MISSSED OPPORTUNITY FOR VACCINATION AMONG UNDER FIVE-YEAR-OLD CHILDREN AT MAKADARA SUB-COUNTY, NAIROBI COUNTY

By

KOMU WILFRED MUTUNGA

W62/82048/2015

A thesis submitted to the University of Nairobi in partial fulfilment for the Degree of Master of Science in Medical Statistics.

NOVEMBER, 2017

DECLARATION

STUDENT

I declare that this research proposal is my original work and has not been presented for a degreeor any award in any other University.

Signature ……. **Date**……

Komu Wilfred Mutunga

W62/82048/2015

SUPERVISORS

This research proposal has been submitted for examination with our approval as the University supervisors.

Signature…… **Date** ……

Dr. Peter Wanzala

Centre for Public Health Research

Kenya Medical Research Institute

Signature…… **Date** ……

Dr. Anthony Karanja

Institute of Tropical and Infectious Diseases

University of Nairobi

ACKNOWLEDGEMENT

First and foremost, I acknowledge the Almighty God who has given me the power and strength to carry out this work to this extent it has reached.

I would also like to express my appreciation and gratitude to the entire staff of COHES and my supervisorsDr. Karanja and Dr.Wanzalaforthe guidance. Further, I acknowledge the help from UNITID for imparting me with the knowledge, skills and materials required to undertake this work.

DEDICATION

I dedicate this research project to my entire family, especially to my dear wife, my lovely daughter and niece.

DEFINITION OF TERMS

Bacteria: Microscopic unicellular organisms that cause diseases.

Diagnosis: Identification of a disease from its symptoms.

Epidemic: A disease attacking many people at the same time in a region.

Immune: Not susceptible to a specified disease through inoculation or natural resistance.

Immunization: To make immune especially against infection.

Inoculate: To inject a serum or a vaccine into, in order to create immunity.

Symptom: Bodily sensation experienced by a patient indicative of a certain disease.

Virus: Microorganism capable of replicating within living cells causing a disease.

Missed opportunity: Any contact with a health service that did not result in an eligible child or woman receiving the needed vaccines according to WHO. In this study missed opportunity will be broadly defined as a child failing to receive at least one immunization out of the six immunization recommended for children in their first year of life

LIST OF ABBREVIATIONS

CHV	Community Health Volunteer
CHW	Community health worker
CNS	Central Nervous System
CSF:	Cerebrospinal fluid
DTap:	Diphtheria, Tetanus and a cellularpertussis
DHS	Demographic Health Survey
DPT:	Diphtheria, Pertussis Tetanus
FGD	Focus Group discussion
HBV:	Hepatitis B virus
IPV:	Inactivated Polio virus Vaccine
MMR:	Measles Mumps and Rubella
OPV:	Oral Polio Virus Vaccine
PV:	Polio virus
TB:	Tuberculosis
THP	Trained health professional
WBC:	White blood cells
WHO:	World Health Organization

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background: Immunizable diseases have been a major public health problem among under five-year-old children globally;of which Kenya is not an exception. According to KDHS (2014), 2 in every 3 Kenyan children were fully vaccinated, whereas in North Eastern 2 in every 5 children and in Mandera County 2 in every 10 children were fully vaccinated which implies a large number of children are still at risk of contracting immunizable diseases. Evidently, there's a variation in immunization coverage at local level that could perhaps be attributed to factors specific to different localities.

Objective: This research set out to investigate missed opportunity for immunizationamong under-five-year old children in Makadara Sub-county

Methodology: This was a retrospective cohort study conducted at Makadara Sub-county. The study population comprised of under-five-year old children living in Makadara Sub-county. 248 children were recruited from the households through a multistage sampling approach. Data was collected using semi-structured questionnaires, entered and stored in Microsoft Excel 2013.Data cleaning, coding and analysis was done using STATA version 13.

The main outcome of interest was the level of completion of vaccination depending on the age of the child.Univariate analysis was done to describe and summarize the data. The results were presented in graphs and tables The effect of the factors associated with the outcome was evaluated using multiple log binomial regression models. The risk ratio and 95% confidence intervals werereported..

Results: The study findings indicated that only education level and occupation type werefound significant. Mothers with low education are 48 % less likely to missed opportunity for their child (RR= 0.52 p-value=0.003) compare to those with high education

level. For occupation type, mother who are not working are 44 % less likely to missed opportunity for their child (RR=0.56 p-value=0.031) compared to those who are working.

Conclusion: However, there's need to increase the uptake of specific immunizationsespecially those given at 9 months (Measles) whose rates were lower compared to the rest of the vaccines

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Immunizable diseases are highly infectious viral or bacterial illnesses that can lead to serious complications. They can be prevented by use of vaccines to create immunity. There are two categories of Immunizable diseases that is bacterial and viral infections. Some of those caused by bacteria include TB, tetanus, and diphtheria while those examples of viral diseases include measles, Hepatitis B and poliomyelitis. Tuberculosis is a highly contagious infection affecting primarily the lungs caused by bacteria known as mycobacterium. Tetanus on the other hand is also a contagious disease spread through faeces and caused by a toxin produced by clostridium tetany bacteria. Similarly, diseases caused by viruses such as measles caused by rubella virus, Hepatitis B brought by Hepatitis B virus and poliomyelitis caused by polio virus are also infectious and can lead to serious complications.(KEPI)

Globally, immunizable diseases have been a big problem affecting children under 5 years of age, UNICEF (2014). This problem is not different in Makadarasubcounty being in a third world and has been attributed to the ruin of the critical years of children affected by these diseases if not intervened on time.

1.2 Problem statement and Justification

As a strategy to lessen infant morbidity and mortality rates, Kenya Expanded Programme on Immunization (KEPI) was set up to increase access to immunization services. An estimated 19.4 million infants worldwide didn't get routine immunization services by the end of 2015, WHO (2016). According to KDHS (2014), 2 in every 3 Kenyan children were fully vaccinated, whereas in North Eastern 2 in every 5 children and in Mandera County 2 in every 10 children were fully vaccinated. Evidently,there's a variation in immunization coverage at

local level that could perhaps be attributed to factors specific to different localities. This research sets out to investigate the childhood immunization coverage in Makadara County.

Studies have been done to assess child immunization status nationally Onsomu et al., (2015), targeting specific regions such as Nakuru Sub county, Maina, Karanja&Kombich (2013). Both studies were designed as cross-sectional whose results are suitable for generating hypothesis for further research. Education level of the mother was among the factors found to be significantly associated,) with missed opportunity for vaccinantion.Onsomu et al., (2015 This study adopted a cohort design to evaluate the adjusted effect education level among other factors on the risk of missed opportunity for vaccination.

The study findings will be useful in guiding Makadara Sub-County health administration in coming up with interventions for increasing childhood immunization uptake.

1.3 Broad objective

To assess missed opportunity for vaccination among under-five-year old children residing in Makadara Sub-County, Nairobi County.

1.3.1 Specific objectives

1. To determine the uptake of childhood immunization among under-five-year old children residing in Makadara Sub-county.
2. To evaluate factors associated with missed opportunity among under-five-year old children in Makadara Sub-county.

1.3.2 Research questions

1. What is the level of childhood immunization uptake among under-five-year old children residing in Makadara Sub-county?

2. What are the factors associated with missed opportunity among under-five-year old children in Makadara Sub-county?

1.4 Null hypothesis

The risk of missed opportunity among under-five-year old children whose mothers/guardians had primary education level and below is not different from the risk among under-five-year old children whose mothers had secondary education level and above at the time of birth of the child after adjusting for the effect of other independent variables (such as employment status, proximity to hospital, availability of the vaccines, awareness level of the vaccination schedule).

CHAPTER TWO

LITERATURE REVIEW

2.1 Immunizable diseases affecting children under age 5

Immunizable diseases are highly contagious infections caused by either bacteria or viruses but can be prevented by inoculating a serum or vaccine in order to create immunity in the body (WHO, 2017). Outbreak of IDs is common in urban slums areas than in other urban areas and have a larger number of cases that are secondary to high inhabitants' density and continuous invasion of a new pool of infective agents with nomadic population (Bahl et al., 2004). Crowding increases childhood mortality from VPDs (Howie et al., 2016; Aaby et al., 2007). Common viral diseases include measles; poliomyelitis, and hepatitis B. Tuberculosis, diphtheria and tetanus on the other hand constitute the common bacterial diseases.

2.1.1 Diphtheria

Diphtheria is one of the lives' threatening bacterial infections commonly caused by Corynebacterium diphtheria. The bacteria are transmitted from one person to the other through close physical and respiratory contact. It is characterized by laryngitis, pharyngitis or tonsillitis and a pathognomonic adherent membrane of the tonsils and pharynx. The sternest complication of the disease is respiratory obstruction that is mostly followed by death. A good number of patients with diphtheria experience inflammation of the heart muscle and valves, in most cases it leads to chronic heart disease and heart failure. The most effectual way to prevent the disease is by maintaining a high level of immunization. (DTP) (WHO 2015).

2.1.2 Hepatitis B

The disease is caused by a virus that infects the liver of a human being. 90% of infants who are infected during birth or before one year of age mostly develop persistent disease. On average 780,000 people die each year as a result of hepatitis B such as cirrhosis or liver cancer (WHO, 2009). Symptoms include fatigue, nausea, and vomiting, abdominal pain and jaundice (yellowing of the skin and eyes. This disease can be easily prevented by immunization. Infants must receive their first dose of HepB as soon as possible (less than 24 hours) after birth. HepB vaccine must be given with DTP and Hib in the form of pentavalent (DTP+HepB+Hib) vaccine after the birth dose. All children should be given stand-alone hepatitis B vaccine at birth, this should be followed by two to three doses administered with the DTP and Hib schedule (WHO, 2009).

2.1.3 Measles

This is a highly contagious disease caused by a virus. The virus is the main cause of death among young children regardless of the accessibility of a safe and successful vaccine (UNICEF, 2014). It is spread through contact with nose and throat secretions of a person who is infected with the virus and through airborne droplets released when an infected being sneezes or coughs.

Maina, (2013) indicates that the disease spreads easily in places where children gather such as health centers and schools and it is characterized by high fever, running nose, watery eyes, a cough and small white spots inside their cheeks. Later, a slightly raised rash develops, will usually appear on the face and upper neck which spreads to the body and then to the hands and feet. Mohammued, (2014) says that complications include dehydration due to severe diarrhoea, malnutrition, pneumonia, inflammation of the middle ear and encephalitis. This disease is a major basis of blindness among children where it is widespread. On the other hand, Pneumonia is the most frequent cause of death linked with measles. Measles is easily

prevented by immunization with measles-containing vaccine (MCV) whereby all children must obtain 2 doses of measles vaccine.

2.1.4 Poliomyelitis

It is also referred to as polio which is a highly communicable disease caused by poliovirus types 1, 2 or 3. Polio mainly affects children who are less than 5 years of age (WHO, 2009). According to statistics, one in 200 infections cause permanent paralysis once the spinal cord that controls the muscles is affected. The virus spreads by the faecal-to-oral route and it can be barred through immunization with oral polio vaccine (OPV) and/or inactivated polio vaccine. The World Health Organization recommends that countries where OPV is used must add at least one dose of IPV to the routine immunization plan.

According to UNICEF, (2014), Afghanistan, Nigeria and Pakistan remain polio-endemic in 2012 down from more than 125 in 1988. So far here has been no polio cases reported in Kenya except for imported cases from Somalia, Sudan and Uganda with the latest case reported in November 2011 (MOH, 2013).

2.1.5 Tetanus

The disease is caused by Clostridium tetani, a bacterium commonly found in soil. The infection occurs when soil enters a wound or cut of a human being with a release of toxin bacterium causes severe, painful muscle spasms that in some cases may lead to death. This infection may occur during unclean delivery of babies, when infected objects are used or whenever the bacteria enters a wound or cut of a person. Infants and children may get amalgamation vaccines like DTP, pentavalent (DTP+HepB+Hib) or DT to help in preventing them from the bacterium. WHO, (2009) indicates that the best way to prevent neonatal tetanus is by immunizing women of reproductive age during or before pregnancy with tetanus toxoid.

2.1.6 Tuberculosis

According to W.H.O, (2009), TB is the world's seventh-leading cause of death and is a common illness in Kenya that affects all age groups and has been on the increase since the onset of the HIV/AIDS pandemic. Kenya is ranked 13th on the list of 22 high- burden TB countries in the world and has the fifth highest burden in Africa (MOH, 2013).

TB is caused by the bacterium called Mycobacterium tuberculosis that attacks the lungs and at times the bones, joints and brain. TB is spread through coughing or sneezing. Some symptoms are general weaknesses, weight loss, fever and night sweats.

2.2 Immunization

Immunization is the best way to end avoidable child deaths, saving up to 3 million children a year (UNICEF, 2014). Four out of five children around the world today are vaccinated against the many fatal diseases compared to only 1 out of 5 in just over 30 years ago. Since the year 2000, approximately 15.6 million child deaths have been saved by immunizing children with measles vaccine**.** The Pan American Health Organization (PAHO) confirmed that measles was eradicted from the Americas region in the year 2002; for the last two decades, governments and national authorities, UNICEF and the World Health Organization, the US Centers for Disease Control and Prevention, Rotary International and the Bill & Melinda Gates Foundation and many other partners have led a major push for vaccination that has shown a reduction of measles cases by 99% and also a reduction on the number of countries where polio is still widespread (2014 data). PAHO was able to eliminate maternal and neonatal tetanus in many developed countries. This was made possible by improving hygiene during deliveries. According to UNICEF, (2014), Immunization has also contributed greatly to this decline with more than 128 million women of reproductive age in at-risk countries have received two doses of tetanus toxoid vaccine since 2000 by the use of a campaign style approach.

2.3 Immunization Coverage

Childhood immunization is proved to be the most effective approach used to prevent contagious diseases in the World (Anderson, 1992).

WHO & UNICEF (2008) provides an estimate of more than 2.5 million deaths among under-5 children worldwide that are stopped yearly by immunization against measles, tetanus and diphtheria. Recent statistics shows that the worldwide DTP3 immunization coverage of infants is 82%, out of this percentage 23.5 million children did not have the opportunity to receive DTP3 vaccine in 2008 (WHO & UNICEF, 2008). Although 120 countries reached 90% DTP3 vaccination coverage in 2008, pockets of under vaccination are reported in parts of sub-Saharan Africa (WHO, 2009). In Kenya, children aged 12-23 months that have received all recommended vaccinations stand at 77.4% (KNBS & ICF Macro, 2009). However, this proportion varies, 48.3% was recorded in North Eastern Province while 85.8% was recorded in Central Province. This geographical disparity in coverage reflects the discrepancy in persuade of determinants of full vaccination across the different provinces (Mutua et al., 2011).

2.4 Barriers to Immunization Services

2.4.1 Distance/travel conditions/access

Several studies have documented diffidence of health care services as an obstruction to their exploitation and an important cause of limited or no vaccination. More than a 1/3 of mothers in a six- state survey in Nigeria claimed distance/access as the biggest impediment (Babalola et al., 2005), 43% in Siaya, Kenya (Fields R. Measles Initiative, 1992), and 30% in Liberia (Bender et al., 1988).

2.4.2 Health staff's incentive, performance and attitudes

Health staff attitude is one of the most vital issues discouraging immunization of children in many countries. It has been reported that, some health workers treat mothers in a

disrespectful, unfriendly, and abusive manner.For instance, in Ethiopia (Ministry of Health, UNICEF/Ethiopia, 2001), Zimbabwe (Razum, 1993), Kenya (Abilla and Munguti, 1993) there are reported cases of health workers screaming at mothers who forgets the child's card, those who have missed a scheduled vaccination appointment or mothers with poorly dressed or malnourished children. This move humiliates mothers and discourages them from coming back to the health Centre for more immunizations (Blanchet, 1989). Health workers also lack proper language of communication with mothers (Pillsbury, 1990).

2.4.3 Lack of resources/logistics

A Survey carried out in Armenia found that the prime reason for non-immunization was due to lack of vaccine (UNICEF/Armenia, 2006). Vaccine stock outs are caused by deficient in of habitual funding, poor ordering, and lack of storage capacity and distribution systems (Africare, 2005; Bukenya, 1998).

2.4.4 False contraindications

In many cases, Health workers frequently refuse to immunize children due to various fears and false beliefs. This includes fears like a sick child should not be vaccinated or receive multiple vaccinations on the same visit. Other fears and false beliefs are that, the child is over one years of age and therefore "too old" for measles vaccination, other beliefs are that the underweight children should not be vaccinated due to their weight (WHO, 2009).

2.4.5 Reliability

Vaccination sessions takes place in health facilities, however, there are reported problems of cancelled and truncated sessions in many countries. For instance, it is reported that in many instances outreach sessions in particular are frequently cancelled or postponed due to shortage of vaccine or supplies, lack of a vehicle, or lack of per diem (WHO, 2009). Abilla&Munguti, (1993) reported that in Kenya, mothers stated that the frequent

postponement of immunization days made them to lose faith in the services provided; this made many of them to hesitate even when services resumed.

2.4.6 Appropriateness of time/limited day/hours

Immunization services are provided in many public health facilities during only limited days and hours which constitutes an important impediment for some families (PATH-Kenya, 1992). In Somalia, Indonesia and many other countries for instance, these services were only made available in the mornings when a good number of mothers are moving up and down with their day to day activities.

2.4.7 Waiting time

Many immunized children receive this service in public health facilities with short staffed work force, poorly organized health care givers, etc. (Department of State of Health-Gambia, 2004). In Liberia, approximately 30% of mothers commented on the nuisance of long waiting hours (Bender &Macauley, 1988). While mothers in Uganda complained that they waited for long hours to have their child vaccinated but the vaccinator did not come at the end of the day (Africare, 2005).

2.4.8 Lack of promotion/health communication

Many findings reported that parents whose children were not immunized completely were due to lack of support or follow-up of routine immunization (Bhanot et al., 2004). Different countries employ various special marketing campaigns such as mass media and social mobilization in promoting polio immunization but a good number of parents did not receive any message on the same.

2.4.9 Income/socioeconomic status

This status is mostly associated with child health status and wellbeing. In India, studies have found that poor urban children were 10 times more likely to have no immunizations than the richest children, consequently, poor rural children were less likely to receive full

immunization and more likely to have no immunizations than the children from rich families (Pnade et al., 2002). There is a strong feeling for mothers that it is socially unacceptable to appear in public with a sick or weak child (Millimouno et al., 2006). In many cases, such feelings are often armored when health workers humiliate poor mothers in public. According to Abilla&Munguti, (1993), mothers in Kenya feared attending vaccination lessons if their children had a skin disease.

2.4.10 Education (paternal and maternal)

Mothers' education is a helpful factor for appropriate use of health services (Bjerregaard et al., 1991; Brown et al., 1980). In Nigeria for instance, people who have received formal education were less likely to immunize their children than those who have not gone to school (Babalola, 2005).

2.4.11 Parental practical knowledge

There is need for Parents to fully comprehend on various vaccine-preventable diseases in the world,they also need to know well on how vaccination works and the vaccination timetable in order to be highly aggravated so that they can have their children vaccinated (Babalola et al., 2005). Parental perceptions and knowledge requires the appreciation of the essential concept that vaccination is vital for the health of their children (Alconde, 2002).

2.4.12 Fear of side effects

Gentle side effects, such as redness, fever or rash, are common and normally clear up on their own. Parents mention fear of side effects as a one of the reasons for not vaccinating their children in many countries like Liberia and Somalia (Bender and Macauley, 1988). In some cases, if an older sibling had side effects, parents refuse vaccinations for the younger children (Bhanot et al., 2004)

2.4.13 Religious/cultural/social beliefs/norms and rumors

Religion plays an integral part in vaccination of children in many countries, it is reported that parents of non-vaccinated children felt that it was against their religious beliefs to immunize their children (Kabir et al., 2006). The poor and illiterate parents report that they did not vaccinate their children due to instructions from their religious and social leaders (Razum, 1993). In Africa and Asia, some parents have developed a belief that vaccination sterilizes children in order not have families in future (Kabir et al., 2006).

2.4.14 Lost or forgotten health cards

Health cards are designed to aid the health workers and parents keep a track of individuals' service history. They also assist in serving as a reminder for parents to come back for vital and timely health care services. Many findings indicated that lost or misplaced cards were a surprisingly widespread issue that slowed down immunization in many countries in Africa and Asia. After some mothers lose their cards, many of them get scared going back in search of services for fear of being yelled at by the health staff, made forced to replace the lost card, and/or asked to return home to recover the forgotten card (Millimouno et al., 2006)

2.5 Missed Opportunity for Immunization (MOI)

According to W.H.O a missed opportunity is an instance when someone eligible for immunization and with no suitable contraindication visits a health service facility and does not obtain all suggested vaccines (WHO, 2013). The WHO's Expanded Program on Immunization (EPI) provides a recommendation for all children to be vaccinated at any health facility (EPI, 1986). This missed immunization opportunities arise due to system factors such as failure by facilities to provide immunization services frequently, non-availability of vaccines, , or negative parental beliefs (Borus, 2004). Every preventive and curative health service encounter is an opportunity to vaccinate an eligible individual (Olorunsaiye et al., 2015). MOI are common; a 2014 review in low and middle-income

countries (LMICs) concluded that MOI occurred in 32%–46% of public health service encounters (Sridhar et al., 2014). Recent assessments in Africa reported high MOI prevalence, ranging from 43% to 57%, and documented multiple reasons for an MOI (Restrepo-Méndez et al., 2016; SAGE, 2016), including healthcare providers not checking a child's vaccination eligibility during a sick child visit, false contraindications for vaccination, and hesitancy to open multi-dose vaccine vials. In Kenya, a small study that involved 23 children in the first decade of the existence of the Kenya Expanded Programme on Immunization (KEPI) was carried out. The study reported that 4% of children were missed for immunization when they attended an outpatient clinic (KEPI, 1983). In 2016 the WHO Strategic Advisory Group of Experts on Immunization endorsed a global strategy to identify and reduce MOI prevalence worldwide following the evidence from the above study (SAGE, 2016; WHO, 2017).

2.5.1 Reasons for Missed Opportunities for Immunization

In an evaluation of missed opportunities in developing and developed countries, Hutchins and colleagues (1993) found the reasons for missed opportunities to be the same in both settings, variations was only seen in their prevalence. Failing to immunize children for vaccines provided on a single visit in the routine schedule i.e. OPV and DPT at 6, 10 and 14 weeks, was reported as a common reason for missed immunization opportunities. Other reasons were false contraindications of immunization as well as indecent health worker practices. Other reported reasons included weaknesses in logistics, poor clinic organization and inefficient scheduling of vaccination. Parental refusal to let their children vaccinated was not common basis (Hutchins et al., 1993).

2.5.2 Reducing MOI

Strategies for reducing MOI include screening for vaccination status during visits to health facilities for mild illness, ensuring children receive all recommended injectable vaccinations

during a single visit, and using facility-based child vaccination registers to help track when individuals are due for vaccination (Velandia-González et al., 2015). Both private and public health sectors could play important roles in implementing MOI reduction strategies. Although MOI have been examined in the public sector, little is known about MOI in the private health sector (Olorunsaiye et al., 2015). WHO, has come up with a guide that is designed to help decision-makers interested in using the MOI policy to advance vaccine uptake and immunization coverage by in order to reduce the big number of missed opportunities (WHO, 2017).

2.5.3 Strategy to reduce MOI

The MOI strategy has been from time to time used a participatory research approach to get the obligation and leverage the understanding and experience of users to resolve problems affecting them. There is need for every effort to be put in place in ensuring that the Ministry of Health (MOH) and EPI team incorporate reducing MOIs into their program improvement plans and to use the MOI strategy to optimize health service. The MOI strategy must be included with other ongoing country work plans in improving vaccine coverage and vaccination timeliness and coverage impartiality. In order to reduce MOIs there is need for investment on repeated monitoring of coverage and helpful supervision from senior health managers. It is also vital to take note of the number of children vaccinated on monthly basis. Standard monitoring charts should also be used by health facilities in helping to track monthly vaccination coverage (WHO, 2017)Monitoring charts that are large enough to be displayed should be displayed clearly and be made visible to all health facility users.

CHAPTER THREE

METHODOLOGY

3.1 Study area

The research was conducted in Makadara Sub-County in Nairobi County. Makadara has an estimated population of 150,000 children below five years of age (DHS 2012).The Sub County has 20 government owned health facilities as well several private facilities and FBOs. The socio economic status of residents of Makadara cut across the high, medium and low end tiers who spend differently when trying to seek for health services.

3.2 Study design

Information on the history of the selected children for the study was collected and analysed.Therefore aretrospective cohort study design was adopted to establish factors that influencedmissed opportunity for vaccination among under-five-year old children.Missed opportunity in this study refers to a child failing to receive at least one immunization out of allimmunizations recommended for children in their first year of life as per kepi schedule.

3.3 Study population

The study population comprised of under-five-year old children residing in Makadara sub-county during the study period. Among the factors reported to be associated with missed opportunity from previous studies education level of the mother was the most common. In this study, education level of the mother/guardian at the time of birth of the child was used as the exposure variable in defining the cohort. The exposed group included the children whose mother/guardian had low education level (primary level education and below). The unexposed group comprised of children whose mother/guardian had high level of education (secondary level education and above) at the time of birth of the child.

3.3.1 Inclusion criteria

Unexposed group

- Under-five-year old child whose mother/guardian had secondary education and above at the time of birth of the child
- Child should have stayed in Madarakasub-county at least 1 year since birth
- Child whose mother/guardiangave a signed consent

Exposed group

- Under-five-year old child whose mother/guardian had primary education and below at the time of birth of the child
- Child should have stayed in Madaraka sub-county at least 1 year since birth
- Child who mother/guardian gave a signed consent

3.4 Sample size determination

The hypothesis being tested in this study was that, the risk of missed opportunity among children whose mother/guardian has low education level is not different from the risk for children whose mother/guardian has high education level. The relative risk statistic was used to compare the risk of missed opportunity in the two groups. The sample size was therefore estimated using the formula by Fleiss (1981);

$$n = \frac{Z_{\alpha/2}\ \sqrt{1+1/m\ p\ 1-p} + Z_{\beta}\ \sqrt{\frac{P_0\ 1-P_0}{m+p_1\ 1-p_1}}\ ^2}{p_0 - p_1\ ^2}$$

$$p = \frac{p_1 + mp_0}{m+1}$$

$$n_c = \frac{n}{4}\left(1 + \sqrt{1 + \frac{2(m+1)}{nm(p_0 - p_1)}}\right)^2$$

Where,

$\boldsymbol{n}$: Minimum sample size required in the exposed group

$\boldsymbol{n_c}$**:** Continuity-corrected sample size

$\boldsymbol{Z_{\alpha/2}}$**:** Standard normal distribution critical value at α (type I error) - probability of detecting a false effect for a two sided test (**α=0.05;** $\boldsymbol{Z_{\alpha/2}}$**=1.96**)

$\boldsymbol{Z_{\beta}}$**:** Standard normal distribution critical value at β (type II error) - probability of failing to detect a true effect (**β=0.2;** $\boldsymbol{Z_{\beta}}$**=0.84**)

$\boldsymbol{p_0}$**:** Probability of event in unexposed group which can be estimated as the population prevalence of event under investigation ($\boldsymbol{p_0}$) =0.17 based on the proportion of children not immunized or received part immunization in Nairobi (mumbi at el,2012)

$\boldsymbol{p_1}$**:** Probability of event in the exposed group **(**$\boldsymbol{p_1 = RR * p_0}$**)** where **RR is** expected relative risk (**RR=2.21** (based on the immunization status among children in Kenya report by Onsomu (2015)**);** therefore$\boldsymbol{p_1}$**=0.38**)

$\boldsymbol{m}$**:** Number of unexposed subjects per exposed subject (**m**=1)

Based on this formula and defined parameters the calculated minimum sample size in the exposed group was be n=121 children; and n*1=121 in the unexposed group giving a total sample size of 242 children

3.5 Sampling method

Multistage sampling method was used in this study. Cluster sampling was done in the first stage to select wards (cluster) in Makadara sub-county. Makadara sub-county is divided into four wards Maringo/Hamza, Viwandani, Harambee and Makongeni. Due to limitations in the budget and time, two wards wereselected from the four wards using simple random sampling. In the second stage the sampling unit was sub-locations (clusters);five sub locations were selected using simple random sampling from the two wards selected. In the third stage, ten roads were selected through convenience sampling in each of the ten sub-locations. For each sampled road, one side (left or right of the road) were randomly assigned to the road (e.g. Road 6 left side). In the final stage, a minimum of 24 houses were selected from each of the assigned sides of the selected roads using systematic sampling at a K interval of 10 houses. Only one child was selected in each house based on the education level at the time of birth of the last born child (below five years of age) until the required sample size for each group was attained.

3.6 Data collection

3.6.1 Training of Research Assistants

Two research assistants were selected from year 2 nursing students at the school of nursing of the University of Nairobi. They were trained and orientated in the requirements of the research for three days in data collection.

3.6.2 Recruitment Process and consenting procedure

Recruitment of study participants took place during the weekends to reduce the probability of having cases of the mother/guardian missing at home. Eligible participants were children who meet the inclusion criteria. Only one child was recruited from each household. For households with more than one under-five-year old children, the last born was considered. Once they are recruited consent was obtained from the mother/guardian of the child.

The researcher gave evidence of approval to undertake the study to the Makadara Sub-county administration office to introduce self and to the mother/guardian. Upon contact with the mothers, the researcher introduced self and research assistants and issue invitation to the study participant to participate in the study. The participants were given information that pertains to their participation in order to make informed consent.

3.6.3 Interview Procedure

Each mother/guardian was approached and explained about the study. Once the respondent consents to participate in the study, he/shewasasked provide the immunization booklet of the child for purposes of collecting information of the vaccination clinics attended. For mothers who did not have the immunization booklet, they were asked to give account of the vaccinations attended by the child. Thereafter a face to face interview was conducted using the semi-structured questionnaires administered by the research assistants.

The data included information in the following variables;

Dependent variable- Whether a mother/guardian missed any child vaccination schedule

Independent variables- Education level of the mother/guardian at birth of the child, marital status, proximity to health facility, employment status of the mother/guardian, age of guardian, awareness level of the immunization schedule of the child, relationship of respondent to the child

3.7 Data management and analysis

Data collected was entered and stored in Microsoft Access 2013. Data cleaning, coding and analysis was done using STATA version 13.

Univariate analysis was done to explore the data; for categorical data such as education level, marital status etc, bar/pie charts were plotted to show the distribution, frequencies and

proportions were reported. For continuous/discrete data such as mother's age, number of children, age of the child etc; histograms were plotted to show the distribution, Shapiro Wilk test for normality was done to check for normality of data, mean/median/mode and SD/IQR were reported depending on the distribution.

Multiple log binomialregression model was used to evaluate the effect of predictors on the risk of missed opportunity. The adjustedrisk ratioand corresponding p-values were reported.

Log-binomial regression model

$\boldsymbol{log}\ (\boldsymbol{P}) = \sum_{i=0}^{j} \boldsymbol{\beta_i x_i}$ Where, **β** is the coefficient of predictor $\boldsymbol{X_i}$ and $\boldsymbol{e^{\beta}}$ = **Riskratio**

3.8 Ethical consideration

The research proposal was submitted to UON/KNH research and ethical committee for clearance and approval. Signed informed consent was sought from all mothers/guardians selectedand only consenting mothers participated in the study. All the information obtained from the respondents was treated with utmost confidentiality. All data collected was used for this study alone. No participant wascoursed or forced to participate in the study.

CHAPTER FOUR

RESULTS

A total of 248 infant primary caregivers were recruited to participate in this study based on exposure status. The exposure variable in this study was the highest education level attained by the caregiver at the time of birth of the infant. The exposed group (n=124) comprised of caregivers who had attained primary level education and below whereas the unexposed group (n=124) comprised of caregivers who had attained secondary level education and above.

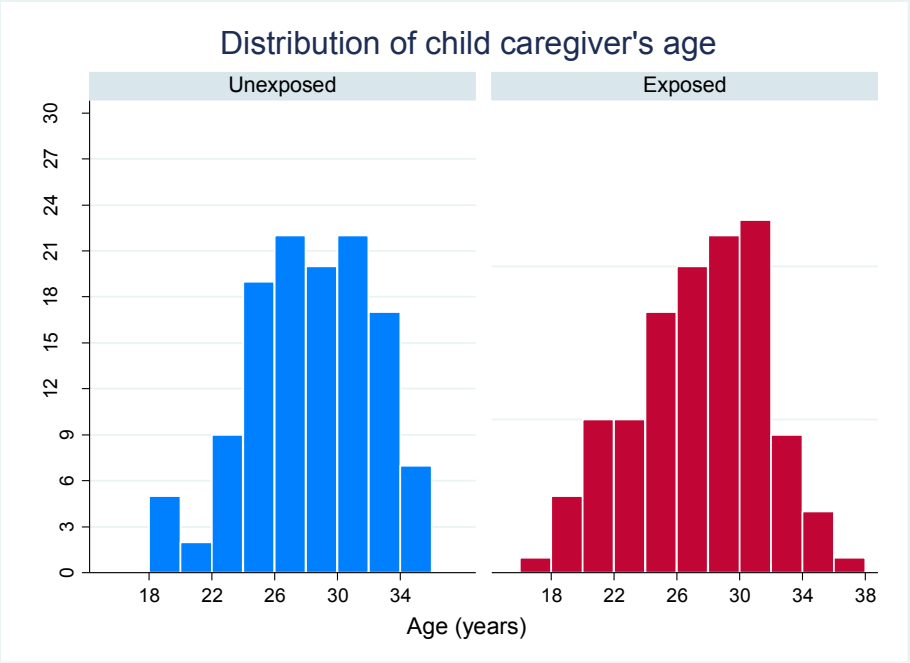

Figure 1: Distribution of caregivers' age in years by exposure

The caregiver's age ranged between 18 and 36 years in the unexposed group and between 17 and 37 years in the exposed group. Three quarters of the caregivers were younger than 31 years.

With regards to the relationship of the caregivers to the infants in the study majority were the mothers, 87.9% in the exposed group and 91.9% in the unexposed group. In the exposed

group, self-employed were the majority representing 50.8% whereas in the unexposed group, most were employed either in the government or private sector representing 56.5%.

Table 1: Characteristics of the caregiver and access to the hospital

Variable	Category	Exposed n (%)	Unexposed n (%)
Respondent's occupation	Employed (private/govt)	23 (18.5)	70 (56.5)
	Self employed	63 (50.8)	36 (29.3)
	Not working	38 (30.7)	18 (14.2)
Relationship caregiver to the child	Mother	109 (87.9)	114 (91.9)
	Guardian	15 (12.1)	10 (8.1)
Fare to nearest hospital (Ksh)	<50	69 (55.6)	86 (69.4)
	50-100	55 (44.4)	38 (30.6)
Time taken to nearest health facility	<30 minutes	72 (58.1)	70 (56.5)
	30-60 minutes	5 (4.0)	9 (7.3)
	>60 minutes	47 (37.9)	45 (36.2)
Transport means used to hospital	Bodaboda	34 (27.4)	23 (18.5)
	Matatu	58 (46.8)	77 (62.1)
	Walking	32 (25.8)	24 (19.4)

The study sought to also understand the accessibility of the infants' caregivers to health facilities. Asked about the transport cost to the nearest health facility, 55.6% of the caregivers in the exposed group and 69.4% in the unexposed group spent less than Ksh. 50 to the nearest hospital. With regards to time taken to reach the nearest health facility, slightly more than half of the caregivers in the exposed (58.1%) and unexposed (56.5%) groups take less than 30 minutes to access the nearest health facility. Public service vihicles (Matatu) was the main means of transport used by caregivers in both groups to access the nearest hospital.

Table 2: Child immunization

Variable	Category	Exposed n (%)	Unexposed n (%)
Where was the child delivered?	Health facility	120 (96.8)	114 (91.9)
	Home	4 (0.3)	10 (8.1)
Do you know what child immunization means?	Yes	109 (87.9)	112 (90.3)
	No	15 (12.1)	12 (9.7)
What is your source of information about	Health worker	94 (86.2)	100 (89.2)
	Media	24 (22.0)	44 (39.3)
Immunization (*multiple responses*)	Friends/relatives	35 (32.1)	28 (25.0)
	Others	3 (2.8)	7 (5.6)
Has your child received any immunization since births?	Yes	120 (96.8)	123 (99.2)
	No	4 (3.2)	1 (0.8)

Majority of the children in both groups were delivered in a health facility. Asked about the meaning and importance of child immunization, 87.9% of caregivers in the exposed group and 90.3% in the unexposed group were conversant. Health workers were the most frequently mentioned sources of information about child immunization followed by friends/relatives in the exposed group and media in the unexposed group.

Most of the children in this study had received at least one immunization since birth; 120/124 in the exposed group and 123/124 in the unexposed group. The children were aged between

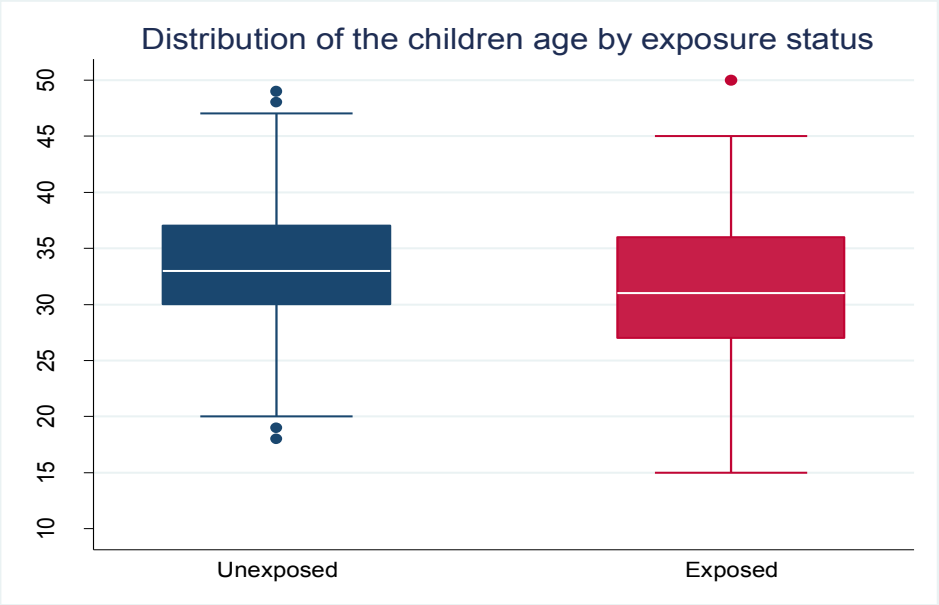

Figure 2: Distribution of child's age in weeks by exposure status

The children in this study were aged between 14 and 50 weeks. Half of the children in the unexposed group were younger than 33 weeks whereas in the exposed group, half of them were younger than 31 weeks.

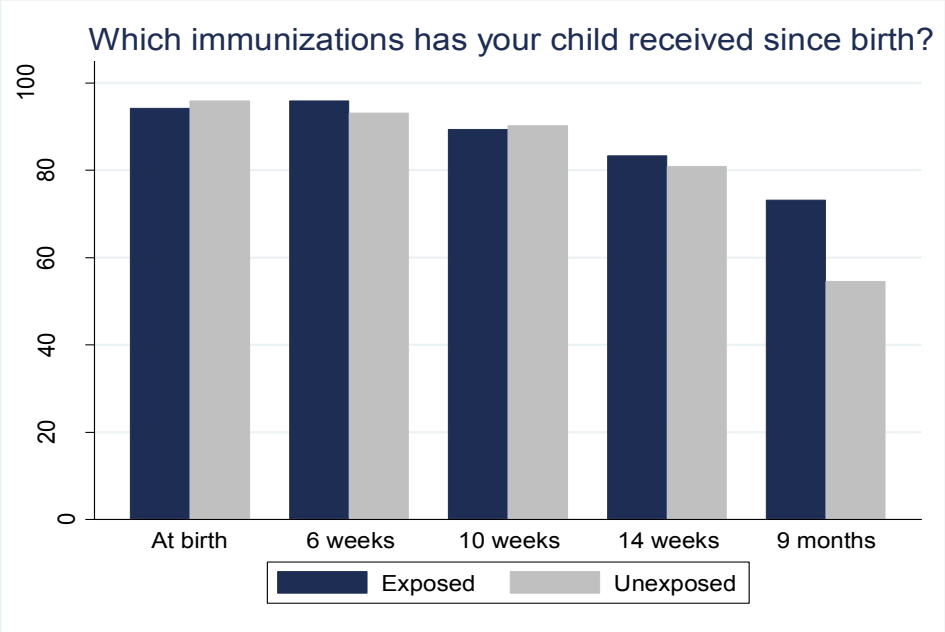

Figure 3: Distribution of children by immunizations received

The caregivers were asked about the immunizations that the child had received since birth; it emerged that at least 80% of the children had been immunized at birth, at 6 weeks, 10 weeks and 14 weeks. At 9 months approximately 78.2% of the children in the unexposed group had been immunized which was markedly lower than the proportion of children immunized in the exposed group (54.5%). Overall, 71.3% of the children had received all the recommended immunizations

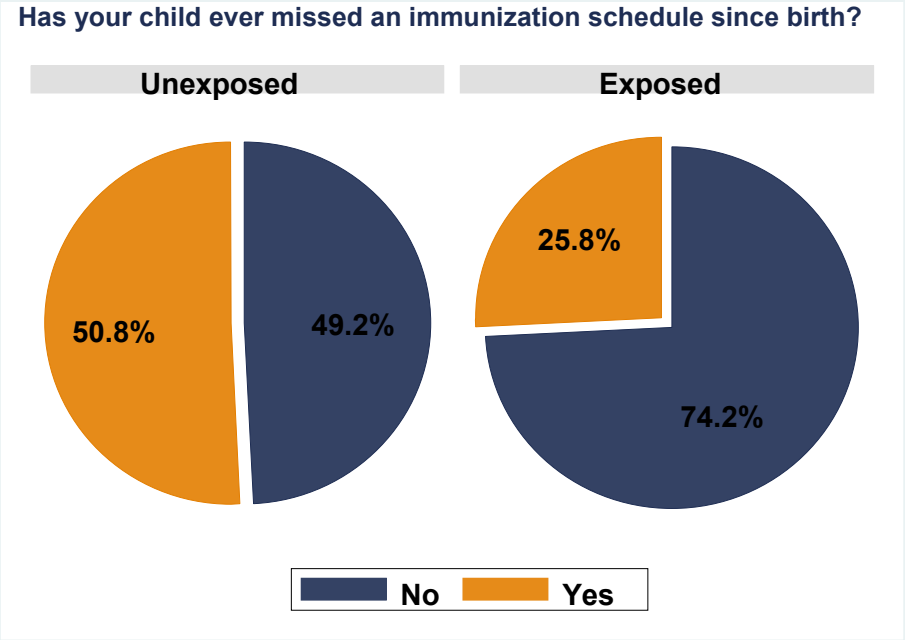

Figure 4: Proportion of missed opportunity by exposure status of child's caregiver

Approximately half (50.8%) of the caregivers in the unexposed group reported having missed at least one scheduled immunization since the child was born. In the exposed group, only 25.8% reported having missed at least one scheduled immunization since the child was born. Among the most frequently given reasons for missing a scheduled immunization, were work commitment and vaccine stock outs in the unexposed group; and travel and transport difficulty followed by vaccine stock outs in the exposed group. The figure below shows the distribution of the reasons given by the respondents for missing a scheduled immunization.

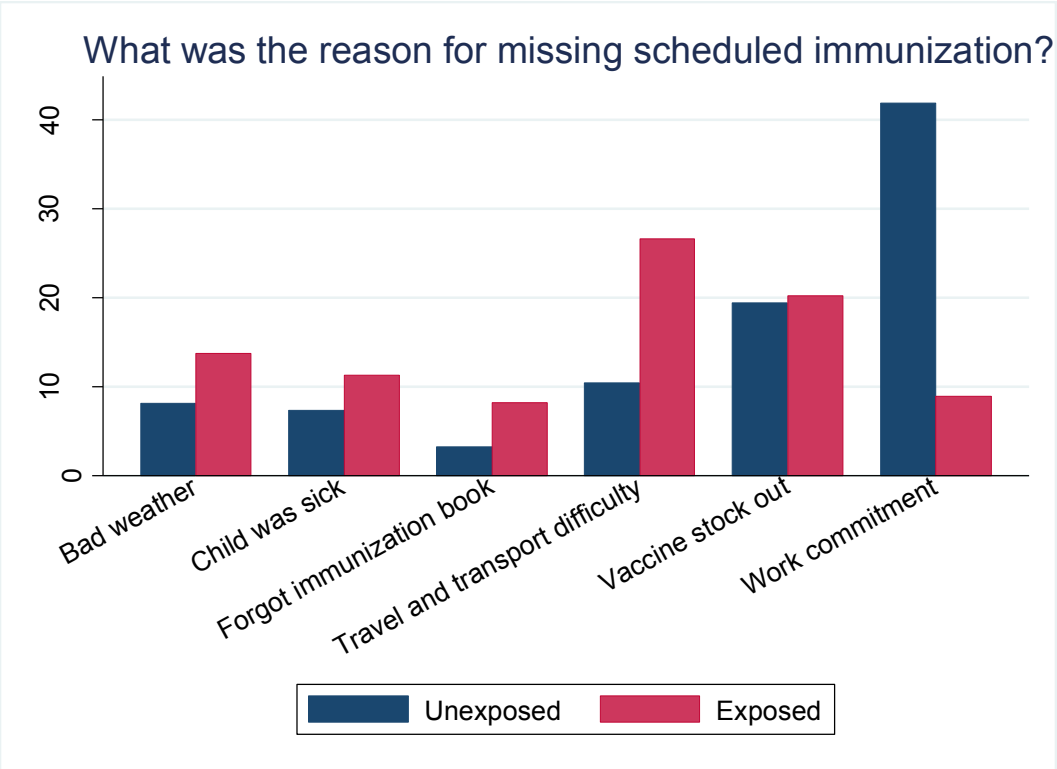

Figure 5: Distribution of reasons given by caregivers for missed opportunity

A Cox Proportional hazard regression model with constant time was fit to evaluate the association between the characteristics of the caregiver and accessibility of health facilities on the risk of missed opportunity for immunization among the children this study.

The model was significant; Log likelihood =-517.25, p-value=0.036. The table below shows the results of the model output. Only the caregivers' education level and occupation were found to be significantly associated with the risk of missed opportunity for immunization.

A caregiver who had attained at most primary level education had 48% reduced risk of missing an immunization opportunity for the child relative to a caregiver who had attained at least secondary level education after adjusting for the effect of other covariates in the model. While the risk of a self-employed care giver missing a scheduled immunization for the child, was not significantly different from that of an employed caregiver; a caregiver who is not

working had 44% reduced risk of missing a scheduled child immunization compared to a working one after adjusting for the effect of other covariates in the model.

Table 3: Multiple log binomial regression-factors associated with missed opportunity for immunization

Variable	Category	Adjusted RR	95% CI (RR)	P-value
Highest Education level	Secondary and above (base)			
	Primary and below	0.52	[0.34; 0.81]	0.003*
Occupation type	Employed (base)			
	Self employed	0.94	[0.57; 1.52]	0.330
	Not working	0.56	[0.42; 0.76]	0.031*
Age group of mother	≤25 years (base)			
	≥26 years	1.08	[0.69; 1.71]	0.729
Time taken to nearest hospital	≤30 minutes (base)			
	31-60 minutes	0.81	[0.25; 2.58]	0.716
	>1 hour	0.96	[0.55; 1.66]	0.882
Means of transport to nearest hospital	Bodaboda (base)			
	Matatu	0.99	[0.50; 1.97]	0.98
Relationship to child	Mother (base)			
	Guardian	1.17	[0.62; 2.21]	0.628
Place of delivery	Home (base)			
	Health facility	0.98	[0.42; 2.28]	0.962

CHAPTER FIVE

DISCUSSION

The study sought to investigate the factors influencing missed opportunity for immunization of children below the age of five years. Immunization has proved to be one of the most cost effective way of preventing child morbidity and mortality (Negussie et al, 2016) due to vaccine preventable diseases. It is for this reason that the Expanded Program on Immunization (EPI) was implemented in Kenya to ensure that primary immunization is delivered to all infants. The primary caregiver of an infant, mostly the mother, plays a very important role in ensuring that the child receives all recommended immunizations in EPI (Abdulraheem et al, 2011) making them key respondents in studies focusing on child immunization. In this study most of the primary caregivers were the children's mothers; very few were under the care of guardians.

The study found out that 71.3% of the children in this study had received all the recommended vaccines taking their (infant's) current age into account. This estimate was higher compared to the proportion of children who were reported to have been fully immunized (67%) in Nairobi County in 2015 by the age of 12 months (Mutua et al, 2016) and almost two times higher compared to the rate reported in Jijiga District in Ethiopia (36.6%) (Mohamud et al, 2014). This improvement is vaccination can be attributed to the immunization campaigns and communication to the general public on the importance of child immunization over the last one year and perhaps a change in attitude towards the vaccines. It was noted that majority of the children in this study were delivered in a health facility; it is expected that upon discharge the health worker responsible should give information to the mother pertaining the child immunization as part of the postnatal care guidelines.

An estimated 38.3% of the children had experienced a missed opportunity for immunization since the child was born. This proportion of missed opportunity was modestly higher

compared to the median prevalence of missed opportunity reported by Sridhar et al, (2014) following a systematic review and meta-analysis of studies and data from different countries. The level of education of the caregiver at the time of birth of the child, and occupation type were found to be significantly associated with the risk of missed opportunity for immunization among children. While one would expect caregivers with a higher level of education to be more informed on matters child immunization compared to one with low education, in this study a child under care of a mother/guardian with secondary level education and above was found to have a higher risk of missed opportunity for immunization compared to a child raised by a caregiver with primary level of education or none. This finding contrasts with the findings of a study by Mokdad et al, (2015) in which children whose mothers had primary level and secondary education were less likely to experience missed opportunity for vaccination compared to children whose mothers had no education. The finding in this study could however be probably explained by the fact that majority of the caregivers with above secondary level education were mostly employed and therefore end up failing to take their children for immunization due to work commitments. In Kenya, living cost is high therefore mothers/guardians have to work to meet the family needs which sometime negatively affect the child care especially on matters immunization.

A child being born at home or at the health facility was not found to significantly influence the risk of missed opportunity for vaccination. This finding contrasts the finding of Mohamud et al (2014) in a study conducted in Ethiopia where the place of delivery of the child was found to be significantly associated with the likelihood of missed opportunity for vaccination. The accessibility of health facilities in terms of transport cost, time taken to reach the hospital and the means of transport used to the nearest hospital was also found not to be significantly associated with the risk of missed opportunity for immunizations. However, among the reasons given for missed opportunity were travel and transport difficulties which are directly

linked to accessibility of the health facility in terms of means of transport and fare. Whether a child is being raised by a guardian or the mother, the risk of missed opportunity for vaccination was also not significantly different. This again perhaps would depend on other factors such as the knowledge of the caregiver about the importance of child immunization, work related issues which do not discriminate a mother to a guardian. That said, one can still argue that the biological mother is more likely to be keen on the child's welfare and by extension ensure all vaccinations recommended and given to the child compared to a guardian.

CONCLUSION

The overall immunization uptake among children from Makadara Sub-County was fairly good compared to the uptake in Nairobi County. However, there's need to increase the uptake of specific immunizations especially those given at 9 months (Measles and yellow fever vaccine) whose rates were lower compared to the rest of the vaccines. The incidences of missed opportunity need to be reduced through outreach activities and possible reminders to mothers on the immunization schedules for the children. It will also be helpful to bring the employers on board, when it comes to addressing the issue of day offs for nursing mothers to enable them take their children to hospital for vaccination.

REFERENCES

1. **Aaby P (2007)**. Is susceptibility to severe infection in low-income countries inherited or acquired? *J Intern Med.*;261(2):112–22.
2. **Abdulraheem I. S, Onajole A. T, Jimoh A. A. G, Oladipo A. R. (2011)** Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *Journal of Public Health and Epidemiology* Vol. 3(4), pp. 194-203
3. **Abilla, WD, KK Munguti (1993)**. A National Qualitative Study of Factors which Promote and Hinder Immunization Activities in Kenya.*KEPI and REACH*.
4. **Africare – CIMCI NTUNGAMO. Community-Based Integrated Management of Childhood Illness (CIMCI-PLUS) Project (2005)**.Africare-Ntungamo. Factors Affecting Immunization Coverage among Children under Two Years in NtungamoSubcounty. (Uganda)
5. **AlConde S.A (2002)**. Reporte Final. Estudio de percepciones y expectativas a nivelpoblacionalsobre la prestación de servicios de inmunización, con énfasisen la vacunaPentavalente.For*USAID's CHANGE Project*. Santo Domingo,.
6. **Anderson RM (1992)**: The concept of herd immunity and the design of community-based immunization programmes. *Vaccine*, 10:928-935.
7. **Babalola S and AAdequyi (2005)**. Factors Influencing Immunization Uptake in Nigeria: Theory-Based Research in Six States. *PATHS*.
8. **Bahl R, Sinha A, Poulos C, Whittington D, Sazawal S, Kumar R, et al (2004)**. Costs of illness due to typhoid fever in an Indian urban slum community: Implications for vaccination policy. *J Health PopulNutr*.; 22(3):304–10.
9. **Bender D, R Macauley (1988)**. Immunization Drop-outs and Maternal Behavior: Evaluation of Reasons Given and Strategies for Maintaining Gains Made in the National Vaccination Campaign in Liberia. Presented at the 116th Annual Meeting of

the *American Public Health Association [APHA]*, Boston, Massachusetts, November 13-17.

10. **Bhanot A, Agarwal S, Srivastava K (2004)**. Improving age appropriate immunization among urban poor infants.Possible Options and Approaches.*USAID/ Environmental Health Project*. (India)
11. **Bjerregaard, P, SK Lwanga, DD Mutie (1991)**. Factors affecting immunization coverage.Availability of services, parental education and social situation. (Kenya)
12. **Borus P.K (2004)**. Missed opportunities and inappropriately given vaccines reduce immunisation coverage in facilities that serve slum areas of Nairobi *East African Medical Journal Vol. 81*, (3), 124–129.
13. **Breiman RF, Cosmas L, Njuguna H, Audi A, Olack B, Ochieng JB, et al (2012)**. Population-based incidence of typhoid fever in an urban informal settlement and a rural area in Kenya: Implications for typhoid vaccine use in Africa. *PLoS One*.;7(1):e29119.
14. **Brown, J, P Djogdom, K Murphy, G Kesseng, D Heymann (1980)**. Identifying the Reasons for Low Immunization Coverage: A Case Study of Yaounde, United Republic of Cameroon. Geneva: *World Health Organization*. EPI/GEN/80/4.
15. **Bukenya GB (1998)**. KAP Study of Immunisation Services in Uganda. Study Report. *Health Management Consult Uganda*: Kampala.
16. **CDC Kenya (2016)**. Kenya Annual Report, 2016.
17. **Cutts, F. T. (2000)**. Strategies to improve immunization services in urban Africa, 407–414.
18. **Department of State for Health, The Gambia (2004)**. Draft report on the rapid assessment of system wide [barriers] to immunization.

19. **Expanded Programme on Immunisation (1986)**. Global Advisory Group. I. Global Programme. *Weekly Epidem*.Record.; 61:13-14

20. **Fields R. Measles Initiative (1992)**.Trip report. Arlington, VA: *REACH Project*.

21. **Fleiss J. L.(1981)** Statistical Methods for Rates and Proportions. *John Wiley & Sons*

22. **Global Programme for Vaccines and Immunization, Expanded Programme on Immunization (1996).**Immunization Policy. WHO/EPI/GEN/95.03. Rev 1.

23. **Howie SRC, Schellenberg J, Chimah O, Ideh RC, Ebruke BE, Oluwalana C, et al (2016)**. Childhood pneumonia and crowding, bed-sharing and nutrition: A case-control study from the Gambia. *Int J Tuberc Lung Dis.*;20(10):1405–15.

24. **Hutchins, S.S., Janse, H.A.F.M., Robertson S.E., Evans, P. and Kim-Farley R.J. (1993)**.Studies of missed opportunities in developing and industrialisedcountries.*Bull. World Hlth. Org*.; 71:549-560.

25. **Kabir M. et al (2006)**. Beliefs about Childhood Immunization and Attitude Towards Uptake of Poliomyelitis Immunization in Nort. Bayero University, Kano; Ahmadu Bello University, Zaria, *National Program on Immunization* (Nigeria).

26. **Kenya Expanded programme on Immunisation, (1983)**. WHO/EPI/ GEN/83.

27. **Kenya National Bureau of Statistics (2014)**.The 2014 Kenya Demographic and Health Survey.

28. **Kenya National Bureau of Statistics (KNBS), ICF Macro (2009)**. Kenya Demographic and Health Survey 2008-09. Calverton, Maryland: KNBS and ICF Macro;

29. **LaFond AK (1990)**. A study of immunization acceptability in Somalia.*Save the Children (UK).*

30. **Lodha R, Dash NR, Kapil A, Kabra SK (2000)**. Diphtheria in urban slums in north India.*Lancet*.;355(9199):204

31. **Loening WE, Coovadia HM (1983)**. Age-specific occurrence rates of measles in urban, peri-urban, and rural environments: Implications for time of vaccination. *Lancet*.;2(8345):324–6

32. **Maina L. C., Karanja S., Kombich J. (2013)** Immunization coverage and its determinants among children aged 12-23 months in a peri-urban area of Kenya. *Pan Afr Med J:* 14 (3) 2181

33. **Ministry of Health (2013)**.National Policy Guidelines on Immunization.

34. **Ministry of Health, UNICEF/Ethiopia (2001)**.National Immunization KABP Survey Report.

35. Mohamud A.N, Feleke A, Worku W, Kifle M, Sharma H.R. (2014) **Immunization coverage of 12-23 months old children and associated factors in Jigjiga District, Somali National Regional State, Ethiopia. BMC Public Health. 14:865**

36. **Mokdad AH, Gagnier MC, Colson KE, Dansereau E, Zúñiga-Brenes P, Ríos-Zertuche D, et al. (2015)** Missed Opportunities for Measles, Mumps, and Rubella (MMR) Immunization in Mesoamerica: Potential Impact on Coverage and Days at Risk. *PLoS ONE10 (10)*

37. **Mutua, M. K., Kimani-murage, E., &Ettarh, R. R. (2011)**. Childhood vaccination in informal urban settlements in Nairobi, Kenya : Who gets vaccinated ?

38. **Negussie A, Kassahun W, Assegid S, Hagan A.K. (2016)** Factors associated with incomplete childhood immunization in Arbegona district, southern Ethiopia: a case – control study. *BMC Public Health*.16:27.

39. **Olorunsaiye, C. Z., Langhamer, M. S., & Wallace, A. S. (2015)**. Missed opportunities and barriers for vaccination: A descriptive analysis of private and public health facilities in four African countries.

40. **Onsomu E.O., Abuya B. A., Okech I.N., Moore D., Collins-McNeil J. (2015)** Maternal Education and Immunization Status Among Children in Kenya. *Matern Child Health J:* 10995-015-1686-1
41. **Pande RP, Yazbeck AS (2002)**. Beyond National Averages for Immunization in India: Income, Gender, and Regional Inequalities. Washington, DC: *Health, Population and Nutrition, The World Bank.*
42. **PATH Kenya (1992)**. Qualitative research for measles initiative/Kenya – Final report to *Resources for child health project (REACH)*.
43. **Pillsbury B (1990)**. Immunization: The Behavioral Issues. Monograph #3 of Behavioral Issues in Child Survival Programs. Prepared for the Office of Health, USAID, by International Health and Development Associates.
44. **Rahman SR, Ahmed MF, Islam MA, Rahman MM (2016)**. Effect of risk factors on the prevalence of influenza infections among children of slums of Dhaka city.*Spring*.;5
45. **Razum O (1993)**. Mothers voice their opinion on immunization services. *World Health Forum*; 14(3): 282-6.
46. **Report(2014)** Kenya Demographic and Health Survey (KDHS)
47. **Restrepo-Méndez MC, Barros AJ, Wong KL, et al (2016)**.Missed opportunities in full immunization coverage: findings from low-and lower-middle-income countries.*Global health action*; 9.
48. **SAGE (2016)**.Meeting of the Strategic Advisory Group of Experts on immunization, April 2016– conclusions and recommendations.*WeeklyEpidemological Record*; 91:265-84.

49. **Saha I, Haldar D, Paul B, Shrivastava P, Das DK, Pal M, et al (2012)**. An epidemiological investigation of mumps outbreak in a slum of Kolkata.*JCommun Dis*.; 44(1):29–36.

50. **Sharma MK, Bhatia V, Swami HM (2004)**. Outbreak of measles amongst vaccinated children in a slum of Chandigarh.*Indian J Med Sci*.;58(2):47–53.

51. **Sridhar S, Maleq N, Guillermet E, Colombini A, Gessner B.D. (2014)** A systematic literature review of missed opportunities for immunization in low- and middle-income countries. Vaccine 32: 6870–6879

52. **Sridhar S, Maleq N, Guillermet E, Colombini A, Gessner BD (2014)**. A systematic literature review of missed opportunities for immunization in low-and middle-income countries.*Vaccine*; 32:6870-9.

53. **Torun SD, Bakirci N. (2006)**. Vaccination coverage and reasons for non-vaccination in a Subcounty of Istanbul. BMC Public Health;6:125

54. **UNICEF (2014)**. Vaccination: Keeping Children Alive and Healthy.

55. **UNICEF/Armenia, WHO/Armenia; and Ministry of Health (2006)**.Immunization coverage survey.Republic of Armenia.

56. **Velandia-González M, Trumbo SP, Díaz-Ortega JL, et al (2015)**. Lessons learned from the development of a new methodology to assess missed opportunities for vaccination in Latin America and the Caribbean. *BMC international health and human rights*; 15:1.

57. **WHO (2009)**: WHO Vaccine-Preventable Diseases: Monitoring System. *2009 Global Summary. Geneva: WHO*.

58. **WHO (2013)**.Systematic review of missed opportunities for vaccination.

59. **WHO (2015)**. Immunization in practice: a practical guide for health staff – 2015 update.

60. **WHO (2017)**. Planning Guide to Reduce Missed Opportunities for Vaccination (MOV), 1–34.
61. **WHO, UNICEF (2008)**: Global Immunization Data.
62. **World Health Organization (2009)**.Epidemiology of the Unimmunized Child Findings from the *Grey Literature*.

APPENDIX I: QUESTIONNAIRE

Instructions: Thank you for your willingness to respond to the following questions and participate in the study. The session will take 20 – 30 minutes. You will be interviewed by a research assistant who will fill the questionnaire for you. Your responses will be recorded just the way you put them. You are encouraged to be as accurate in your responses as possible. All gathered information will be kept confidential and will only be used for the purposes of this study.

Thank you.

SECTION A: RESPONDENT DETAILS

Housecode	
Study ID	

SECTION B: QUALITY CHECKS

Interviewer	Name				
Date		Start Time		End Time	

SECTION C: DEMOGRAPHICS

DM1 Record gender of respondent (DO NOT ASK)

Gender	**Tick (X)** ***only one response allowed***
Male	
Female	

DM2 Age of respondent in years…….

DM3

Level of education at the birth of the child (below 5 years)	**A: None** **B: Primary** **C: Secondary** **D: Tertiary**
Child 1	
Child 2	
Child 3	

Dm 4 Occupation

OCCUPATION CATEGORY	**Tick (X)** ***only one response allowed***
Employed by Government/parastatal company	
Employed in a private sector company	
Self-employed service provider (lawyer, doctor, certified public accountant, consultant, freelance trainer etc.)	
Self-employed –small/ medium sized business (trading, shop/ duka / kiosk, security,-transport	
Large business owner (industry/ factory/ hotels/restaurants/ estates/ import/ export/ distribution etc.)	
Not working (student, house wife, retired, unemployed)	

SECTION D: IMMUNIZATION HISTORY

Q1. Child's immunization booklet presented? Yes---------- No----------

Q2. How far is the nearest hospital facility from your residence in terms of fare?

.....

Q3.

How far is the nearest hospital facility from your residence in terms of km or fare	**Tick (X) *only one response allowed***
0-2 Km	
2-5 Km	
6-10 Km	
Over 10 Km	

Q4.

How long does it take you to reach at the facility?	**Tick (X) *only one response allowed***
0-30 Mins	
30-60 Mins	
1-2 hours	
Over 3 hours	

Q3

What means of transportation did you use to get there?	**Tick (X) only**
Walking	
Bicycle	
Bodaboda	
Matatu	
Taxi	
Personal vehicle	
Others (combination)	

Q4.

What is the age of the child (less than 5 years)	Age in months
Child 1	
Child 2	
Child 3	

Q5

What is your relationship to this child	Tick (X) only one response
Mother	
Guardian	

Q7.

Was this child/other children born in a health facility	Indicate (Yes/No)	Instructions
Child 1		If yes proceed to Q8
Child 2		
Child 3		

Q8.

Who attended to you/child's mother during delivery of the last child	Tick (X)
Traditional birth attendant	
Community health worker	

Trained health professional	
Others (specify)	

Q9.

Do you know what immunization is?	**Tick (X) *only one response allowed***	**Instructions**
Yes		Go to 10
No		Skip to 11
Not sure		13

Q10

How did you learn about immunization?	**Tick (X) *only one response allowed***
From health care worker.	
From the media and posters	
From friends, relatives barazas or chamaas	
Others (specify)	

Q11

Do you know the importance of immunization?	**Tick (X) *only one response allowed***	**Instructions**
Yes		
No		Go to 14
Not sure		Go to 14

Q12.

How many immunization schedules has the child (below 5 years) attended since birth?	Number	Instructions
Child 1		
Child 2		Go to 20
Child 3		

Q13 (*Gauge based on prevailing list and answers as to when administered*)

How many types of recommended immunizations are you aware of?	Tick (X) *only one response allowed*
One	
Two	
Three	
Four	
More than five	

Q14.

Has this child received any immunization?	CODE	
Yes	1	
No	2	Skip to 20
Not aware	3	Skip to 21
Others (specify)	4	

Q15 *(Gauge by age of the child)*

Which immunizations did/has your last child received?	Tick (X) *multiple response allowed*
At Birth	
At six weeks	

At 10 weeks	
At 14 weeks	
At 9 Months	
Received All	

Q16.

Which immunizations did your last child not receive?	**Tick (X)** ***multiple responses allowed***
At Birth	
At six weeks	
At 10 weeks	
At 14 weeks	
At 9 Months	
Received All	

Q17

Has this child ever missed scheduled immunization	**Tick (X)** ***only one***	
Yes		
No		Go to 21

Q18.

By how many days did the child miss the immunizations below?	**Duration in days**
At birth	
At 6 weeks	
At 10 weeks	
At 14 weeks	
At 9 months	

What reasons made the child miss the immunization?	**Tick (X) *multiple responses allowed***
Travel and Transport difficulties	
Forgot	
Work commitment	
Lack of vaccines at the hospital	
Health care worker attitude	
Religious faith	
Crowding at health facility	
Child sickness	
Bad weather	
Other reasons specify	

Q20

Why was the child not immunized?	**Tick (X) *multiple responses allowed***
Child born at home	
Did not Know importance	
Work commitment	
Lack of finances	
Transport difficulties	
Religious faith	
Felt no need	
Child sickness	
Bad weather	
Other reasons specify	

Thank you very much for your participation

Signature…….. Date……

APPENDIX II: CONSENT FORM

If you Consent to Participate in the study please sign below:

I hereby consent to participate in this study. I have been informed of the nature of the study being undertaken. I also understand that my participation in the study is voluntary and the decision to participate or not to participate will not affect my employment status at this facility in any way whatsoever. I may also choose to discontinue my involvement in the study at any stage without any explanation or consequences. I have also been reassured that my personal details and the information I will relay will be kept confidential. I confirm that all my concerns about my participation in the study have been adequately addressed by the investigator and the investigator have asked me questions to ascertain my comprehension of the information provided.

Participants Signature(or thumbprint)……Date……

I confirm that I have clearly explained to the participant the nature of the study and the contents of this consent form in detail and the participant has decided to participate voluntarily without any coercion or undue pressure.

Investigator Signature……Date……...

For any Clarification, please contact

KomuMutunga
Researcher
Mobile Number: 0700858348
Email: wkomu@gmail.com

MAHUMU YA II: FORM YA SASA

IkiwaUnakubaliKushirikikatikautafititafadhaliisharahapachini:

Mimi nikubalikushirikikatikautafitihuu. Nimetambuliwakuhusuhaliyautafitiunaofanywa. Pia ninaelewakuwaushirikiwangukatikautafitihuoniwahiarinauamuziwakushiriki au usiohusikahauathirihaliyanguyaajirakatikakituohikikwanamnayoyote. Naweza pia kuchaguakuachaushirikiwangukatikautafitiwakatiwowotebilamaelezoyoyote au matokeo. Pia nimehakikishiwakuwamaelezoyanguyakibinafsinataarifanitayayotumiaitahifadhiwasiri. Ninahakikishiakwambawasiwasiwanguwotejuuyaushirikiwangukatikautafitiwamekuwakushughulikiwakwakutoshanauchunguzinauchunguziameniulizamaswaliilikuthibitishaufahamuwanguwataarifailiyotolewa.

Washiriki Saini (au thumbprint) ..... Tarehe .....

Ninahakikishiakuwanimeelezeawazikwamshirikihaliyautafitinamaudhuiyafomuhiiyakibalikwaundaninamshirikiameamuakushirikikwahiaribilashinikizololote au shinikizo la kutosha.

SahihiyaMpelelezi ..... Tarehe ....

Kwa Ufafanuziwowote, tafadhaliwasiliana

KomuMutunga
Mtafiti
NambayaSimu: 0700858348
Baruapepe: wkomu@gmail.com