in (**Table 4.10)**

Association between pentavalent vaccine immunization coverage and place of the last delivery was also statistically significant (χ^2=4.50, P=0.034). A Higher proportion of pentavalent vaccine immunization was observed among children whose mothers had their last delivery in the health facility (90.1%; 91) compared to those whose mothers had their last delivery at home (80.5%; 157). A child born in a health facility was 2.20 [95% CI = 1.05 – 4.63, P=0.034] times more likely to receive full dose of pentavalent vaccine immunization compared to those who were born at home.

The facilitator during birth was also significantly associated with pentavalent vaccine immunization coverage (χ^2=11.08, P=0.011). There was a higher proportion of children receiving pentavalent vaccine among mothers whose facilitator at time of delivery was a health worker (92.8%; 90) compared to those who facilitated themselves at time of delivery (90.9%; 20). Children born by mothers who sought health worker at time of delivery as the facilitator were 2.19 [95% CI = 1.25– 6.66, P=0.017] times more likely to receive pentavalent vaccine compared to children born by mothers who facilitated themselves.

Further, there was also a significant association between full dose of pentavalent vaccine immunization coverage and time taken to the health facility (χ^2=7.14, P=0.007). A higher proportion of complete dose of pentavalent vaccine

immunization was observed among children whose mothers took less than 1 hour to get to the health facility (89.2%; 140) compared to those whose mothers took more than 1 hour to get to the health facility (77.7%; 108). A child born by a mother who took less than 1hour to get to the health facility was 2.36 [95% CI = 1.24 – 4.49, P=0.007] times more likely to receive complete dose of pentavalent vaccine immunization compared to those who took more than hour to get to the health facility.

Table 4.10: Pentavalent Vaccine Coverage in Association with Access to Health Services by the study respondents in Mwaluphamba Sub- County

	Given full dose of pentavalent					95% CI		
	Yes		No					
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Distance to the Facility (X^2=7.08, df=2, P=0.032)								
< 5 km	144	88.9	18	11.1	2.29	0.63	7.7	0.243
5 km	90	77.6	26	22.4	0.99	0.3	3.26	0.164
> 5 km	14	77.8	4	22.2	Ref			
Type of transport to nearest hospital (X^2=4.73,df=4, P=0.404)								
Foot	222	83.8	43	16.2	1.03	0.29	3.72	0.961
Bicycle	0	0	1	100	NA	NA	NA	0.999
Matatu	10	90.9	1	9.1	2	0.18	22.06	0.571
Personal car	1	100	0	0	NA	NA	NA	NA
Motorbike	15	83.3	3	16.7	Ref			
Time taken to the hospital (X^2=7.14, df=1, P=0.061)								
<1 hour	140	89.2	17	10.8	2.36	1.24	4.49	**0.007**
>1hour	108	77.7	31	22.3	Ref			
Place of last delivery (X^2=4.50, df=1, P=0.034)								
Health facility	91	90.1	10	9.9	2.2	1.05	4.63	**0.034**
Home	157	80.5	38	19.5	Ref			
Facilitator (X^2=11.08, df=3 P=0.011)								
Health worker	90	92.8	7	7.2	2.19	1.25	6.66	**0.017**
Traditional birth attendant	100	77.5	29	22.5	0.34	0.08	1.56	0.167
Relative	38	79.2	10	20.8	0.38	0.08	1.9	0.239
Self	20	90.9	2	9.1	Ref			

NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, OR=Odds Ratio, KM=Kilometers

Two successive iterations were performed using backward conditional method retaining three factors shown in **(Table 4.11)**

Adjusting for other factors, there was a significant association between full dose of pentavalent vaccine and gender of the children. Female children were 2.09 [95% CI: 1.07 –4.07, P=0.030] times more likely to receive full dose of pentavalent vaccine compared to male children.

The place of delivery was significantly associated with full dose of pentavalent vaccine. A child born at the health facility was 10.62[95% CI: 1.03 – 109.26, P=0.047] times more likely to receive full dose of pentavalent vaccine compared to one born at home.

A child born in a household that takes less than 1 hour to get to the health facility was 2.38[95% CI: 1.20 – 4.72, P=0.013] times more likely to receive full dose of pentavalent vaccine compared to one born from a family that takes more than 1hour.

Table 4.11: Predictors of Full Pentavalent Vaccination Coverage among Children Aged between 12 to 23 Months in Mwaluphamba Sub-County, Kwale County

		95% C.I		
Indicator	**AOR**	**Lower**	**Upper**	**P-Value**
Gender				
Female	2.09	1.07	4.07	**0.030**
Male	Ref			
Place of delivery				
Health facility	10.62	1.03	109.26	**0.047**
Home	Ref			
Time taken to the health facility				
<1hour	2.38	1.20	4.72	**0.013**
1 hour or more	Ref			

AOR= Adjusted Odds Ratio, CI= Confidence Interval, P-Value = Probability value

On assessing Measles vaccination coverage, there was no statistically significantly relationship with the assessed socio demographic/ socio-economic characteristics (Table 4.12)

Table 4.12: Measles Vaccine Coverage in Relation to Socio Demographic/Economic Characteristics of the Respondents in Mwaluphamba Sub- County

	Given measles Vaccine		Not given measles Vaccine			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Gender of the child (X^2=0.18, df=1, P=0.892)								
Female	109	68.1	51	31.9	1.03	0.64	1.68	0.892
Male	93	67.4	45	32.6	Ref			
Age group of the participants (X^2=10.33,df=4, P=0.066)								
15-19	24	64.9	13	35.1	Ref			
20-24	53	58.2	38	41.8	0.76	0.34	1.67	0.488
25-29	51	70.8	21	29.2	1.32	0.57	3.06	0.525
30-34	38	70.4	16	29.6	1.29	0.53	3.14	0.580
35+	36	81.8	8	18.2	2.44	0.88	6.77	0.080
Head of household (X^2=0.12, df=2, P=0.994)								
Husband	179	67.8	85	32.2	0.97	0.36	2.65	0.956
Wife	10	66.7	5	33.3	0.92	0.22	3.92	0.914
Other	13	68.4	6	31.6	Ref			
Marital Status (X^2=2.82,df=3, P=0.420)								
Single	5	27.8	13	72.2	0.8	0.17	3.67	0.774
Married	84	34.1	162	65.9	0.59	0.19	1.88	0.374
Widow	3	17.6	14	82.4	1.44	0.27	7.68	0.672
Divorced	4	23.5	13	76.5	Ref			
Religion of the participant (X^2=0.58,df=1, P=0.446)								
Christian	25	73.5	9	26.5	1.37	0.61	3.05	0.448
Muslim	177	67	87	33	Ref			
School attendance (X^2=2.11,df=1, P=0.146)								
No	0	0	1	100	NA	NA	NA	NA
Yes	202	68	95	32	Ref			
Highest level of education (X^2=1.19, df=2,P=0.667)								
Primary	193	67.2	94	32.8	Ref			
Secondary	8	80	2	20	1.95	0.41	9.35	0.405
Tertiary	1	100	0	0	NA	NA	NA	NA
Household radio ownership (X=2.38, df=1,P=0.669)								
No	116	69.9	50	30.1	1.24	0.76	2.02	0.386
Yes	86	65.2	46	34.8				
Type of employment (X=0.75,df=4, P=0.386)								
Formal	3	100	0	0	NA	NA	NA	NA
Casual	5	55.6	4	44.4	0.64	0.16	2.5	0.521
Self employed	30	68.2	14	31.8	1.1	0.53	2.28	0.805
Farming	78	69.6	34	30.4	1.17	0.68	2.02	0.563
Unemployed	86	66.2	44	33.8	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval DF=Degrees of Freedom, OR=Odds Ratio

Two out of five access to health factors presented in table **4.13** were significantly related to measles vaccine coverage at P<0.05.

The association between measles vaccine immunization coverage and place of the last delivery was statistically significant (χ^2=7.61, P=0.006). A higher proportion of measles vaccine immunization was observed among children whose mothers had their last delivery in the health facility (78.2%; 79) compared to those whose mothers had their last delivery at home (62.4%; 123). A child born in a health facility was 2.16 [95% CI = 1.24 – 3.76, P=0.006] times more likely to receive measles vaccine immunization compared to those who were born at home.

The facilitator during birth was also significantly associated with measles vaccine immunization coverage (χ^2=16.90, P<0.001). There was a higher proportion of children receiving measles vaccine among mothers whose facilitator during the time of delivery was a health worker (78.4%; 76) compared to those who facilitated themselves at time of delivery (45.5%; 10). Children born by mothers who sought health worker at time of delivery as the facilitator were 4.34 [95% CI = 1.65– 11.44, P=0.003] times more likely to receive measles vaccine compared to children born by mothers who facilitated themselves. Children born by mothers who sought help of a relative during the time of delivery as the facilitator were 4.56 [95% CI = 1.53– 13.57, P=0.006] times more likely to receive measles vaccine compared to children born by mothers who facilitated themselves.

Table 4.13: Measles Vaccination coverage in Relation to Access to Health Services in Mwaluphamba Sub- County

	Given Measles Vaccine		Not given Measles Vaccine			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Distance to the Facility (X^2=0.96, df=2, P=0.619)								
Less than 5 km	109	66.5	55	33.5	0.57	0.18	1.8	0.336
5 km	79	68.1	37	31.9	0.61	0.19	1.98	0.411
More than 5 km	14	77.8	4	22.2	Ref			
Type of transport to nearest hospital (X^2=4.85, df=4, P=0.291)								
Foot	176	65.9	91	34.1	0.55	0.18	1.73	0.308
Bicycle	1	100	0	0	NA	NA	NA	NA
Matatu	10	90.9	1	9.1	2.86	0.28	29.56	0.379
Personal car	1	100	0	0	NA	NA	NA	NA
Motorbike	14	77.8	4	22.2	Ref			
Time taken to the hospital (X^2=2.25, df=1, P=0.542)								
<1 hour	108	67.9	51	32.1	1.01	0.62	1.65	0.956
>1hour	94	67.6	45	32.4	Ref			
Place of last delivery (X^2=7.61, df=1, P=0.006)								
Health facility	79	78.2	22	21.8	2.16	1.24	3.76	**0.006**
Home	123	62.4	74	37.6	Ref			
Facilitator (X^2=16.90,df=3, P<0.001)								
Health worker	76	78.4	21	21.6	4.34	1.65	11.44	**0.003**
Traditional birth attendant	78	59.5	53	40.5	1.77	0.71	4.38	0.22
Relative	38	79.2	10	20.8	4.56	1.53	13.57	**0.006**
Self	10	45.5	12	54.5	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, DF=Degrees of Freedom, OR=Odds Ratio, KM=Kilometers

4.11 Predictor of measles vaccine intake among children aged between 12 to 23 months

Binary logistic regression was used to identify variables predictive of measles vaccine intake. Two factors associated to measles vaccine intake at P<0.05 in bivariate analysis were considered for multivariable analysis. Two successive iterations were performed using backward conditional method retaining one factor shown in (**Table 4.14)**

Adjusting for other factors, there was a significant association between measles vaccine intake and place of delivery. Children born at the health facility were 2.16 [95% CI: 1.24 – 3.76 P=0.006] times more likely to receive measles vaccine compared to those born at home.

Table 4.14: Predictor of measles vaccine intake among children aged between 12 to 23 months in Mwaluphamba Sub-County, Kwale County

		95% C.I		
Indicator	**AOR**	**Lower**	**Upper**	**P-Value**
Place of delivery				
Health facility	2.16	1.24	3.76	**0.006**
Home	Ref			

AOR= Adjusted Odds Ratio, CI= Confidence Interval, P-Value = Probability value

On assessing VAS doses received, this study reported that majority of children received first dose (45%; 134) of VAS compared to second dose (29.5%; 88) of VAS.

4.12 First Dose Vitamin A Supplementation Coverage in Relation to Socio-Demographic/Economic Characteristics of the study respondents in Mwaluphamba Sub- County

Two out of nine factors on socio demographic/economic characteristics of the respondents was significantly associated with Vitamin A supplementation at first dose as presented in **(Table 4.15)**

Gender of the child was significantly associated with Vitamin A supplementation at first dose (X^2=4.47, P<0.034). There was a higher proportion of female children receiving Vitamin A supplementation at first dose (50.6%; 81) compared to male children (38.4%; 53). Female children were 1.64 [95% CI = 1.04 – 2.61, P=0.034] times more likely to receive vitamin A supplementation compared to male children.

There was also a statistically significant association between Vitamin A supplement at first dose and the religion of the respondent (X^2=6.04, P=0.014). There was high proportion of children receiving Vitamin A supplement at first dose among families whose religion was Christian (64.7%; 22) compared to those whose religion was Muslim (42.7%; 112). Children born in families whose religion was Christian were 2.49 [95% CI = 1.18 – 5.24, P=0.014] times more likely to receive Vitamin A supplement at first dose compared to the ones whose religion was Muslim.

Table 4.15: First Dose Vitamin A Supplementation Coverage in Relation to Socio-Demographic/Economic Characteristics of the study respondents in Mwaluphamba Sub- County

	Yes		No			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Gender of the child(χ^2=4.47, df=1, P=0.034)								
Female	81	50.6	79	49.4	1.64	1.04	2.61	**0.034**
Male	53	38.4	85	61.6	Ref			
Age group of the participants (χ^2=5.34, df=4, P=0.376)								
15-19	13	35.1	24	64.9	0.41	0.16	1.01	0.051
20-24	39	42.9	52	57.1	0.57	0.27	1.18	0.127
25-29	31	43.1	41	56.9	0.57	0.26	1.22	0.150
30-34	26	48.1	28	51.9	0.71	0.31	1.57	0.393
35+	25	56.8	19	43.2	Ref			
Head of household (χ^2=3.10,df=2, P=0.205)								
Husband	115	43.6	149	56.4	0.86	0.34	2.18	0.747
Wife	10	66.7	5	33.3	2.22	0.55	9.02	0.264
Other	9	47.4	10	52.6	Ref			
Religion of the participant (χ^2=6.04, df=1, P=0.014)								
Christian	22	64.7	12	35.3	2.49	1.18	5.24	**0.014**
Muslim	112	42.4	152	57.6	Ref			
Marital status (χ^2=4.04, df=3, P=0.257)								
Single	10	55.6	8	44.4	0.68	0.17	2.66	0.581
Married	141	57.3	105	42.7	0.41	0.15	1.13	0.085
Divorced	9	52.9	8	47.1	0.48	0.12	1.92	0.303
Widowed	6	35.3	11	64.7	Ref			
School attendance (χ^2=0.820, df=1, P=0.365)								
No		0	1	100	NA	NA	NA	0.999
Yes		45.1	163	54.9	Ref			
Highest level of education (χ^2=2.19, df=2, P=0.262)								
Primary	127	44.3	160	55.7	Ref			
Secondary	6	60	4	40	1.89	0.522	6.841	0.332
Tertiary	1	100	0	0	NA	NA	NA	NA
Type of employment (χ^2=5,df=4, P=0.290)								
Formal	3	100	0	0	NA	NA	NA	NA
Casual	3	33.3	6	66.7	0.68	0.16	2.85	0.599
Self employed	22	50	22	50	1.36	0.69	2.71	0.375
Farming	51	45.5	61	54.5	1.14	0.69	1.90	0.614
Unemployed	55	42.3	75	57.7	Ref			
Household radio ownership (χ^2=0.02, df=1, P=0.880)								
No	74	44.6	92	55.4	0.97	0.61	1.53	0.880
Yes	60	45.5	72	54.5	Ref			

NA-Not Applicable NA-Not Applicable, χ^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval OR=Odds Ratio, DF=Degrees of Freedom

4.13 First dose Vitamin A Supplementation Coverage in Relation to Access to Health Services by the study respondents

Two out of five health access factors were significantly associated with Vitamin A supplementation coverage at first dose as shown in (**Table 4.16**)

Association between Vitamin A supplementation coverage at first dose and place of the last delivery was statistically significant (χ^2=14.69, P<0.001). A higher proportion of children receiving Vitamin A supplementation was observed among children whose mothers had their last delivery in the health facility (60.4%; 61) compared to those whose mothers had their last delivery at home (37.1%; 73). A child born in a health facility was 2.59 [95% CI = 1.58 – 4.24, P<0.001] times more likely to receive Vitamin A supplementation coverage at first dose compared to those who were born at home.

The facilitator during birth was also significantly associated with Vitamin A supplementation coverage at first dose (χ^2=21.01, P<0.001). There was a higher proportion of children receiving Vitamin A supplementation among mothers whose facilitator at time of delivery was a health worker (61.9%; 60) compared to those who facilitated themselves at time of delivery (31.8%; 7). Children born by mothers who were facilitated by a health worker were 3.47 [95% CI = 1.3 – 9.32, P=0.013] times more likely to receive Vitamin A supplementation coverage at first dose compared to children born by mothers who facilitated themselves.

Table 4.16: First dose Vitamin A Supplementation Coverage in Relation to Access to Health Services by the study respondents in Mwaluphamba Sub-County.

	Yes		No			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Distance to the Facility (X^2=1.29, df=2, P=0.524)								
Less than 5 km	77	47	87	53	1.77	0.63	4.94	0.276
5 km	51	44	65	56	1.57	0.55	4.47	0.399
More than 5 km	6	33.3	12	66.7	Ref			
Type of transport to nearest hospital (X^2=2.38, df=4, P=0.665)								
Foot	121	45.3	146	54.7	1.04	0.4	2.71	0.943
Bicycle	0	0	1	100	NA	NA	NA	NA
Matatu	4	36.4	7	63.6	0.71	0.15	3.33	0.669
Personal car	1	100	0	0	NA	NA	NA	NA
Motorbike	8	44.4	10	55.6	Ref			
Time taken to the hospital (X^2=3.28, df=1 P=0.349)								
<=1 hour	76	47.8	83	52.2	1.27	0.80	2.02	0.293
>1 hour	58	41.7	81	58.3	Ref			
Place of last delivery (X^2=14.69, df=1, P<0.001)								
Health facility	61	60.4	40	39.6	2.59	1.58	4.24	**<0.001**
Home	73	37.1	124	62.9	Ref			
Type of delivery assistant (X^2=21.01,df=3, P<0.001)								
Health worker	60	61.9	37	38.1	3.47	1.3	9.32	**0.013**
Traditional birth attendant	43	32.8	88	67.2	1.05	0.4	2.76	0.926
Relative	24	50	24	50	2.14	0.74	6.19	0.159
Self	7	31.8	15	68.2	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval OR=Odds Ratio, DF=Degrees of Freedom, KM=Kilometers

Binary logistic regression was used to identify variables predictive of intake of Vitamin A supplementation at first dose. Four factors associated to Vitamin A supplementation at first dose (P<0.05) in bivariate analysis were considered for multivariable analysis. Four successive iterations were performed using backward conditional method retaining two factors shown in **(Table 4.17).**

Adjusting for other factors, there was a significant association between Vitamin A supplementation at first dose and religion. Children born by Christian mothers were 2.19 [95% CI: 1.01 – 4.76, P=0.047] times more likely to receive Vitamin A supplementation at first dose compared to children born by Muslim mothers.

The facilitator was significantly associated with Vitamin A supplementation at first dose. Children whose mothers were facilitated by health worker at time of delivery were 3.31[95% CI: 1.21 – 9.01, P=0.019] times more likely to receive Vitamin A supplementation at first dose compared to children born by mothers who facilitated themselves.

Table 4.17: Predictors of Vitamin A Supplementation Coverage at First Dose among Children Aged Between 12 To 23 Months in Mwaluphamba Sub-County.

		95% C.I		
Indicator	**AOR**	**Lower**	**Upper**	**P-Value**
Religion				
Christian	2.19	1.01	4.76	**0.047**
Muslim	Ref			
Facilitator during birth				
Health worker	3.31	1.21	9.01	**0.019**
Traditional birth attendant	1.04	0.39	2.79	0.935
Relative	2.16	0.74	6.35	0.160
Self	Ref			

AOR= Adjusted Odds Ratio, CI= Confidence Interval, P-Value = Probability value

One out of nine factors on socio demographic characteristics of the respondents was significantly associated with Vitamin A supplementation at second dose as shown in (Table 4.18).

There was a statistically significant association between Vitamin A supplement at second dose and the age of the respondent (χ^2=9.04, P=0.010). There was a higher proportion of children receiving Vitamin A supplement at second dose among mothers/ care givers whose ages were 40 and above (60%; 4) compared to those whose mothers/ care givers aged between 15-19 years (16%; 6). Children born by mothers who were aged 40 years and above were 7.75 [95% CI = 1.67 – 36.07, P=0.009] times more likely to receive Vitamin A supplementation at second dose compared to the ones whose mothers aged between 15-19 years.

Table 4.18: Vitamin A Supplementation Coverage for Second Dose in Relation to Socio-Demographic Characteristics of the study respondents in Mwaluphamba Sub- County.

	Yes		No			95% CI		
Variables	n	%	n	%	OR	Lower	Upper	P-Value
Gender of the child(X^2=2.95, df=1, P=0.087)								
Male	54	33.8	106	66.3	1.56	0.94	2.59	0.087
Female	34	24.6	104	75.4	Ref			
Age group of the participants (X^2=9.04, df=5, P=0.010)								
15-19	6	16.2	31	83.8	Ref			
20-24	24	26.4	67	73.6	1.85	0.69	4.98	0.223
25-29	22	30.6	50	69.4	2.27	0.83	6.23	0.11
30-34	19	35.2	35	64.8	2.8	0.99	7.91	0.051
35-39	11	32.4	23	67.6	2.47	0.8	7.66	0.117
40+	6	60	4	40	7.75	1.67	36.07	**0.009**
Head of household (X^2=1.95, df=2, P=0.377)								
Husband	81	30.7	183	69.3	2.36	0.67	8.33	0.396
Wife	4	26.7	11	73.3	1.94	0.36	10.43	0.182
Other	3	15.8	16	84.2	Ref			
Religion of the participant (X^2=2.50, df=1, P=0.114)								
Christian	14	41.2	20	58.8	1.8	0.86	3.74	0.144
Muslim	74	28	190	72	Ref			
Marital status (X^2=1.48, df=3, P=0.685)								
Single	5	27.8	13	72.2	1.79	0.36	9.05	0.479
Married	74	30.1	172	69.9	2.01	0.56	7.19	0.284
Divorced	6	35.3	11	64.7	2.55	0.52	12.55	0.251
Widowed	3	17.6	14	82.4	Ref			
School attendance (X^2=0.42, df=1, P=0.999)								
No	0	0	1	100	NA	NA	NA	NA
Yes	88	29.6	209	70.4	Ref			
Highest level of education (X^2=4.25,df=2, P=0.096)								
Primary	82	28.6	205	71.4	Ref			
Secondary	5	50	5	50	2.5	0.71	8.86	0.156
Tertiary	1	100	0	0	NA	NA	NA	NA
Type of employment (X^2=10.25, df=4, P=0.052)								
Formal	3	100	0	0	NA	NA	NA	NA
Casual	2	22.2	7	77.8	0.69	0.14	3.48	0.655
Self employed	17	38.6	27	61.4	1.52	0.75	3.12	0.248
Farming	28	25	84	75	0.81	0.46	1.43	0.462
Unemployed	38	29.2	92	70.8	Ref			
Household radio ownership (X^2=0.06, df=1, P=0.802)								
No	50	30.1	116	69.9	1.07	0.65	1.76	0.802
Yes	38	28.8	94	71.2	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, OR=Odds Ratio, DF=Degrees of Freedom

Two out of five access to health factors were significantly related to Vitamin A supplementation coverage at second dose (Table 4.19)

The association between Vitamin A supplementation coverage at second dose and place of the last delivery was statistically significant (χ^2=10.67, P<0.001). A higher proportion of children receiving vitamin A supplementation at second dose was observed among children whose mothers had their last delivery in the health facility (41.6%; 42) compared to those whose mothers had their last delivery at home (23.4%; 46). A child born in a health facility was 2.34[95% CI = 1.40 – 3.91, P=0.001] times more likely to receive Vitamin A supplementation coverage at second dose compared to those who were born at home.

The facilitator during birth was significantly associated with Vitamin A supplementation coverage at second dose (χ^2=14.38, P<0.002). There was a higher proportion of children receiving Vitamin A supplementation among mothers whose facilitator at time of delivery was a health worker (43.3%; 42) compared to those who facilitated themselves at time of delivery (18.2%; 4). Children born by mothers who sought health worker at time of delivery as the facilitator were 3.44 [95% CI = 1.08 – 10.91, P=0.036] times more likely to receive Vitamin A supplementation coverage at second dose compared to children born by mothers who facilitated themselves.

Table 4.19: Vitamin A supplementation Coverage for Second Dose in Relation to Access to Health Services among the study respondents in Mwaluphamba Sub-County.

	Yes		No			95% CI		
Variables	**n**	**%**	**n**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Distance to the Facility (X^2=4.63, df=2, P=0.098)								
Less than 5 km	55	33.5	109	66.5	4.04	0.9	18.19	0.069
5 km	31	26.7	85	73.3	2.92	0.63	13.43	0.169
> 5 km	2	11.1	16	88.9	Ref			
Type of transport to nearest hospital (X^2=5.65,df=4, P=0.226)								
Foot	82	30.7	185	69.3	1.55	0.5	4.86	0.451
Bicycle	0	0	1	100	NA	NA	NA	NA
Matatu	1	9.1	10	90.9	0.35	0.03	3.62	0.379
Personal car	1	100	0	0	NA	NA	NA	NA
Motorbike	4	22.2	14	77.8	Ref			
Time taken to the hospital (X^2=3.05, df=1, P=0.360)								
<1 hour	52	32.7	107	67.3	1.39	0.84	2.30	0.198
1 hour or more	36	25.9	103	74.1				
Place of last delivery during birth (X^2=10.67,df=1, P=0.001)								
Health facility	42	41.6	59	58.4	2.34	1.4	3.91	**0.001**
Home	46	23.4	151	76.6	Ref			
Type of delivery assistant (X^2=14.38, df=3, P=0.002)								
Health worker	42	43.3	55	56.7	3.44	1.08	10.91	**0.036**
Traditional birth attendant	28	21.4	103	78.6	1.22	0.38	3.91	0.734
Relative	14	29.2	34	70.8	1.85	0.53	6.46	0.390
Self	4	18.2	18	81.8	Ref			

NA-Not Applicable NA-Not Applicable, X^2=Chi-Square value, P-Value = Probability value, CI= Confidence Interval, OR= Odds Ratio, DF=Degrees of Freedom, KM=Kilometers

Binary logistic regression was used to identify variables predictive of Vitamin A supplementation coverage at second dose. Two factors associated to Vitamin A supplementation at second dose (P<0.05) in bivariate analysis were considered for multivariable analysis. Two successive iterations were performed using backward conditional method retaining one factor as presented in (**Table 4.20)**

Adjusting for other factors, there was a significant association between Vitamin A supplementation at second dose and the facilitator at time of delivery. Children whose mothers were facilitated by health worker at time of delivery were 3.44[95% CI: 1.08 – 10.91, P=0.036] times more likely to receive vitamin A supplementation at second dose compared to children born by mothers who facilitated themselves.

Table 4.20: Predictors of Vitamin A supplementation Coverage at Second Dose among Children Aged between 12 to 23 Months in Mwaluphamba Sub-County.

		95% C.I		
Indicator	**AOR**	**Lower**	**Upper**	**P-Value**
Facilitator during birth				
Health worker	3.44	1.08	10.91	**0.036**
Traditional birth attendant	1.22	0.38	3.91	0.734
Relative	1.85	0.53	6.46	0.333
Self	Ref			

AOR= Adjusted Odds Ratio, CI= Confidence Interval, P-Value = Probability value

CHAPTER FIVE:

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 DISCUSSION

5.1.1 Immunization Coverage among Children

The study results showed that immunization coverage of BCG and Pentavalent coverage were good in relation to recommended levels by WHO of 90% (WHO, 2005). In addition, all the vaccinations coverage levels were also similar to the coverage reported by KDHS survey in Kwale County (KDHS, 2014). The high BCG vaccine coverage may be due to the fact that for all mothers who delivered at the health facility, their babies received the BCG vaccination at the facility.

It was also observed in this study that there were variations in the coverage of different vaccines, including those that were administered concurrently. For instance, there was difference between the coverage of the full dose of OPV-3 and that of the pentavalent vaccine. These vaccines are administered together and could be expected to have similar coverage rates. This is in agreement with a study conducted in Kakamega Central which reported discrepancy between third dose of pentavalent and third dose of polio (Sunguti *et al*., 2016). To better understand the discrepancies in these dosages, qualitative research could be carried out to explore reasons behind missed opportunities from the perspective of all stakeholders.

Measles vaccine coverage in this study was lower than the mean national coverage of 87% (KDHS, 2014). The low coverage could be due to recall bias by

the mother and incompliance of the mothers on vaccine schedule as well as gap in time between vaccines given concurrently and measles vaccine which is given later on the schedule.

5.1.2 Immunization coverage and Associated Factors

5.1.2.1 Distance to the nearest health facility

Distance to health facility has been reported to influence the polio vaccine coverage of the children. A study conducted in Mozambique showed that distance to health facility and spending more than an hour to reach the nearest health facility had a negative influence on the immunisation coverage with 52% mothers/ caregivers interviewed during the survey living far away from the nearest health facility (Jani *et al.*, 2008). Similar studies found that immunization coverage declined with increasing distance from the vaccination clinics (Mutua *et al*., 2011; Takum *et al*., 2011). This is in agreement with the study findings where respondents who live less than five kilometres away from the health facility are likely to vaccinate their children against polio, pentavalent compared to those who live more than five kilometres away. This could be explained by the fact that covering short distance requires less transport cost compared to when covering a longer distance. However, the study findings differ with some other studies done in Kenya where distance had no effect to immunization coverage (Kamau *et al.*, 2001; Okunga *et al.*, 2015). This could be attributed to better modes of transportation in these study areas as compared to Mwaluphamba Sub-County where majority walked to the health facility.

5.1.2.2 Time to the Nearest Health Facility

Related to distance, time taken to reach the facility was another factor that influenced pentavalent vaccination. The study found that respondents who walked for one hour or less were two times likely to vaccinate their children with pentavalent vaccine compared to those who took more than one hour to reach the health facility. The study area has poor road network that contribute to health care services inaccessibility. The cost of immunization comprises many components, such as the out-of-pocket costs, transportation costs, and time costs. The time cost is higher to caregivers (usually mothers) who live far from the health centres with fewer wage-earning opportunities. This association between time and pentavalent vaccine coverage could reflect the idea that those who walked for one hour or less lived near the health facility hence they could easily access health services as well as health information. These observations however differ with those of a study conducted in Kilifi which found out that travel time had no association with vaccination coverage (Moisi *et al*., 2010).

5.1.2.3 Place of delivery

The association between place of delivery and immunization coverage against Pentavalent and Measles vaccines reported in this study is in agreement with other studies where children born in a health facility are more likely to be immunized against all basic immunizations than children born at home. (Odiit *et al*, 2003; Masand e*t al*, 2012; Elizabeth *et al*., 2015). This could be attributed to the fact that a child that is born in a health facility would have more access to immunization than a child born at a non- health facility. At birth, a child is given

Polio vaccination and this makes the parent to be more aware of polio vaccine subsequent doses. This depicts that when delivering in the hospital, the health care provider is likely to create awareness on the importance of vaccinations as compared to when one delivers at home. Also BCG vaccine which is given immediately after birth is less likely to be missed out when one delivers in the hospital.

5.2.1.4 Type of Delivery Assistant during Birth

Type of delivery assistant during birth influenced respondent's decision to take their children for vaccination. Polio vaccine reported strong association with type of delivery assistant. Mothers who are assisted by skilled health worker were 21 times more likely to immunize their children compared to those who delivered themselves. These findings reveal that if delivery occurs in health care facility, some vaccines such as BCG are normally administered which increases the likelihood of the child being immunized which in turn amplifies the immunization coverage. Furthermore, a mother who delivers in a health facility by the help of trained health care provider is bound to be more informed concerning the immunization to the extent that she has higher chances of having her child receive the immunizations. This finding is in agreement with other studies done in Africa (Etana *et al*., 2012; Jani *et al*. 2008).

5.2.1.5 Gender of the child

Gender of the child had influence in the pentavalent vaccine coverage. Female children are two times likely to receive pentavalent vaccine compared to male children. This is consistent with studies conducted in Nigeria and Ireland that

reported that female children had a higher likelihood of being immunized (Jessop *et al*., 2010; Antai, 2012). Contrary to this finding, other studies indicate no association between gender of the child and immunization (Owino *et al*., 2009; Sunguti *et al*., 2016). To date, no clear literature exists to explain the association between immunization coverage and sex of the child. However, some literature suggest this could be due to gender mainstreaming campaigns by both government and non-governmental organisation advocating for equal rights for both male and females (Sunguti *et al.,* 2016). There is a need for qualitative studies to be conducted to gain an in-depth understanding of this association.

5.1.3 Vitamin A supplementation Coverage and Associated factors

The overall VAS coverage in this study was 45.9%, while the two doses are 45% at 6 months and 29.5% at 12 months. The coverage is lower than 72% reported in KDHS, 2014 and similar to one reported in arid and non- semiarid parts of Kenya (Clohossey *et al*., 2013; KDHS, 2014). The coverage of the first dose of VAS is high due to the fact that younger children and caregivers of these children are likely to visit health facilities as they go for routine check-up.

The coverage of the two VAS doses was, however lower than that reported in a study conducted in Nairobi (Kamau *et al.,* 2012). This could be due to literacy levels between the two places where the study area is reported to have high illiteracy levels.

5.1.3.1 Religion of the respondents

Religion shows significance association with VAS coverage, children born of Christian mothers were found to be 2.49 times likely to receive VAS. This agrees with a study that found children whose mothers had only Islamic education were less likely to receive VAS (Adamu *et al*., 2016). In addition, Christian families in Sub Saharan Africa tend to follow western culture that includes using modern medicine than Muslims this is because mainstream medicine and western culture tend to have historical ties (Nath, 2007; Babalola, 2009; Kalule *et a*l., 2014). A study conducted in Bhangel showed religion had significant association with VAS coverage where higher levels of VAS was high among the Muslims when compared with the Hindus (Mahajan *et al*., 2016).

Lower Vitamin A supplementation coverage rate among certain religious groups could be due to several factors such as marginalization and alienation from the surrounding society, and respect for their religious leaders' opinions. In this regard, certain religious leaders have cited vaccination services which include Vitamin A supplementation as a sin against God (Gyimah 2007; Fourn *et al*., 2009)

5.1.3.2 Place of Last Delivery

Mothers who delivered in the hospital had 2.34 chances of taking their children for VAS than those delivered at home. This reflects the idea that mothers get advice from health professionals on when to come back for the next set of vaccines as well as supplements the baby should get within the span of five years. This is contrarily to babies who are delivered at home as they only get first contact with health care provider when brought to hospital for other illness. This finding concurs with other studies that found similar association between place of delivery and VAS coverage (Diekema, 2004; Elizabeth *et al.*, 2015). In Kenya, VAS and immunisation uses same delivery channels. Studies have shown that mothers who deliver in the health facilities are more likely to receive training from health professionals on the importance of vaccination (Mosand *et al*, 2012).

5.2 Conclusions

- Coverage for individual immunizations were BCG 99%, OPV3 31.6%, Pentavalent three 83.2% and Measles 67.8%. .
- The overall VAS coverage in this study was 45.9%, while the two doses are 45% at 6 months and 29.5% at 12 months.
- The factors that were significantly associated with immunization coverage included, distance to health facility, type of facilitator during delivery, gender of the child, place of last delivery and time taken to the hospital
- The factors that were significantly associated with Vitamin A supplementation coverage after logistic regression were religion of the mother or caregiver and type of facilitator during delivery.

5.3 Recommendations

- Effective vaccination outreach services need to be put in place to target those who miss out on receiving vaccinations during immunization days.
- Further efforts should be put in improving delivery rates in health facilities, and with assistance by health workers, as these are positively associated with higher vaccination coverage.
- Health education and sensitization on the importance of child vaccinations and Vitamin A supplements should be provided in the study area
- Interventions to upscale VAS coverage needs to be employed in the area.

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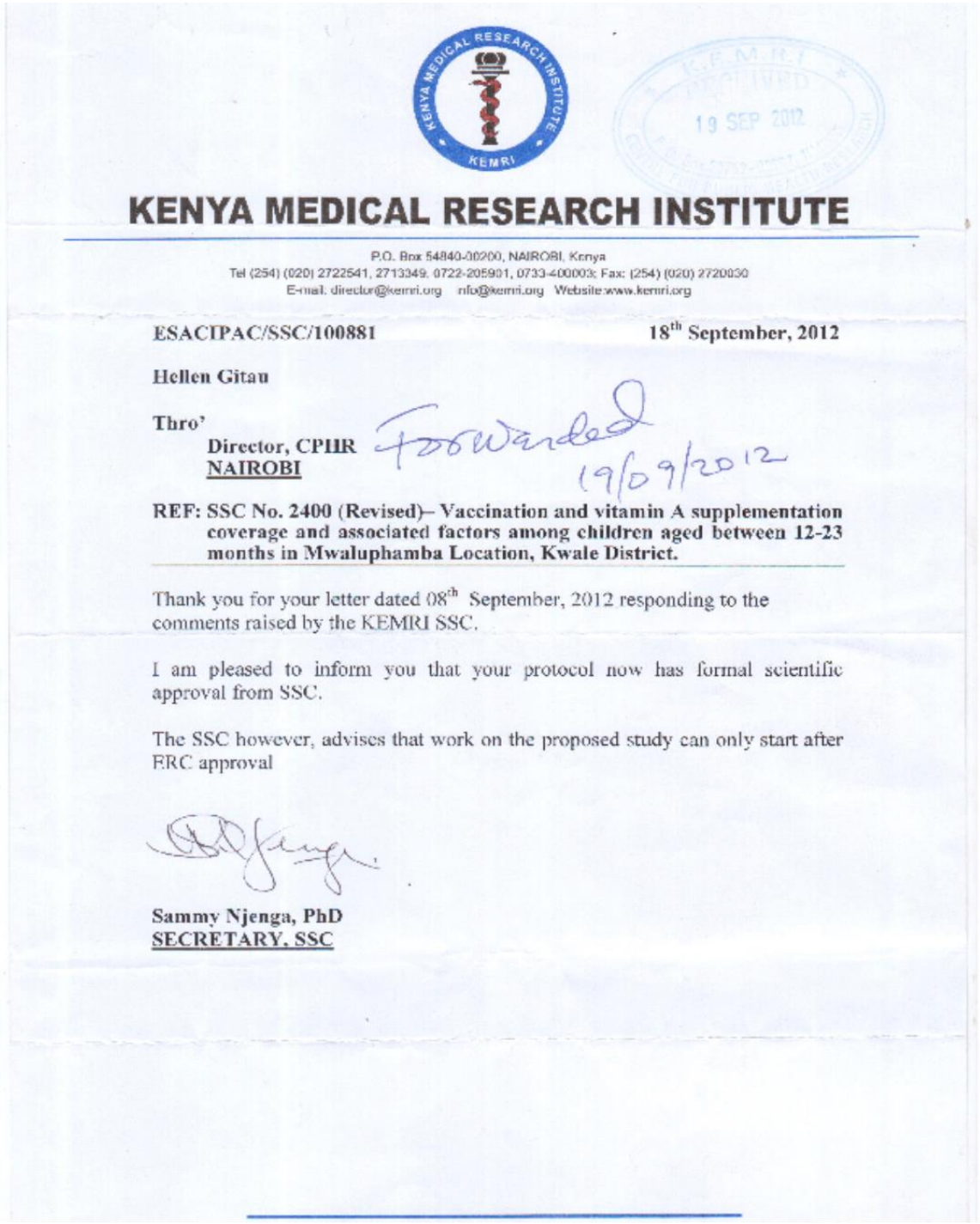
APPENDICES

APPENDIX 1: Scientific and Ethical Clearance



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E-mail: director@kemri.org nfo@kemri.org Website:www.kemri.org

ESACIPAC/SSC/100881 18th September, 2012

Hellen Gitau

Thro'
Director, CPHR
NAIROBI

Forwarded
19/09/2012

REF: SSC No. 2400 (Revised)– Vaccination and vitamin A supplementation coverage and associated factors among children aged between 12-23 months in Mwaluphamba Location, Kwale District.

Thank you for your letter dated 08th September, 2012 responding to the comments raised by the KEMRI SSC.

I am pleased to inform you that your protocol now has formal scientific approval from SSC.

The SSC however, advises that work on the proposed study can only start after ERC approval

Sammy Njenga, PhD
SECRETARY, SSC

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KEMRI/RES/7/3/1 **March 11, 2013**

TO: **Ms. HELLEN WANGUI GITAU (PRINCIPAL INVESTIGATOR)**
STUDENT NUMBER: TM 306-1305/2010

THROUGH: **DR. YERI KOMBE,**
THE DIRECTOR, CPHR,
NAIROBI

12/03/2013

Dear Madam,

RE: **SSC PROTOCOL No. 2400 - REVISED (*RESUBMISSION*): VACCINATION AND VITAMIN SUPPLEMENTATION COVERAGE AND ASSOCIATED FACTORS AMONG CHILDREN AGED BETWEEN 12-23 MONTHS IN MWALUPHAMBA LOCATION, KWALE DISTRICT (*VERSION 1.3 DATED 27 FEBRUARY 2013*)**

Reference is made to your letter dated February 26, 2013. The ERC Secretariat acknowledges receipt of the revised proposal on 27th February, 2013.

This is to inform you that at the Committee determines that the issues raised at the 211th ERC meeting of 06th October 2012 are adequately addressed.

Consequently, the study is granted approval for implementation effective this **11th March 2013** for a period of one year. Please note that authorization to conduct this study will automatically expire on **March 10, 2014.**

If you plan to continue data collection or analysis beyond this date, please submit an application for continuation approval to the ERC Secretariat by **January 28, 2014**. The regulations require continuing review even though the research activity may not have begun until sometime after the ERC approval.

You are required to submit any proposed changes to this study to the SSC and ERC for review and the changes should not be initiated until written approval from the ERC is received. Please note that any unanticipated problems resulting from the implementation of this study should be brought to the attention of the ERC and you should advise the ERC when the study is completed or discontinued.

Work on this project may begin.

Sincerely,

DR. ELIZABETH BUKUSI,
ACTING SECRETARY,
KEMRI ETHICS REVIEW COMMITTEE

APPENDIX 2**:** Informed Consent Form (ICF**)**

Proposal Title: VACCINATION AND VITAMIN A SUPPLEMENTATION COVERAGE AND ASSOCIATED FACTORS AMONG CHILDREN BETWEEN 12-23 MONTHS IN MWALUPHAMBA SUB-COUNTY, KWALE DISTRICT

Introduction: I am Hellen Wangui Gitau from Jomo Kenyatta University of Agriculture and Technology (JKUAT), in conjunction with Kenya Medical Research Institute (KEMRI). I am conducting a study on Vaccination and Vitamin A Supplementation coverage and associated Factors among Children Between 12-23 months in Mwaluphamba Sub-County, Kwale County. You are asked to participate in the study to help stakeholders both at district level and national levels develop better ways of making immunizations and Vitamin A Supplementation accessible to all children between 12-23 months in the area.

Freedom of Participation: This consent form gives you information about the study, the risks and benefits and the procedure will be explained to you. Once you have understood the study and agreed to take part, you will be asked to sign or make your mark on this form. Before you learn about the study, it's important to note that; your participation in the study is voluntary and you may decide to terminate the study at any time without facing any consequences.

Purpose of the study: The study is trying to look on to factors affecting immunization and Vitamin A Supplementation uptake. You are asked to participate in this study since the findings will be helpful to local and national health stakeholders in improving the immunization status as well as Vitamin A supplementation status of children between 12-23 months in Mwaluphamba Sub-County through formulation of policies that will ensure all children receives the key immunizations and supplements which are important for the child's growth and health.

Precautions: There are no expected complications associated with this study

Study procedure: The study will involve short interviews of about twenty minutes per participant where participants will be required to answer questions on socio-demographic, socio economic and their child's vaccination history. They will also be required to provide their child's vaccination card. The whole study will take duration of about one month.

Benefits: Participating in the study will help mothers and care takers know the immunization status of their children. Vitamin A will be given to children who have not received the supplement within the last six months. Information provided will also assist the relevant stakeholders in the health sector at District and national level come up with strategic intervention for immunisation programme in Mwaluphamba Sub-County. You will not be given any monetary benefits, and neither will you incur any costs

Harm and/or risk/and or/discomfort: The research will not involve any risks or discomfort to you during the study. You will be requested to avail yourself for an interview. Your privacy and confidentiality during your participation in the study will be protected by omitting identification information and limiting accessibility of your information. The interview will take place in private. It is unlikely that any harm could happen to you as a result of being in this study.

Data security and confidentiality: I shall also keep personal information about you and other persons confidential and I will use the information for analysis only. No names of the respondents will appear in any report. No report will allow anyone to relate results to your house hold. Aggregated results of the research will be provided to the health system and may lead to improved services. Participant's information will also be kept confidential by limiting the accessibility after the interview; this will be done by storing all questionnaires in a lockable drawer. After data is entered in the computer, password will be used to safeguard the confidentiality. You will only be identified by a code and you will receive a copy of this consent form and data will not be released without your written permission. However records may be reviewed by ethics committee at KEMRI

Problems and questions: If you have questions about this study please do not hesitate to contact the following:

1. Ms Hellen Wangui Gitau:
   Principal Investigator
   Tel: +254-720 550 019.
   Email.kuitriza@gmail.com
   P. O. Box 53, 000232.Ruiru, Kenya

2. Prof. Mohamed Karama,
   Co- investigator
   Ummah University
   Tel; 0722-885366
3. Prof. Anselimo Makhoha
   Co-investigator
   Jomo Kenyatta University of Agriculture and Technology
   Tel; 0713817436

Other contacts for further information pertaining to right as research participants are;

The Secretary, KEMRI Ethics Review Committee, P.O.Box 54840-00200, Nairobi; Telephone numbers: 020-2722541, 0722205901, 0733400003; Email address: erc@kemri.org

To participant,

I have read and agreed to give information. I have had an opportunity to ask question about the study and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate in this research and understand that I have the right to withdraw from the research at any time. If I have questions about my rights as a respondent, I can contact the chairperson of KEMRI Ethical Review Committee at 020-272-2541, 0722205901 or0733400003

Participant: .....Signature: .....Date: .....

Investigator: .....Signature: .....Date: .....

KWA MSHIRIKI

Nafanya utafiti kuhusu chanjo na vidonge vya Vitamin A katitka watoto walio na umri wa chini ya miaka mbili katika eneo la Mwaluphamba Sub-County. Madhumuni ya utafitii huu ni kuwatambua idadi ya watoto wanao pokea chanjo na vidonge vya Vitamin A na shida zinazo wakumba wanapopokea chanjo hizi

Matokeo ya utafiti huu yatatumika kuvumbua mbinu za kuhakukisha kila motto katika eneo hili wataweza kupokea chanjo na vidonge vya Vitamin A kama inavyo hitajika na shirika la KEPI ili kuzuia maradhi na maafa yanayo tokana na ukosefu wa kinga mwilini.

Utafiti huu umeidhinishwa na kamati ya Utendaji wa Sayansi ya KEMRI.

Utafiti huu uko chini ya uongozi wa Ms Hellen Wangui Gitau akisimamiwawa na Profesa Mohamed Karama na Profesa Anselimo Makhoha.

UTARATIBU WA UTAFITI: mimi na wasaidizi wangu tutakuwa na mahojiano nawe. Tutakuuliza maswali kuhusu hali ya mtoto na aiana za chanjo ambazo mtoto amepokea pamoja na maswali kuhusu vidonge vya Vitamin A

HATARI/FAIDA: Mahojiano haya hayatakuwa na adhari ya muda mrefu. Hakutakuwa na faida yoyote ya kifedha wala haitakugharimu kitu chochote. Utashauliwa vilivyo kuhusu faida za kumpea mwanao chanjo na vidonge vya Vitamin A.

SIRI: Tutaweka habari yako binafsi na watu wengine siri na habari hiyo itatumika kwa ajili ya utafiti pekee. Majina ya wahusika hayatatumika kwa ripoti yeyote, majibu hayataonekana kama yanahusiana na wahusika wa utafi huu. Matokeo ya utafiti yatasaidia katika kuimarisha mifumo ya afya.

HAKI ZA MSHIRIKI: Kushiriki kwako ni hiari yako, una haki ya kukubali ama kukata ama kusimamisha mahojiano wakati wowote kama hufurahishwi nayo.

MAWASILIANO: Ukiwa na swali yoyote ile kuhufusu utafiti huu, tafadhali wasiliana na watafitii wafuatao:

1. Ms Hellen Wangui
   Mtafiti
   SLP 53, Ruiru
   Simu: 0720-550019
2. Prof. Mohamed Karama,
   Msimamizi,
   S. L.P. 20752-00202
   Simu: 0722-885366.
3. Prof. Anselimo Makhoha
   Simu: 0713817436

Kwa mshiriki,

Nimekubali ana na habari ambayo nimepewa. Nimepewa fursa ya kuuliza maswali kuhusu utafiti huu na nimejibiwa nikaridhika. Kwa hiari yangu nimekubali kuwa mshiriki katika utafiti huu na ninaelewa kwamba ninayo haki ya kutoka wakati wowote. Nikiwa na maswali kama mhusika, nitawasiliana na mwenyekiti wa kamati ya uchunguzi kimaadili kemri nambari 020- 272-2541, 0722205901 or 0733400003

Mhusika…… sahihi…….
Tarehe…….
Mtafiti……. Sahihi…… tarehe…….

APPENDIX 3. Questionnaire

NO	QUESTION	CODING CATEGORIES	
Q1	Participants number	|__|___|___|	
Q2	How old are you?		
Q3	Who is the head of this household?	Husband.....1 Wife.....2 Other (specify).....3	
Q4	Which religion do you practice?	Christian.....1 Muslim .....2 None.....3 Any other(specify).....4	
Q5	What is your current marital status?	Single.....1 Married (monogamous).....2 Married(polygamous).....3 Divorced.....4 Widowed.....5	
Q6	Have you ever attended school?	Yes.....1 No.....2	
Q7	What is the highest level you attended?	primary …1 secondary….2 Technical(middle level)….2	
Q8	What is your occupation?	Formal employment.....1 casual employment.....2 self-employment.....3 farming...4 unemployed...5	
Q9	How many children of your own do you live with here?	1 child.....0 2children.....1 3chldren.....2	

		4children.....3 5 children ....4 6 children....5	
Q10	Do you take care of other children who are not your own?	No .....1 Yes.....2	
Q11	Do you own radio or television?	No…1 Yes…2	

Now I would like to ask you some few question on provision of health services in this area		
Q12	How far is the nearest hospital?	Less than 5KM….1 5 KM....2 More than 5 KM.....3
Q13	Where did your child receive the immunization?	Public hospital.....**1** Private hospital**.....2** Faith based hospital.....**3** Outreach...4 NGO.....5 Don't know....4
Q14	Which means of transport do you use to get to the nearest hospital?	Foot.....**1** Bicycle.....**2** Public means.....**3** Personal car.....**4**
Q15	How long do you take to reach to the nearest hospital	Less than 30 min….1 30min-1Hr .....2 1 hour 2Hrs.....3 More than 2 hours....4

Q16	Where did you deliver your last child?	Health facility.....**1** Home.....**2**
Q17	Who facilitated your last delivery?	Skilled health attendant….1 Traditional birth attendant…2 Relative….3 Self……4

NO	QUESTION	CODING CATEGORIES
	Participants number	|___|___|___|
Q18	Do you have your child's vaccination card with you?	No.....**1** Yes.....2 (seen) Yes..... 3(not seen)
Q19	How old is your child?	Age ( )
Q20	What is the child's date of birth?	dd mm yy |_____|____|____|
Q21	What gender is your child?	F (1) M (2)
Q22	Did **your** child ever receive any vaccinations to prevent him/her from getting diseases, including vaccinations received in national immunization days(NID)	No.....**1** Yes.....**2** Don't know...4
Q23	Please tell me if your child has received the following vaccinations a) BCG vaccination against TB that is injected on the arm or on the shoulder that usually causes a scar?	No.....1 Yes....**2** Don't know....**3**

Q24	b) A Pentavalent (DPT-Hep-HiB) vaccine that is injected on the thigh sometimes given with polio?	No.....**1** Yes.....**2** Don't know....**3**
Q25	d) Did your child receive first dose of pentavalent vaccine at six weeks?	Yes….2 No…1
Q26	e) Did your child receive second dose of pentavalent vaccine at 10 weeks?	Yes….2 No…1
Q27	f) Did your child receive third dose of pentavalent vaccine at 14 weeks?	Yes….2 No…1
Q28	d) Has your child ever received Polio vaccine that is dropped in the mouth?	Yes….2 No…1
Q29	e) Was the first polio vaccine received at after birth or later?	First two weeks....**1** later.....2 don't know....3

Q30	f) Did your child receive the second dose at six weeks?	No…….1 Yes----2
Q31	Did your child receive third dose of polio at 10 weeks	No….1 Yes….2
Q32	Did your child receive fourth dose of polio at 14 weeks	No….1 Yes…2
	g) Has your child received a measles injection that is a shot in the right upper arm at the age of 9 Months or older to prevent him or her from getting measles?	No....**1** Yes.....**2** Don't know....**3**
Q33	a)Has your child received a vitamin A dose (like this/any of these) in his/her sixth month after birth (SHOW COMMON TYPES AMPULES/CAPSULES/SYRUPS)	No....**1** Yes.....**2** Don't know....**3**
Q34	Has he/she received a vitamin A dose within the last six months?	No....**1** Yes.....**2**

	(SHOW COMMON TYPES AMPULES/CAPSULES/SYRUPS)	Don't know....**3**
Q35	Immunization Status	Not immunized.....1 Partially immunized.....2 Fully immunized.....3

APPENDIX 4: Publication Letter of Approval

KENYA MEDICAL RESEARCH INSTITUTE

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KEMRI/AJHS/CORRESP/VOL 1/2015

28th August 2015

Gitau Hellen Wangui,
JKUAT,
P.O BOX 62000-00200,
College of Health Sciences,
Nairobi.

Dear Gitau Hellen Wangui,

REF: AJHS/2015/483 "VITAMIN A SUPPLEMENTATION COVERAGE AND MATERNAL, SOCIO-DEMOGRAPHIC, SOCIO-ECONOMIC AND HEALTH FACILITY RELATED FACTORS AMONG CHILDREN AGED 12-23 MONTHS IN MWALUPHAMBA KWALE COUNTY BY GITAU HELLEN WANGUI

We are pleased to inform you that your manuscript titled above was approved for publication in the African Journal of Health Sciences (AJHS).

Thank you for taking interest in the AJHS.

Kind Regards,

Jane M Rintari (Miss), B.A (Hons) Degree in Sociology & Gov't (UON), MPSM (AU), Zimbabwe,
Principal Administrative Officer/Head of Administration (AJHS),
For: Editor-in-Chief, AJHS,
KENYA MEDICAL RESEARCH INSTITUTE (KEMRI).

In Search of Better Health