SCHOOL OF PUBLIC HEALTH
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FACTORS ASSOCIATED WITH INCOMPLETE CHILDHOOD VACCINATION AMONG CHILDREN AGED 24-35 MONTHS IN KANIFING MUNICIPALITY, THE GAMBIA, 2020.

BY

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DECLARATION

I, Baba Ceesay hereby affirm that the evidence presented in this work is the result of my work apart from the references of other people's work which were appropriately acknowledged. The thesis work was conducted under the supervision and has not been presented to any university for another degree.

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DEDICATION

This work is dedicated to my late dad Sumbundu (Omar) Ceesay and my mum Ida Sanyang for their exceptional support, care, and guidance to my life and throughout my academic career.

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LIST OF ACRONYMS

AOR	Adjusted Odd Ratio
BCG	Bacillus Calmette Guarin
CHN	Community Health Nurse
COR	Crude Odd Ratio
DPT	Diptheria Pertussis Tetanus
EA	Enumeration Area
EPI	Expanded Programme on Immunization
IWC	Infant Welfare Card
KM	Kanifing Municipality
LGA	Local Government Area
MCV	Measles-Rubella Vaccine
MICS	Multiple Indicator Cluster Survey
MRC	Medical Research Council
OPV	Oral Polio Vaccine
OIC	Officer-In-Charge
PHO	Public Health Officer
VPD	Vaccine-Preventable Diseases
WAHO	West African Health Organization
WHO	World Health Organization
WHR	Western Health Region
YF	Yellow-Fever

ABSTRACT

Background

Vaccination continues to be the leading public health intervention in the fight against infectious diseases contributing to the drop of morbidity and mortality globally. Improvements in child survival in the developed world are due to childhood vaccination since the 1960s. The attainment of 86% coverage for infants is inadequate in the prevention of vaccine-preventable diseases (VPDs) globally. Kanifing Municipality is one of the administrative areas with low vaccination coverage. According to the Multiple Indicator Cluster Survey report 2018, only 34.6% received all the recommended vaccines. This proportion was less than WHO targets for vaccination coverage at the district level of ≥ 80%. To improve uptake of immunization services and address the existing gaps in vaccination coverage, it is essential to research factors related to incomplete vaccination. The study aimed to determine the prevalence and factors associated with incomplete childhood vaccination among children between the ages of 24-35 months in Kanifing Municipality of The Gambia.

Methods

We conducted a cross-sectional study. The study enrolled 355 children between the ages of 24-35 months and their caregivers. A two-stage cluster approach was used to identify enumeration areas and caregivers of children. Face-to-face interviews were conducted using semi-structured questionnaires. We collected data on caregiver socio-demographic characteristics, characteristics of the child, and healthcare-related factors. Data were entered into Microsoft Excel version 10 and imported into STATA version 15 for analysis. Bivariate analysis and multiple logistic regression were conducted at a p-value of ≤ 0.05.

Results

The median age was 30 months with an age range of 24-35 months. Of the children's caregivers that participated in the study, 89.0% were married. The prevalence of incomplete vaccination was 57.7% (205) (95% CI: 52%-62%) whilst, 42.3% (150) of the children were completely vaccinated. Predictors of incomplete vaccination were the children of caregivers who belong to monogamous family type (aOR=1.90, [95% CI:1.12-3.22]), caregivers who are not aware of diseases for which vaccines are available (aOR=1.62, [95% CI=0 .99-2.64]), caregivers who do not know the age at which the child graduates from routine immunization (aOR=1.66, 95%CI=1.04-2.64) and caregivers who walked to the clinic (aOR=1.78, 95% CI:1.11-2.84).

Conclusion

There was a high prevalence of incomplete vaccination among children in Kanifing Municipality. Predictors related to incomplete vaccination among children 24-35 months were children of caregivers who belong to monogamous family type, caregivers who are not aware of diseases for which vaccines are available, caregivers who do not know the age at which a child graduate from immunization, and caregivers who walked to the clinic. The EPI should conduct further studies on incomplete vaccination and work with partners to ensure timely and consistent availability of vaccines in the routine schedule. Health facility staff should strengthen health education activities during clinics and encourage male participation in RCH clinics.

Keywords: Vaccination, Incomplete, Prevalence, Gambia, Kanifing Municipality

CHAPTER ONE

INTRODUCTION

1.1 Background

Vaccination continues to be the leading public health intervention in the fight against infectious diseases contributing to the reduction of morbidity and mortality globally (Kazungu & Adetifa, 2017b). Vaccines protect the body against infection by activating the body's natural immunity. Multiple doses of vaccines and periodic booster doses are required to produce strong immunity against vaccine-preventable diseases (Brewer et al., 2017). The eradication of smallpox globally was through vaccination programs (Bärnighausen et al., 2014).

In 1974, the World Health Organization (WHO) established the Expanded Programme on Immunization (EPI) to support countries to increase immunization coverage of childhood vaccines such as tuberculosis, polio, diphtheria, pertussis, tetanus, and measles (Plotkin, 2014). Each year, around 2 to 3 million deaths are prevented through routine vaccination of infants and children in industrialized and developing countries (Bärnighausen et al., 2014). From 2000 to 2014 the annual measles estimated deaths declined 79.0% from 546,800 to 114,900 and 17.1 million deaths were averted through measles vaccination (Morbidity and Mortality Weekly Report, 2015).

Access to immunization services was a reason for 19.4 million infants not being vaccinated completely with the third dose of Diphtheria Pertussis, and Tetanus DPT3 in 2018 and out of which 13.5 million missed the first dose. Among children under the age of one, 5.9 million did not complete the required three-dose schedule (Unicef & World Health Organization, 2019).

Developing countries have variations in vaccination coverage but are masked by global data, particularly in sub-Saharan African countries that attained only 76% of DPT3 coverage in 2015 (Kazungu & Adetifa, 2017a).

The Gambia Expanded Programme on Immunization (EPI) was launched in May 1979 following an outbreak of yellow fever in the Upper River Region in 1978 (Scott, Odutola, Mackenzie, Fulford, Afolabi, et al., 2014). The EPI followed the vaccination schedule and the vaccines are against diseases such as; tuberculosis, pertussis, pneumonia, Polio, diphtheria, hepatitis B, tetanus, rotavirus, yellow fever, measles, and Haemophilus Influenzae type B (Hib), (Odutola et al., 2015). (Table 1). The Gambia EPI is among the top ten (10) best-performing countries in Africa with high immunization coverage. In 2014, the coverage for diphtheria pertussis and tetanus 1 (DPT1), diphtheria pertussis, and tetanus 3 (DPT3), and measles second dose were 98%, 96%, and 73% respectively(WHO, 2016).

Table 1: The Gambia EPI vaccination schedule

Antigen	Age Given
BCG, OPV0, Hep.B0	At birth
OPV1, Penta1, Pneumo1, Rota1	2 Months
OPV2, Penta2, Pneumo2, Rota3	3 Months
OPV3, Penta3, Pneumo3, Rota3	4 Months
Measles-Rubella 1st dose, Yellow Fever, OPV4	9 Months
OPV BOOSTER, Measles-Rubella 2nd dose	18 Months
DPT BOOSTER	1 Year After Penta 3

Source: The Gambia Multiple Indicator Cluster Survey 2018

Despite high vaccination coverage, incomplete vaccination among children continues to be a challenge in many parts of Africa including the Gambia. A study carried out in The Gambia revealed that of the total 16 doses of vaccines offered in the national vaccination schedule only 20% of the children were completely vaccinated, 86% received half of the doses, and 67% received at least 12 doses (Payne et al., 2014).

Reasons for incomplete vaccination have been documented in several studies. A study in Northwest Ethiopia showed that unawareness of vaccination benefits, travel time of 15 minutes to 30 minutes, and 30 minutes-1 hour to the clinic were reasons for incomplete vaccination (Yismaw et al., 2019a) and lower birth order, and use of commercial vehicles as a means of transport to health facilities (Odutola et al., 2015).

1.2 Problem statement

About 8.5 million unvaccinated children reside in the African region (Unicef & World Health Organization, 2019). Kanifing Municipality has been one of the administrative areas with low vaccination coverage. Findings of the Gambia Multiple Indicator Cluster Survey revealed that only 34.6% of children aged 24-35 months received all the recommended vaccines in the vaccination schedule (Gambia Bureau of Statistics, 2019). Equally, The Gambia Demographic Health Survey also reported of children aged 12-23 months, 70.9% had received all the vaccines before their first birthday (Gambia Bureau of Statistics, 2014). These proportions were less than WHO targets for vaccination coverage at the district level ≥ 80%.

Factors associated with incomplete vaccination have been attributed to being married, a female child, and belonging to the Christian religion (Baguune et al., 2017). Other factors that may also influence incomplete vaccination of a child were child age <18 months and maternal age <25 years (Emmanuel et al., 2015), being born second to fourth, mothers lack knowledge about immunization benefits (Negussie et al., 2016), children whose parents walked between 30 minutes to 1 hour to reach to the health facility (Ekouevi et al., 2018).

Studies on vaccination coverage have been conducted in the Kanifing Municipality (Scott, Odutola, Mackenzie, Fulford, Afolabi, et al., 2014) however, the studies have so far not clearly established which factors are influencing incomplete vaccination among children in the municipality. Most of these studies have focused on vaccination coverage and limited attention to the factors related to incomplete vaccination.

Incompletion of vaccination may put the child at risk of contracting vaccine-preventable diseases. Furthermore, it may lead to a high wastage of vaccines, increase losses to the government, a burden on the health system, and an outbreak of vaccine-preventable diseases. Children who are not vaccinated against measles are 35 times at risk of contracting the disease. Unvaccinated or incompletely vaccinated children have a high chance of contracting the disease than others and may contribute to the continuing circulation of the pathogens in the community that could lead to death (Singh et al., 2019).

Therefore, the study aimed to determine the prevalence and factors associated with incomplete childhood vaccination among children aged 24-35 months in Kanifing Municipality of The Gambia.

1.3 Conceptual Framework

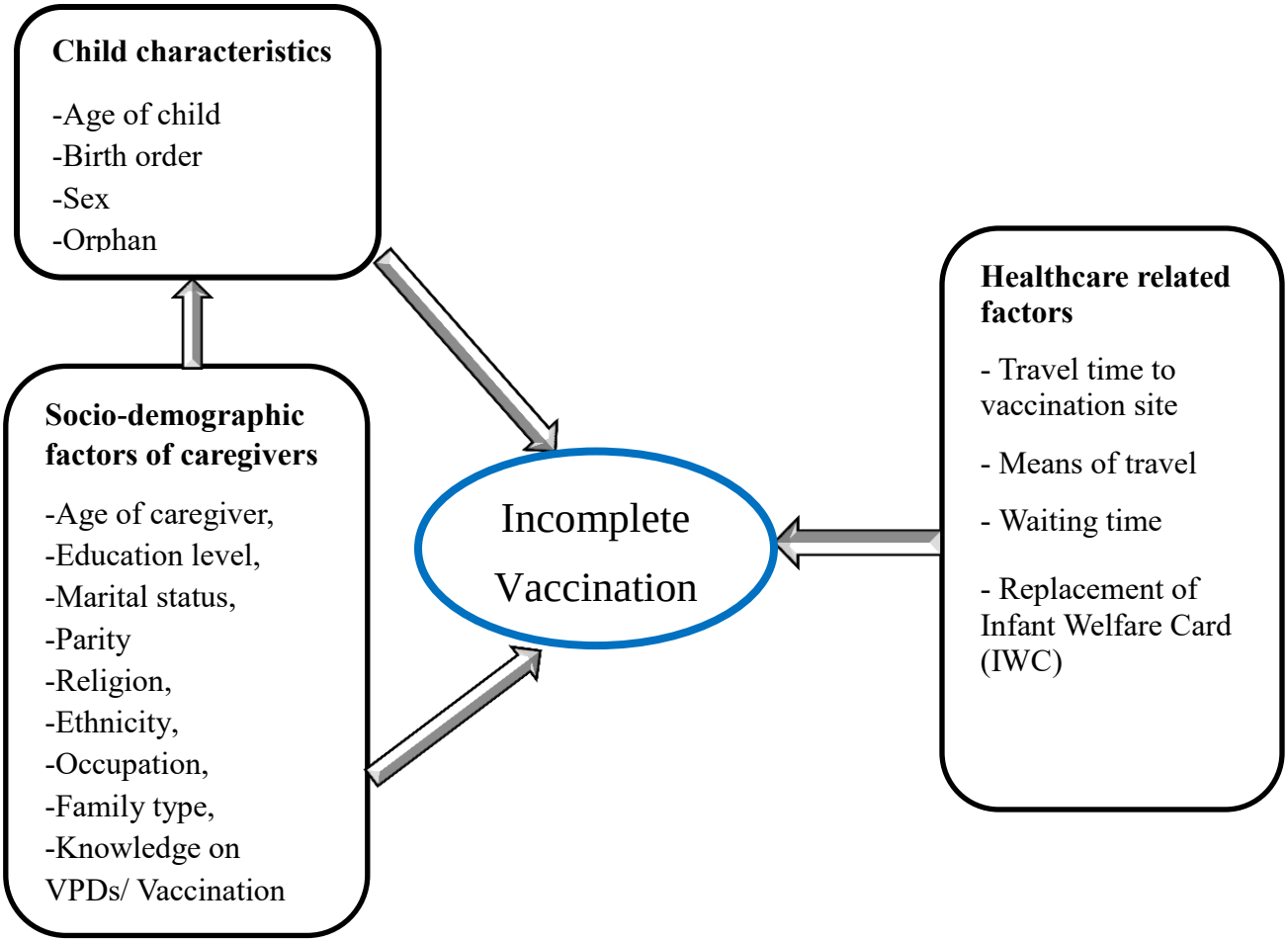

Figure 1: Conceptual framework of factors associated with incomplete childhood vaccination among children aged 24-35 months in Kanifing Municipality

Caregiver: A mother, father, or any family member responsible for taking the child to the infant welfare clinic.

The conceptual framework illustrates the interlink of factors associated with incomplete childhood vaccination among children aged 24-35 months in Kanifing Municipality. Incomplete vaccination was the dependent variable, and independent variables include caregiver's socio-demographic factors, child characteristics, and healthcare-related factors that might influence incomplete childhood vaccination and this has been documented by previous studies (Abadura et al., 2015).

Socio-demographic characteristics of the caregiver may influence incomplete vaccination. These factors may also influence the child's characteristics such as sex and orphanage. The age of the caregiver also influences the birth order of the child. In most instances, caregivers give high priority to the first and second-born compared to successive children which may lead to incomplete vaccination. Child sex has not been documented by most studies as a factor for incomplete vaccination. However, some families may have a preference for male children compared to females which may likely lead to incomplete vaccination. Children whose parents are not alive may be underprivileged from vaccination. They may be left in the hands of their grannies and may not have the needed support or attention to utilize vaccination services and may influence incomplete vaccination

Socio-demographic factors such as the educational level of the caregiver determine the choice of utilizing health care services. Caregivers with poor knowledge of vaccination may likely not attend immunization sessions regularly. This may lead to incomplete vaccination of the child due to limited knowledge on the importance of vaccination in preventing childhood diseases. Married women may likely complete vaccination as opposed to unmarried. The latter may not attend monthly clinics due to limited support by family members and social stigmatization in some societies which may deprive the child of receiving vaccinations. Ethnicity and religion also influence incomplete vaccination. Some Muslim countries do not accept vaccination due to their beliefs against vaccination, while other ethnicities due to their traditions and norms may see vaccination as a western concept. The occupation and family type of caregiver influence incomplete vaccination. Working mothers may not have the time to take their child to the clinic regularly as it may coincide with working hours while extended families may not have the means to support the welfare of all the children below five years to maintain their routine vaccination.

Healthcare-related actors may also contribute to incomplete vaccination. Means of travel to the clinic can deter caregivers from attending vaccination sessions regularly. Easy access to the clinic may encourage the mothers to attend the clinic, because of the limited time and resources that may be spent to reach the vaccination site. Travel time to the vaccination site may also influence incomplete vaccination, especially if caregivers take long hours to reach the facility. Waiting time is an important factor that can impact caregiver decisions to attend the clinic regularly. Health care workers not starting sessions on time or sometimes favoring friends and family members may discourage some caregivers to attend clinics. Health facilities with long waiting hours may influence incomplete vaccination among children.

Unavailability of infant welfare cards may lead to incomplete vaccination. The health care worker may check the card to know the vaccines to be administered. Sometimes due to a delay in receiving a vaccination, the card may help to know the last vaccines received and the next appointment. It can be used to counsel the mother whether the child is receiving the vaccines at the specified time interval and also growth monitoring. It is the same card used to record the medical history of the child when they get sick and also acquire a birth certificate in some parts of the world. However, loss of the Infant Welfare Card (IWC) may deter the caregiver from attending the clinic of fear of charges that may apply to replacement or the child not receiving the vaccination. Sometimes even where the card is replaced the vaccination records may not tally which may lead to dropout or incomplete vaccination of children.

1.4 Justification

The study intended to determine factors such as the socio-demographic factors of caregivers, child characteristics, and healthcare-related factors that may influence incomplete childhood vaccination and provide recommendations to improve vaccination services. Two studies have documented factors associated with delays and timely childhood vaccination among children in the Kanifing municipality (Scott, Odutola, Mackenzie, Fulford, & Afolabi, 2014). Understanding the problem of incomplete vaccination among children and associated factors will inform the stakeholders and implementers to put appropriate interventions and approaches that will ameliorate the situation. The knowledge on vaccination incompletion among children within the municipality will aid the EPI program to target interventions in areas found to have a high vaccination dropout rate through community engagement and expansion of outreach services within the community. Health facilities can further strengthen their health education programs during base and outreach clinics to boost vaccination coverage.

If healthcare-related factors are found to be a determinant of incomplete vaccination it will guide the Regional Health Directorate to revisit the operational plan of routine immunization and prioritize interventions geared towards improving vaccination coverage. Furthermore, the information will help in the involvement of more private health facilities in the immunization that can increase the uptake of vaccination. The findings will also inform policymakers to come up with new strategies that can advance immunization standards, and increase access to other essential health care interventions. To improve uptake of immunization services and address the existing gaps in vaccination coverage, it is essential to find out factors associated with incomplete childhood vaccination.

1.5 Research Questions

1. What is the proportion of incomplete vaccination among children aged 24-35 months in Kanifing Municipality?
2. What are the socio-demographic factors and child characteristics that influence incomplete childhood vaccination among children aged 24-35 months in Kanifing Municipality?
3. What are the healthcare-related factors that determine incomplete childhood vaccination among children between the ages of 24-35 months in Kanifing Municipality?

1.6 Objectives

1.6.1 Main objective

To determine the prevalence of factors associated with incomplete childhood vaccination among children aged 24-35 months in Kanifing Municipality, The Gambia.

1.6.2 Specific objectives

1. To assess the proportion of incomplete vaccination among children aged 24-35 months in Kanifing Municipality
2. To determine an association between socio-demographic factors of caregivers and incomplete childhood vaccination among children aged 24-35 months
3. To determine the association between child characteristics and incomplete childhood vaccination among children aged 24-34 months
4. To determine healthcare-related factors associated with incomplete childhood vaccination among children between aged 24-35 months

CHAPTER TWO

LITERATURE REVIEW

2.1 Background

Improvements in child survival in the developed world are due to childhood vaccination since the 1960s (Mucheye Gizachew et al., 2015). The attainment of 86.0% coverage for infants is inadequate in the prevention of vaccine-preventable diseases (VPDs) globally (Unicef & World Health Organization, 2019). In the past decade, there was only a 5.0% increase in the immunization coverage over the period. The Immunization Agenda 2030 set a key goal to make vaccination available to everyone, everywhere by 2030 (World Health Organziation, 2019).

An estimated 20 million infants do not get fully immunized with basic vaccines and many more do not receive newly introduced vaccines. This left almost 13 million children unvaccinated through immunization programs (World Health Organziation, 2019). In 2017, estimates showed that the first dose of the DTP vaccine was not received in 1 out of 10 children, and 85.0% received three doses of DTP globally (Unicef & World Health Organization, 2019).

Despite improvements in vaccination coverage, there are still gaps in coverage between countries and within countries. Developing countries continue to face challenges with incomplete vaccination with 16% lower coverage for 3 doses of the diphtheria-tetanus-pertussis (DPT) compared to high-income countries ("Global Vaccine Action Plan," 2013).

In the Gambia, children aged 24-35 months that were vaccinated for basic antigens (BCG, OPV 3, Penta3, Measles-Rubella 1), at any time before the survey was 72.9%, while only 22.2% received all the antigens as per vaccination schedule (Gambia Bureau of Statistics, 2019). This was below the WHO 90% target for vaccination coverage at the national level.

2.1 Prevalence of incomplete vaccination among children

Children are completely vaccinated if they receive all the vaccines in the national routine immunization schedule of the country. Every country has vaccines that are included in the schedule and each vaccine is given at the recommended interval according to the age of the child. This is recorded on the infant welfare card of the child that guides the health care workers and caregivers to know the vaccines that the child received and also the next appointment for vaccination. Based on the number of vaccines received determines the vaccination status of a child and also indicates immunization delivery in the country.

Incomplete vaccination among children determines the progress of the country's immunization system. Studies done in Delhi, India showed that of the children who received hepatitis B and the required doses of 4 vaccines, 46.7% had complete vaccination, 45.9% were partially vaccinated and 7.5% were not vaccinated. The author further indicated that the majority of the children received BCG (87.4%) and hepatitis B with the lowest (57.3%) of the 5 vaccines in the vaccination schedule (Devasenapathy et al., 2016).

Vaccination completion continues to be a challenge in many countries in the world. Many studies revealed a good number of children fully vaccinated but a significant proportion still does not complete their vaccination. A study in Bangladesh among children under 2 years indicated that of the eight vaccine-preventable diseases, 88.7% of the children received all the vaccines, 10.8% received them partly and 0.4% did not receive any vaccine at all (Adhikary et al., 2015). A study in Kathmandu valley, Nepal revealed that only 26% of the children had incomplete vaccination, and coverage for the BCG vaccine was 95% whilst the measles vaccine was 80.5% (Shrestha et al., 2016).

There was a significant increase in vaccination coverage with BCG (96.7%), Penta 1 (95.8%), and measles 1 (93.5%). However, there was a reduction in coverage with measles second dose which accounts for (77.6%) (Chaudhari et al., 2016). This could explain that most of the children decline from immunization after one year of age. A study from Ethiopia observed that unvaccinated children account for 8.4%, partially vaccinated children were 49.4%, and fully vaccinated children were 42.2% (Meleko et al., 2017).

Also, a study in Ghana reported that incomplete vaccination among children was only 15.5%. The author further indicated that there was high vaccination coverage for all the vaccines except measles second dose which was 23.9% (Wemakor et al., 2018). Studies done in the Gambia reported that only 20% were completely vaccinated (receiving all the 16 vaccine doses), 86% were partially vaccinated and children who received 12 and above out of the 16 doses were 67% (Payne et al., 2014).

2.2 Socio-demographic characteristics of caregivers

Socio-demographic factors like age of the mother or caregiver, education level, marital status, religion, ethnicity, occupation, have been documented by other studies as factors that influence incomplete vaccination (Landoh et al., 2016)

2.2.1 Age of caregiver

The age of a caregiver influences the choice of utilizing health care services. This may influence a mother's decision in seeking health care for the well-being of the child. This has been revealed by a study in Ethiopia that an increase in maternal age has been a significant factor contributing to vaccination completion (Hailu et al., 2019).

A similar study conducted in Ethiopia found that children whose mothers are between the ages of 21-34 and greater than 35 were 1.26 times the odds of being fully vaccinated than children whose mothers are below the age of 21 years (Asmamaw et al., 2016). This could be because of the good knowledge on the importance of vaccination and the individual healthcare-seeking behavior. However, a study from Cameroon indicated that children who are born to a mother's age ≤24 years old are significantly associated with incomplete immunization coverage (Russo et al., 2015a). A cross-sectional cluster survey in Ghana showed that children whose mothers were between the ages of 40-49 years had their children fully immunized compared to children whose mothers were below 20 years (Baguune et al., 2017).

2.2.2 Educational level

The education level of the caregiver can greatly influence the vaccination status of the child. Maternal education has been reported as a factor that contributes to the vaccination completion of a child and this has been acknowledged by many studies. A study carried out in Togo revealed a 70.0% increase in the odds of incomplete vaccination among children whose mothers were not schooled with reference to children of mothers who had secondary and higher education (Landoh et al., 2016).

Other studies found no association between caregiver formal education and the completion of vaccination. Studies done in Southwest Ethiopia disagree with the claim that higher education level increases the completion of vaccination. The result suggests that children born to illiterate mothers are significantly associated with vaccination completion (Meleko et al., 2017). In another study in Ethiopia, a significant relationship has been observed between maternal education and childhood vaccination coverage.

The author reported that complete immunization coverage was twice the odds among children whose mothers had higher education compared to children whose mothers had no education (Geweniger & Abbas, 2020). The education level of the caregiver contributes to the uptake of vaccination which increases the utilization of health care services. The Ghanaian study found no association between education and child immunization status (Baguune et al., 2017). However, in The Gambia, a study found an association between the education of the mother and vaccine coverage on the seventh day. The odds of timely vaccination among children whose mothers had higher education was 2.43 times, with reference to children born from non-educated mothers (Miyahara et al., 2016a).

2.2.3 Marital status

The marital status of the caregiver may contribute significantly to incomplete childhood vaccination. Mothers are mainly responsible for taking the child to the vaccination center and this has been evident in many settings in the world. However, male participation in reproductive and child health has been encouraged in many clinics recently. A single mother may not have the needed support both morally and financially coupled with work-related activities to regularly attend clinics. This has been documented by several studies in incomplete vaccination.

A cross-sectional study conducted in Timor-Leste reported that children whose mothers were married and received support both financially and morally from their husbands and family members had greater odds of their children having full vaccination compared to their counterparts (Amin et al., 2013). In a Togo, the study reported that being unmarried or single is a factor that was significantly associated with incomplete immunization of children (Compaore et al., 2019).

2.2.4 Religion

The religion of an individual contributes to the acceptance of the practice of immunization due to the perception and beliefs. Many studies attributed religion as a factor to incomplete vaccination especially in Muslim countries where the majority of the people have negative beliefs towards immunization. Among these was a study conducted in Afghanistan that showed no faith in immunization (34.0%) was one of the major contributing factors for dropouts and left-outs in vaccination (Mugali et al., 2017). Conversely, not all Muslim countries are antagonistic to the practice of vaccination. The majority accepted the practice of vaccination as they believe that it will serve as a means to boost the immunity of the child and protect them from vaccine-preventable diseases.

A study from Nigeria showed that full vaccination coverage was lower among Muslims (12.5%) compared to Catholics and other Christians 46.9% and 47.1% respectively. Muslims form 61.2% of the population in the study area. The population of a religious group in an area may not have a true reflection on the child vaccination status rather the perceptions and beliefs of the individual. Studies done in Nouna district, Burkina Faso showed that the odds of a child born to Muslim families being incompletely vaccinated are 0.01 times the odds for children from other religions (Sanou et al., 2009).

A cross-sectional study in Ethiopia from a Demographic Health Survey 2016 revealed that children of Orthodox Christian religion had a 99.0% reduction of being incompletely vaccinated than children of Muslim and other religions (Regassa et al., 2019). This disagrees with a study in the same country which observed that children whose parents were Muslims had a 15.0% reduction of having their children incompletely vaccinated compared to Orthodox Christian (Ababu et al., 2017).

2.2.5 Parity

The parity of the mother is an important determinant of incomplete vaccination and these have been argued in many studies. Among these was a study carried out in Ghana which reported that lower parity was significantly associated with child vaccination status (Sally & Kenu, 2017). In another cross-sectional study conducted in Ghana found no association between the parity of the mother and the child immunization status (Adokiya et al., 2017). Also in an Ethiopian study, the parity of the mother was not a predictor of incomplete vaccination in their study (Asmamaw et al., 2016). However, a significant relationship has been observed between parity and incomplete vaccination in Western Kenya which revealed that vaccination coverage is influenced by the number of children in a family (Calhoun et al., 2014).

2.2.6 Ethnicity

The ethnicity of caregivers can influence incomplete childhood vaccination. Some ethnic groups considered vaccination of the child more important than others. In Senegal, Sarker et al. revealed that the children of the Serer tribe had 1.43 times more odds of having fully immunized than the popular tribes (Sarker, Akram, Ali, Chowdhury, et al., 2019). Studies done in The Gambia found out that vaccination of children by day 7 reduced by 40% among the Fula ethnic group compared to the Wolof ethnic group (Miyahara et al., 2016b). In another study in The Gambia reported that the odds of being vaccinated with BCG and Measles vaccine among Fula ethnicity were 1.50 and 1.26 times more likely compared to Mandinka ethnicity. The findings show that ethnicity also plays a pivotal role in incomplete vaccination (Payne et al., 2014).

2.2.7 Occupation

The occupation of the caregiver has been documented as a significant predictor by studies as a factor that contributes to incomplete vaccination. A study conducted in the Gambia reported that full immunization coverage was associated with children whose mothers were farmers or professionals compared to unemployed mothers (Sowe & Johansson, 2019). A cross-sectional survey in the Western Region of The Gambia reported that children whose mothers were traders were 0.73 less likely to have delays in receiving DPT2 vaccine doses as well as delays in the successive doses of DPT3 (Odutola et al., 2015). However, a study carried out in Ghana found no association between occupation and incomplete childhood vaccination (Adokiya et al., 2017).

Studies were done in Zhejiang province, China showed that delays in receipt of measles 2 vaccine doses have been significantly associated with mothers having permanent work (Hu et al., 2018). In their previous study showed a similar finding. children of mothers who are at home full-time were more likely to be completely vaccinated compared to their counterparts (Hu et al., 2017).

2.2.8 Family type

Family type of caregiver is a determinant factor of incomplete childhood vaccination. Families with fewer people may have the means to financially support the welfare of the child unlike families with many children. However, a study was carried out in Udupi taluka, Karnataka saw no significant relationship between family type and incomplete vaccination (Phadnis et al., 2015).

2.3 Caregiver knowledge on vaccination

Knowledge of caregivers is a key determinant of vaccination and vaccine-preventable diseases and has been highlighted by several studies. The knowledge of the caregiver influences the decision of continuing with the vaccination services. A child completes their vaccination at the age of 18 months but continues up to the age of 5 years where they receive vitamin A supplementation and deworming tablets at six months intervals. A possible explanation for most of the children that decline from vaccination may be due to the limited knowledge of caregivers at the age of which the child should graduate from routine vaccination.

In Southeast Ethiopia, a cross-sectional community-based survey showed that unawareness of the importance of return for subsequent vaccines (62.0%) was a major reason for partial or unvaccinated among children (Legesse & Dechasa, 2015). With adequate knowledge of the caregiver, the child may be opportune to receive many vaccines, if not all during childhood and which may minimize the risk of incomplete vaccination. Another study in Northern Nigeria showed that reasons for children partially vaccinated for recommended vaccinations from the routine immunization services were linked to parents' lack of knowledge on vaccination (Gunnala et al., 2016).

The continuity of vaccination services also lies greatly on caregiver/ mother’s knowledge about vaccination sessions and the age to complete vaccination. The odds of having full vaccination were higher among children of mothers/ caregivers who know the vaccination schedule and the number of doses reference to their counterparts who do not know about the sessions (Kassahun et al., 2015).

2.4 Child characteristics

2.4.1 Age of the child

Studies have documented the age of the child as a predictor for incomplete vaccination. A study in Kenya reported that children who were <18 months were less likely to be fully vaccinated (Emmanuel et al., 2015). Studies done in Ghana found no association between the child's age and incomplete vaccination (Wemakor et al., 2018).

2.4.2 Birth order

The characteristics of a child have been linked to incomplete vaccination. The birth order of the child may determine the mother's/caregiver's responsiveness to the importance of the vaccination and the time series of each vaccine in the routine schedule. A systematic review for observational studies revealed that among the 23 studies reviewed on incompleteness higher birth order was cited as the main factor contributing to incomplete vaccination (Tauil et al., 2016).

A study conducted in Ambo Woreda, Central Ethiopia, found no correlation between the birth order and incomplete vaccination (Etana & Deressa, 2012). The mother may have an idea of the immunization schedules for second or third born based on the previous experiences. This may enhance the timely and full vaccination of the child. But this is sometimes not the case as many studies have shown that incomplete vaccination is higher among children born second or third and above. A cross-sectional survey carried out in Sierra-Leone revealed that incomplete pentavalent vaccination doses were linked with children born second or later (Feldstein et al., 2020). A similar observation made in the Cameroon study showed that children born as 3rd and above were likely to have incomplete immunization status (Russo et al., 2015a).

2.4.3 Sex of the child

The sex of a child has been associated with incomplete vaccination. Studies in Ghana showed a significant relationship between child sex and incomplete immunization. The odds of incomplete vaccination as a female child reduce by 61.0% compared to a male child (Adokiya et al., 2017). The preference for a male child could be a contributing factor in some communities, but not always the case as the welfare of the child is the concern of the parent or caregiver. A study carried out in Iran did not show any relationship between child sex and the delay time of vaccination (Mohammadbeigi et al., 2015). A similar study in Southeast Ethiopia also found no association between child sex and incomplete vaccination (Legesse & Dechasa, 2015). Conversely, studies conducted in Kathmandu Valley, Nepal showed that incomplete vaccination among children was lower among males (11.4%) and higher among females (14.7%) respectively (Manandhar et al., 2018).

2.4.4 Orphan

The majority of the studies did not mention orphans as a factor for incomplete vaccination. It is important to note that parents have a greater influence on the uptake of immunizations. Children whose parents are not alive may be disadvantaged to maintain routine vaccination services due to the care and support that may be rendered by the family members. Some of the children do not get the needed attention since their grandparents, aunts, or even taken to daycare centers to look after their welfare. A cross-sectional survey carried out in Western Kenya, found no significant association between orphans and incomplete childhood vaccination. The author further stated that the proportion of orphaned children was low in the study (Calhoun et al., 2014).

2.5 Healthcare related factors

2.5.1 Travel time to the vaccination site

Travel time to the vaccination post can influence incomplete vaccination considering the resources and energy spent. Despite the travel time to the vaccination post, the individual's willingness to utilize immunization services also contributes to incomplete childhood vaccination. Studies in Southeast Ethiopia showed that caregivers or mothers who traveled more than fifteen minutes but less than thirty minutes had a 60.0% reduction of their children being incompletely vaccinated compared to caregivers who traveled less than fifteen minutes (Legesse & Dechasa, 2015).

Several studies have identified travel time to the health facility as a significant factor associated with incomplete childhood vaccination. Studies carried out in Northwest Ethiopia also found out that caregivers who traveled fifteen to thirty minutes had a 78% reduction of having their children incompletely vaccinated compared to caregivers who traveled less than fifteen minutes (Yismaw et al., 2019b). In another cross-sectional study in Togo reported that children whose parents walked for thirty minutes to one hour to reach the clinic had an increased odds of 57% being incompletely vaccinated compared to those who walked <30 minutes (Ekouevi et al., 2018).

2.5.2 Means of travel to the health facility

Means of travel can be a deterrent factor to incomplete vaccination. In most urban settings, caregivers either walk or use a car to reach the vaccination centers depending on the proximity and location of the facility. In Northwest Ethiopia, it was discovered that children of caregivers who use a car as a means of travel were 0.1 times less likely to be an incompletely vaccinated reference to children whose caregivers walked to the clinic (Yismaw et al., 2019b).

2.5.3 Waiting time at the facility

Waiting time at health facilities during vaccination sessions could discourage the mother from attending clinics regularly and eventually lead to incomplete vaccination. Due to design or space-wise for some clinics coupled with the crying of children, it may be difficult for a caregiver to exercise patience to stay long at the clinic. A study conducted in Nigeria revealed that more than half of the respondents (55%) cited long waiting hours at the immunization center as a factor contributing to compliance with immunization services (Rahji & Ndikom, 2013).

2.5.4 Replacement of Infant welfare card (IWC)

Renewal/ replacement of vaccination cards when lost or torn is important in maintaining the immunization records of the child. An infant welfare card is useful in so many ways. The card guides the health care worker, the caregiver, and researchers to know the vaccines administered and the next appointment dates for the child. Also, it is used by parents to acquire a birth certificate for the child in some parts of the world. Studies have shown that the lack of infant welfare cards was mentioned by families as a factor for not receiving a vaccination at the clinic (Wagner, 2019).

A study in Togo reported that one of the factors contributing to incomplete vaccination was the financial constraints to pay for vaccination services (Compaore et al., 2019). Illegal charges by health care providers may be a major deterrent to incomplete childhood vaccination.

2.5.5 Healthcare staff attitude

The utilization of health care services can be influenced by the attitude of a health care staff. Studies have documented healthcare staff attitude as a predictor for incomplete vaccination. However, the negative or positive behaviors of health care workers influence the return of a caregiver to subsequent clinics. A qualitative study conducted in Timor-Leste reported that 97.0% of the clients were satisfied with the attitude of health care workers. In addition, vaccinators counseling clients for their next or subsequent visit, it was found out that about 90.0% of all the clients were informed of their next visit (Amin et al., 2013). In another study in Nigeria reported that the attitude of health care workers contributed to the low uptake of vaccination. About 60.8% of the respondents cited that the behavior of health care workers dispirits compliance with immunization (Rahji & Ndikom, 2013). Clients rely on the advice given by healthcare providers and discussing their health problems especially reproductive and child health may improve the uptake of routine immunization services.

CHAPTER THREE

METHODS

3. 1 Study design

We conducted a cross-sectional quantitative study. The study was carried out within a time frame (starting from January 2020 to the end of August 2020). Incomplete vaccination (dependent variable) was divided into two categories: completely vaccinated or incompletely vaccinated.

3.2 Study area

Kanifing Municipality is one of the Local Government Areas (LGAs) of the country. It covers most parts of the Greater Banjul Area and is predominantly an urban settlement. It is located between Banjul, which is the capital city of the country, and the Brikama Local Government Area. It has an estimated population of 382,096 which constitutes 20.3% of the country's population and 75.5 square kilometers (km^2). It has an average annual growth rate of 1.70 (Gambia Bureau of Statistics, 2014).

Due to the recent socio-economic developments and search for greener pastures, there has been increased urbanization in the municipality. Internal migration accounts for 35.0% and external migrants about 30.0% which constitutes 9.0% of the population in the municipality. A majority (70.0%) of the population in the Kanifing are youth and under 30 years of age (City profile: Kanifing, 2017). The women of childbearing age (15-49) and under-five population were estimated at 97, 700 and 45,160 respectively (UN Habitat, 2011). There are eighteen (18) health facilities in the municipality that conduct routine immunization services, one (1) hospital, five (5) public health facilities, and twelve (12) private health facilities. There are 173 immunization clinic sessions conducted in the municipality including both outreach and fixed/static clinics.

Figure 2: Map of Kanifing Municipality

Source: https://www.google.com/search?q=map+of+_kanifing+_district+the+gambia[accessed January 1,

2020,]

3.3 Variables

3.3.1 Dependent variable

The dependent variable was incomplete vaccination, measured as either incompletely vaccinated or completely vaccinated.

Definitions

Completely Vaccinated: A child aged between 24-35 months who had received BCG, oral polio (5 doses), hepatitis B vaccine, pneumococcal vaccine (3 doses), pentavalent (3 doses), rotavirus (2 doses), IPV, measles-rubella 1, yellow fever, and booster doses (DPT booster, measles-rubella2, and polio) was considered completely vaccinated (Gambia Bureau of Statistics & UNICEF., 2019).

Incompletely vaccinated: Any child who began vaccination and missed one dose of the aforementioned EPI vaccines (Tesfaye et al., 2018).

3.3.2 Independent Variables

The independent variables include socio-demographic factors of caregivers, child characteristics, and healthcare-related factors and which were assessed through interviews and record reviews. The variables of interest for each independent variable are summarized in the tables below.

Prevalence of incomplete vaccination

Table 3.1: Operational definitions of vaccine variables

Variable	Definition	Scale of measurement
BCG, Hepatitis B & Oral Polio 0	Vaccines received	Binary (Yes, No)
Oral polio 1,Penta 1, Pneumo 1 & Rotavirus 1	Vaccines received	Binary (Yes, No)
Oral polio 2, Penta 2, Pneumo 2 & Rotavirus 2	Vaccines received	Binary (Yes, No)
Oral polio 3, Penta 3, Pneumo 3 & injectable polio vaccine (IPV)	Vaccines received	Binary (Yes, No)
Oral polio 4, Measles& Rubella 1 & Yellow fever	Vaccines received	Binary (Yes, No)
Oral Polio booster & Measles 2	Vaccines received	Binary (Yes, No)
Meningitis A	Vaccine received	Binary (Yes, No)
DPT booster	Vaccines received	Binary (Yes, No)

Table 3.1 summarizes the vaccines in the routine infant vaccination schedule. The vaccines received by the child were recorded to determine incomplete vaccination and categorized into a binary scale of measurement (yes or no) for all the vaccines in the routine schedule. The source of information was through the infant welfare card of the child.

Socio-demographic characteristics of the caregiver

Table 3.2: Operational definitions for socio-demographic characteristics

Variable	**Definition,**	**Scale of measurement**	**Attributes**
Age of caregiver	Age at last birthday	Continuous	15-24 25-34 35-44 ≥45
Education level	Caregiver highest education	Ordinal	None Primary Secondary Tertiary
Marital status	Mothers current marital status	Nominal	Single Married Divorced Widowed
Parity	Mothers number of pregnancy	Nominal	Nulliparous Multiparous Grand multiparous
Religion	Caregiver current religion	Nominal	Christian Muslim
Ethnicity	Ethnicity of the caregiver	Nominal	Mandinka Wollof Fula Jola Sarahule Other ethnic groups Non-Gambian
Occupation	Mothers current occupation	Nominal	Trader Civil Servant Student Unemployed
Family type	The family setting of the caregiver	Nominal	Single parent Monogamous Polygamous
Knowledge on vaccination	Mention at least 3 VPDs, 3 vaccines, and age to graduate from immunization	Nominal	Yes No

Table 3.2 above depicts the variables for socio-demographic characteristics. Age of the caregiver was a continuous variable and categorized into four categories 15-24, 25-34, 35-44, and 45 and above and education level was also a categorical variable (ordinal) categorized into five levels. Marital status, occupation, religion, family type, and ethnicity were categorical variables and classified into a nominal scale of measurement.

Child characteristics

Table 3.3: Operational definitions for child characteristics

Variable	**Definition,**	**Scale of measurement**	**Attributes**
Age of child	Age of the child at birth in months	Continuous- in months	24-27 28-31 32-35
Birth order	The rank of the child at birth	Ordinal	1 2 3 4 and above
Sex of child	Whether male or female	Nominal	Male Female
Orphan	Child both parents alive	Binary	Yes No

In table 3.3 the age of a child was a continuous variable and classified as 24-27, 28-31, and 32-35. Birth order, child sex, and orphan for this study were categorical variables and birth order was categorized into four categories 1, 2, 3, and 4 +, sex of child categorized into two (female male or male), and the orphan was categorized into binary (yes or no). The data was obtained through the interview of the caregiver.

Healthcare-related factors

Table 3.4: Operational definitions for healthcare-related factors

Variable	Definition	Scale of measurement	Attributes
Travel time	Time to the vaccination center	Continuous	< 30 mins 30-59 mins ≥60 mins
Means of travel	Means of traveling to the facility	Binary	Walking Car
Waiting time	Average waiting time per clinic session	Continuous	<30mins 30-59 mins ≥60 mins
Replacement of Infant Welfare Card (IWC)	Infant Welfare Card lost	Binary	Yes No

Table 3.4 illustrates variables for healthcare-related factors. Travel time to the vaccination site and waiting time were continuous variables and categorized into three categories- < 30 minutes, 30-59 minutes, and ≥60 minutes. Means of travel to the health facility and replacement of infant welfare cards were categorized into a binary scale of measurement. The source of information was through the interview of the caregiver.

3.4 Study population

Caregivers whose children were between the ages of 24 to 35 months residing in Kanifing Municipality were included in this study. By 18 months of age, children are expected to complete their vaccination in the routine schedule (Gambia Bureau of Statistics, 2019). This birth cohort of children was selected because the age recommended for the administration of booster doses (MR2, DPT4, OPV5) is between 12-23 months of age (WHO, 2018).

3.5 Inclusion Criteria

- Caregivers whose children are within the ages of 24-35 months and lived in Kanifing Municipality.

3.6 Exclusion Criteria

- Caregivers who cannot provide the child's infant welfare card.

3.7 Sample Size Determination

3.7.1 Quantitative

The single proportion formula used to estimate the sample size:

$$n = p\left(1 - p\right)\left(\frac{Z}{E}\right)^2$$

Then: n= estimated sample size

Z= Z score of confidence level at 95% (e.g., Z = 1.96)

E= margin of error (0.05)

P= proportion of fully immunized children aged 24-35 months in Kanifing Municipality: 34.6% (Gambia Bureau of Statistics & UNICEF., 2019)

$$n = \frac{0.346\ (1-0.346)\ (1.96^2)}{(0.05^2)} \qquad n = \mathbf{347}$$

A non-response rate of 10% was used for this study. The non-response rate of 10% (0.1 × 347) = 34.7≈ 35 Hence; n = 347 + 35= **382.** Other studies also consider the non-response of research participants. (Yismaw et al., 2019b)**.** The modified WHO EPI 30 x 7 cluster sampling technique was adopted for this study. Thirty clusters were identified and an estimated sample per cluster was **12** household that was visited during the data collection (Sally & Kenu, 2017). The final sample size was **355** caregivers that participated in the study.

3.8 Sampling method

3.8.1 Quantitative Sampling

The list containing Enumeration Areas (EAs) in the Kanifing Local Government Area and their respective households was obtained from the 2013 Gambia population and housing census frame. This was used as a sampling frame and was obtained from The Gambia Bureau of Statistics. There are 69,890 households and 773 EAs in Kanifing LGA. There was no stratification since the Kanifing Municipality was urban and all the enumeration areas have more than the expected number of households to be surveyed per EA.

For this study, we employed a two-stage cluster design to select the eligible children. In the first stage, we selected 30 enumeration areas from the list of 773 EAs using probability proportionate to the size (PPs). The EAs serve as clusters and represent the primary sampling units (PSU). In the selection of the 30 clusters, we performed the following procedures; we listed all the EAs with their corresponding total households and calculated their cumulative households through the addition of the household of the next EA on the list to the succeeding one.

To determine the sampling interval, we divided the total households to be surveyed by the thirty clusters. A table of random numbers was generated and the random numbers were 1350. To decide the first cluster to be surveyed, the random number generated should be equal or not exceed the sampling interval and which represented the first cluster. We determine the second cluster by the addition of the sampling interval and the random number generated (2330+ 1350=3680) and the cluster whose cumulative household equals this number was selected. For the selection of the third cluster, the total sum of cluster two was added to the sampling interval to have cluster three and the process continues until the required number of 30 clusters was obtained.

In the second stage, we use cartographic data (maps) which was obtained from the Gambia Bureau of Statistics, to locate the boundaries of clusters. The map further clearly indicated the structures which were occupied and non-inhabited (eg. Schools, markets, etc). Using the EPI random walk (Russo et al., 2015b) we identified the center of the cluster through the map and the aid of the residents. The first household was randomly selected through the spinning of the bottle and the direction it points was where the data collection started. The next nearest household was selected until the required sample was obtained from the cluster. Within the household level, one child was selected for an interview. In a household where there is more than one eligible child, a random selection was conducted.

Table 3.5: Selected clusters and total households in Kanifing Municipality

Enumeration Areas/ Ward	Total households	Cumulative Household	Cluster Number
Bakau New Town and Fajara	283	1350	1
Old Bakau and Cape Point	104	3680	2
Kanifing	115	6010	3
New Jeshwang and Ebo Town	112	8340	4
New Jeshwang and Ebo Town	97	10670	5
New Jeshwang and Ebo Town	95	13000	6
Old Jeshwang	92	15330	7
Old Jeshwang	67	17660	8
Bundung Borehole and Bantaba	84	19990	9
Bundung Borehole and Bantaba	94	22320	10
Bundung Six Junction Muritani	97	24650	11
Bundung Six Junction Muritani	117	26980	12
Sere Kunda and London Corner	108	29310	13
Sere Kunda and London Corner	62	31640	14
Abuko	87	33970	15
Faji Kunda	100	36300	16
Faji Kunda	84	38630	17
Latri Kunda Sabiji	92	40960	18
Latri Kunda Sabiji	97	43290	19
Tallinding	70	45620	20
Tallinding	99	47950	21
Tallinding	78	50280	22
Bakoteh	73	52610	23
Dippa Kunda	110	54940	24
Dippa Kunda	81	57270	25
Kololi	129	59600	26
Latri Kunda Yiringanya	92	61930	27
Manjai Kunda	86	64260	28
Manjai Kunda	134	66590	29
Manjai Kunda	84	68920	30

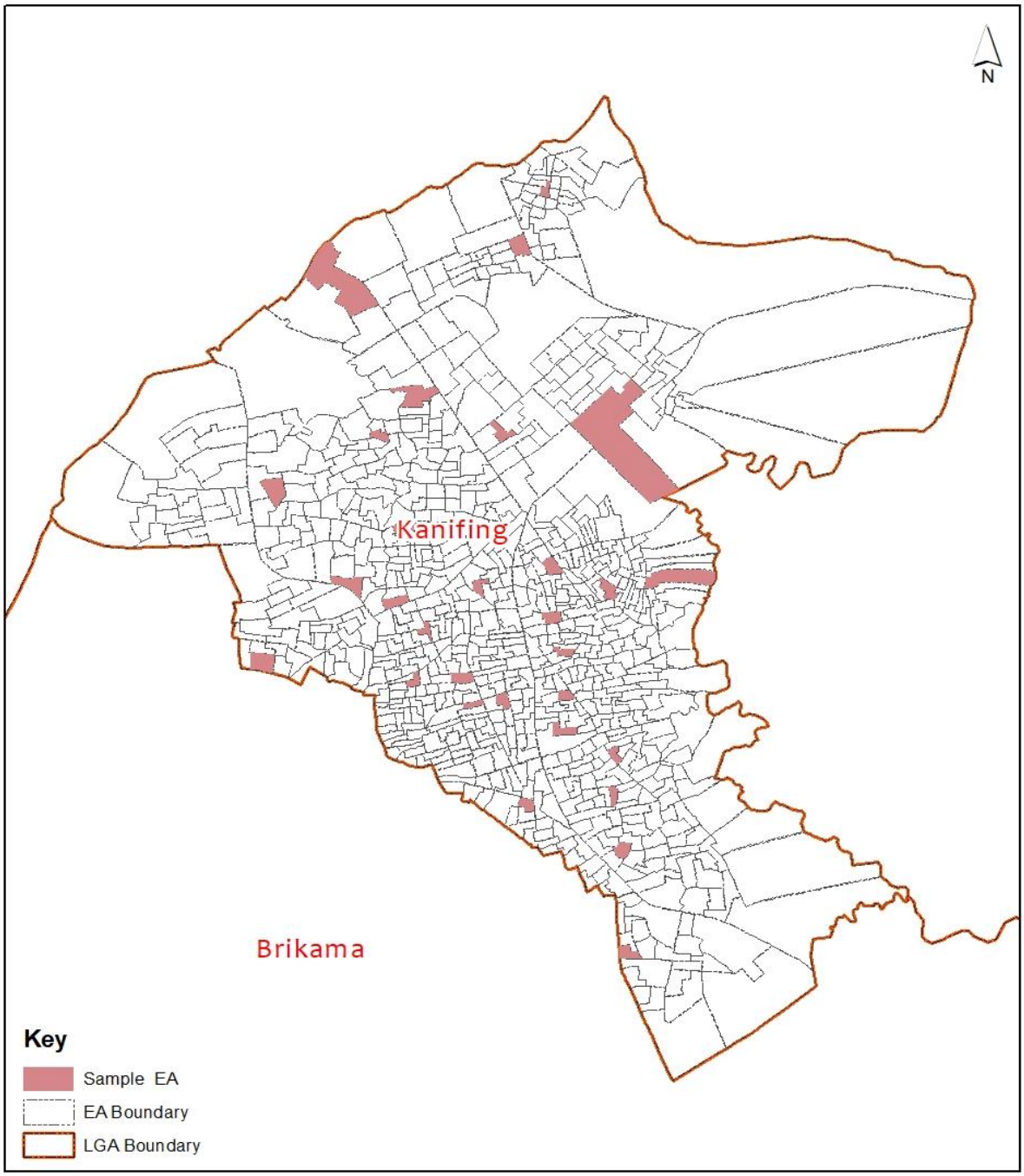

Figure 3: Map of sampled clusters in Kanifing Municipality

3.9 Data collection technique and tools

The principal investigator recruited six research assistants who were involved in routine infant immunization services but working outside the municipality. This was done to avoid or minimize bias during the data collection. Research assistants were Public Health Officers who know routine infant immunization and have worked for more than one year at the health facility level. Research assistants were selected based on the schedule of the individual. The infant welfare card of the child was used to collect information on vaccines received and national document(s) was used for the age of the caregiver and the antenatal care card of the mother, to ascertain the parity and birth order of the child.

3.9.1 Interview

A face-to-face interview was carried out in the study. Caregivers were asked to provide an infant welfare card for the child. If the infant card is available, the research assistants transferred the information on the card. The Infant Welfare Card of the child was snapped to ease follow-up in case of missing information. The mobile number of the caregiver was also taken at the time of the interview. The interview lasted for 20-25 minutes for each participant.

3.9.2 Questionnaire

We used a semi-structured questionnaire for the data collection. The questionnaire comprised the caregiver's socio-demographic characteristics, child characteristics, and healthcare-related factors. Questions were also adapted and modified from the Gambia Multiple Indicator Cluster Survey 2018 and other studies.

3.10 Data Quality Control

The research assistants for this study were Public Health Officers who have an idea of EPI service but work outside the municipality. The principal investigator ensures that the research assistants identified for the data collection were fluent in at least two local languages to ease the translation of questions. A pre-testing of questionnaires took place in Brikama administrative area that has similar characteristics and backgrounds with the study area. In this process, 5% of the study sample was selected to represent the population. The tools were tested to identify gaps and correct them before data collection. After the pre-testing, the questionnaire was reduced to fit the study purpose, and errors were corrected before data collection.

The principal investigator confirms that all the forms submitted were checked for errors and incompleteness that may occur during data collection. In the case of incomplete information, the caregiver was called to get the information, and if unreachable the research assistant goes back and take the information. Meetings were conducted every three days to discuss some of the challenges and ways forward.

3.11 Data Entry and Analysis

Microsoft Excel spreadsheet windows 10 was used for data entry and analyzed using STATA version 15 (STATA Corporation, TX, USA). Variables were created and coded. Variables that have two categories for example “Yes” and “No” are coded as “0” and “1”, whereas variables with more than two categories are coded as 1, 2, and 3, and missing variables are coded as “00”. In the descriptive analysis, frequency tables were generated for socio-demographic characteristics, child characteristics, and healthcare-related factors.

The variables that are continuous for example age of the caregiver were analyzed into mean, standard deviation, and range. Bivariate logistic regression analysis was conducted to examine the strength of the association between the dependent variable and each of the independent variables at a 95% confidence interval. Multiple logistic regression models at a 95% confidence interval were used to determine the true association of variables that were statistically significant at bivariate analysis. For children who were incompletely vaccinated or missed a vaccine dose, the caregivers were asked for the reasons. We analyzed these reasons based on the number of responses given by participants and summarized them into proportions.

3.12 Ethical clearance

Ethical clearance was sought from The Gambia Government/Medical Research Council (MRC) Joint Ethics Committee. Before the start of the research, the principal investigator made a presentation on the thesis proposal at the Regional Health Directorate, Western 1, and Expanded Programme on Immunization unit.

Upon arrival at the household, the research assistant asked for the head of the household and explained the reason for the visit. If the head of the household is not found at the time of the visit, he or she was contacted through a telephone call to seek permission before the interview. The information on the consent form was read out to the caregiver before he or she signs or thumbprints. It was clearly explained to the caregivers that participation was voluntary and no consequence or penalty after withdrawal from the study. The process was done consequently for all the respondents in the study. Confidentiality was guaranteed and maintained throughout the study. The research assistant made it known to the participant that all information gathered remains strictly confidential and each participant was allocated a unique identifier number.

There was maximum control of the information gathered without access by others. All filled questionnaires were kept safely and data files protected with a password accessed by only the principal investigator. The mobile numbers of the principal investigator were made available to all the participants in case of further information However, the data collected was intended for academic purposes only. The study was funded by the West African Health Organization (WAHO) through the REDISSE project.

CHAPTER FOUR

RESULTS

4.1 Characteristics of children aged 24-35 months

The study enrolled 355 children. The median age was 30 months and the age range of 24-35 months. Majority of the children (45.4%) were between 32-35 months of age. About 54.0% (191/355) of children in this study were male and the majority 31.2% (111/355) belongs to birth-order 4 and above. However, a high proportion of children 97.4% (346/355) had both parents alive.

Table 4.1: Characteristics of children 24-35 months of age in Kanifing Municipality, The Gambia 2020 (n=355)

Characteristics of Children	Frequency	(%)
Age of child		
24-27	123	34.6
28-31	71	20.0
32-35	161	45.4
Sex		
Male	191	53.8
Female	164	46.2
Birth order		
1	89	25.1
2	72	20.2
3	83	23.3
4 and Above	111	31.2
Orphan		
Yes	9	2.6
No	346	97.4

4.2 Socio-demographic characteristics of caregivers

The study enrolled 355 caregivers. Caregiver relationship to the child, the majority 91.8% (326/355) of the caregivers were found to be mothers to the children. The age of caregivers ranged from 17 to 60 years, mean age of 29.8 years, and a standard deviation (SD ±6.9). The highest proportions of respondents were married (89.0%) and only 0.8% (3/355) were widowed.

About 42.0% (148/355) of the caregivers attained a secondary level of education and 39.4% (140/355) had no formal education. With regards to ethnicity, 29.8% (106/355) of the caregivers were Mandinka, and the least was non-Gambian 1.9% (7/355)

Ninety-six percent of the caregivers in the study were Muslims and more than half 52.3% (187/355) were unemployed, 21.7% (77/355) were traders, and 5.4% (19/355) were civil servants. Most of the caregivers, 56.1% (199/355) were multiparous, 23.9% (85/355) were grand multiparous and 20.0% (71/355) were nulliparous. Concerning the family type of the caregivers, 62.8% (223/355) belong to a monogamous family type, 25.1% (89/355) were polygamous and 12.1% (43/355) were single parents. (Table, 4.2).

Table 4.2: Socio-demographic characteristics of caregivers (n=355)

Characteristics	Frequency	(%)
Relationship to the child		
Father	10	2.8
Mother	326	91.8
Others	19	5.4
Age of caregiver's		
15-24	80	22.5
25-34	196	55.2
35-44	71	20.0
≥45	8	2.2
Occupation		
Trader	77	21.7
Civil Servant	19	5.4
Student	6	1.8
Unemployed	187	52.3
Education level		
None	140	39.4
Primary	38	10.8
Secondary	148	41.7
Tertiary	29	8.1
Ethnicity		
Wollof	51	14.3
Mandinka	106	29.8
Jola	52	14.6
Fula	75	21.1
Sarahule	40	11.2
Others	24	6.7
Non-Gambian	7	1.9
Religion		
Christian	13	3.7
Muslim	342	96.3
Marital status		
Single	26	7.4
Married	318	89.5
Divorced	8	2.3
Widowed	3	0.8
Parity		
Nulliparous (1 child)	71	20.0
Multiparous (2-4 children)	199	56.1
Granmultiparous (≥5 children)	85	23.9
Family type		
Single parent	43	12.1
Monogamous	223	62.8
Polygamous	89	25.1

Table 4.3: Caregivers knowledge on vaccination and vaccine-preventable diseases

Variable	Frequency	Percent(%)
Awareness of diseases for which vaccines are available		
Yes	109	30.7
No	246	69.3
Mention at least three(3) diseases for which vaccines are available		
Yes	26	7.3
No	329	92.7
Mention at least three(3) vaccines in the EPI schedule		
Yes	10	2.8
No	345	97.2
Age at which a child graduate from immunization		
Know the age to complete immunization	195	54.9
Don't know the age to complete immunization	160	45.1

In table 4.3 above, 30.7% (109/355) know the diseases for which vaccines are available in the routine immunization schedule. Only 7.3% (26/355) know at least three diseases for which vaccines are available and 2.8% (10/355) were able to mention at least three vaccines in the routine schedule. About 55.0% (195/355) of the caregivers know the age at which a child graduates from routine immunization.

4.2 Prevalence of incomplete vaccination among children 24-35 months

Among the 355 children that were included in the study, children between the ages of 24-27 (14.4%), 28-31 (10.4%), and 32-35 (17.5%) were completely vaccinated. The prevalence of incomplete vaccination among children was (205/355) 57.7% (95% CI: 52%-62%).

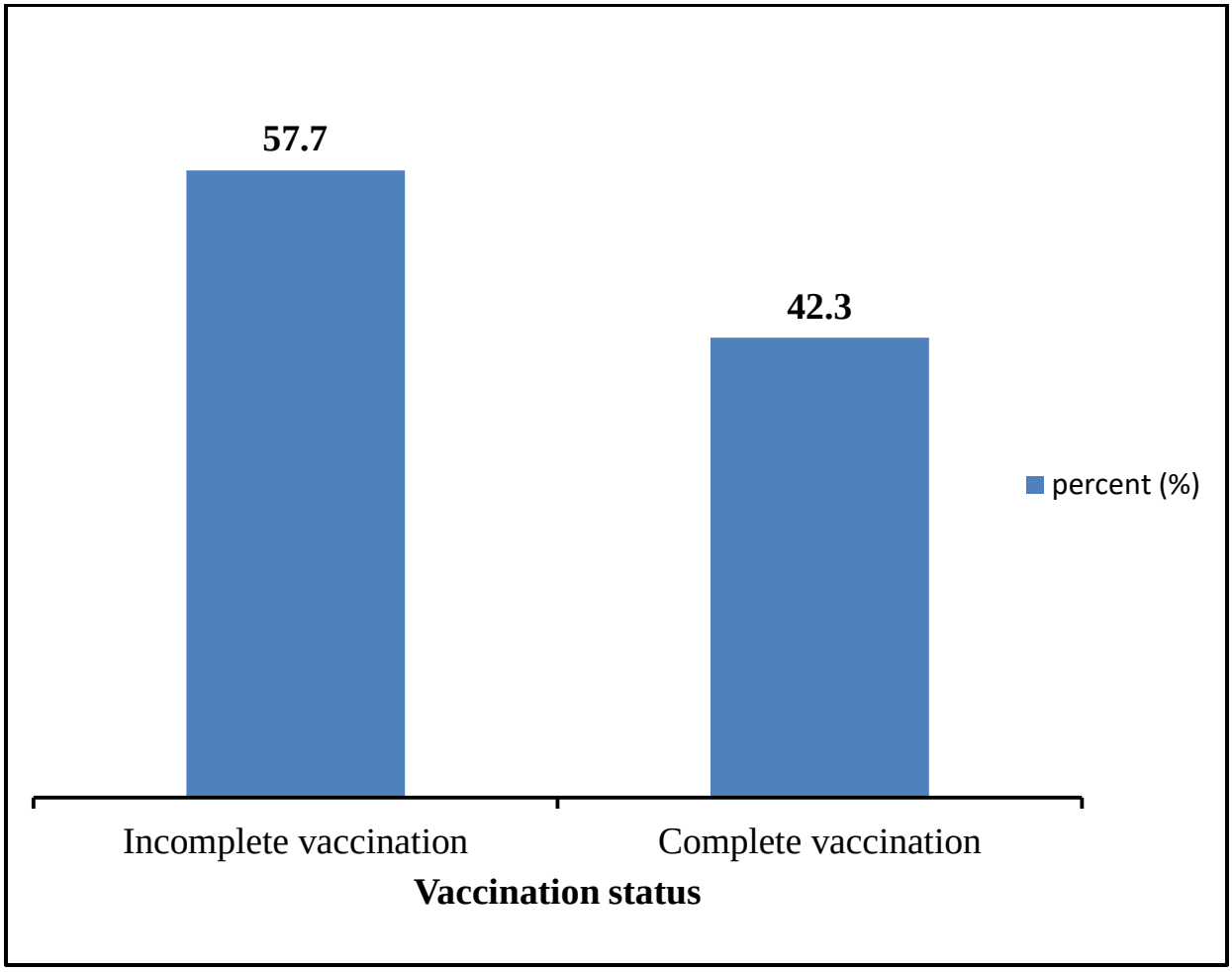

Figure 4: Incomplete vaccination status among children aged 24-35 months in Kanifing Municipality, The Gambia 2020 (n=355)

4.2.1 Reasons for incomplete vaccination or missing a vaccine dose among children

The figure below summarized the reasons for missing a vaccine dose or incomplete vaccination mentioned by the caregivers of the children. Out of the total of 205 children that were incompletely vaccinated, the majority 30.4% (76/250) of the reasons for incomplete vaccination was the busy schedule of caregiver and vaccine stock out and the caregiver do not know the reasons for not missing a vaccine dose had the same percentage score, 22.4% (56/250). However, other reasons were also highlighted and each was below 10.0%. (Figure 4.2)

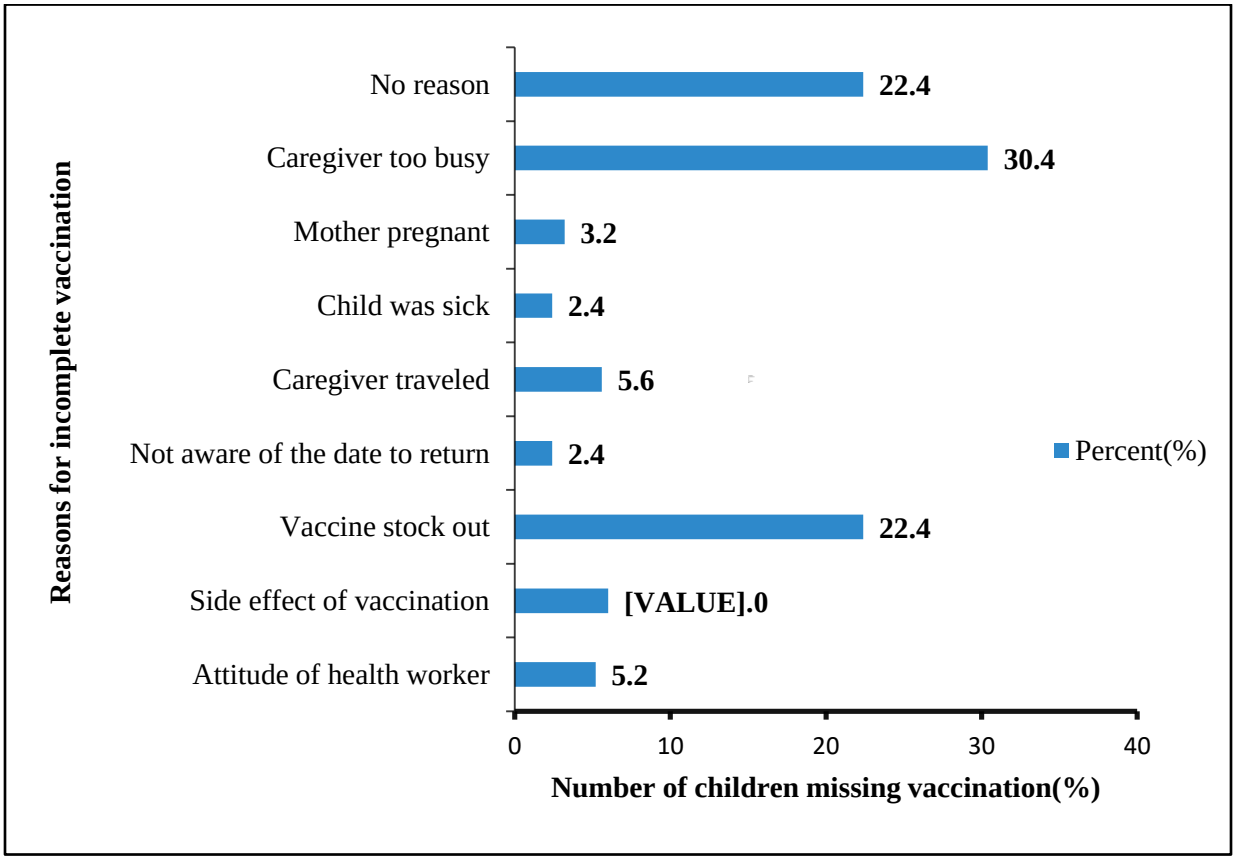

Figure 5: Reasons for missing a vaccine dose or incomplete vaccination among children aged 24-35 months

4.3 Factors associated with incomplete childhood vaccination among children aged 24-35 months

In the bivariate analysis, socio-demographic factors found to be predictors of incomplete vaccination were the caregivers' age (cOR= 0.42, [95% CI= 0.24- 0.73]), and family type (cOR=0.41, [95% CI=0.19-0.88]). For child characteristics, the child's age (cOR=0.57, 95%[CI=0.32-1.01]), and childbirth order (cOR=0.47, [95% CI=0.25-0.87]) were significantly associated with incomplete vaccination. Healthcare-related factors that were associated with incomplete vaccination includes; means of travel to the facility (cOR=0.57, [95% CI=0.37-0.88]), awareness of diseases for which vaccines are available (cOR=1.80, 95% [CI=1.14-2.84]), and the knowledge of the age at which the child graduates from immunization (cOR=1.90, 95%[CI=1.23-2.93]).

4.3.1: Socio-demographic factors associated with incomplete vaccination

Age of Caregiver

The age of the caregiver between 25-34 years (p=0.002) was found to be statistically significant with incomplete vaccination at the bivariate level. The results suggest that 51.0% (100/196) of the caregivers whose ages are 25-34 years had their children incompletely vaccinated, whilst 71.3% (57/80) of the caregivers who are between 15-24 years had children incompletely vaccinated. In the bivariate analysis, caregivers who are 25-34 years had a 58.0% reduction of having a child to be incompletely vaccinated compared to those who are between 15-24 years of age (cOR=0.42, 95% CI 0.24- 0.73).

Table 4.4: Association between the Socio-demographic characteristics of caregivers and incomplete vaccination among children aged 24-35 months

Variable	Vaccination status		cOR(95%CI)	P-value
	Incomplete(%)	Complete(%)		
Caregiver's age				
15-24	57(71.3)	23(28.7)	1	
25-34	100(51.0)	96(49.0)	0.42(0.24-0.73)	**0.002**
35-44	43(60.6)	28(39.4)	0.61(0.31-1.22)	0.17
45+	5(62.5)	3(37.5)	0.67(0.14-3.04)	0.61
Religion				
Christian	8(61.5)	5(38.5)	1	
Muslim	197(57.6)	145(42.4)	0.84(0.27-2.64)	0.78
Education level				
None	84(60.0)	56(40.0)	1	
Primary	27(71.1)	11(28.9)	1.63(0.75-3.56)	0.22
Secondary	79(53.4)	69(46.6)	0.76(0.47-1.21)	0.26
Tertiary	15(51.7)	14(48.3)	0.71(0.31-1.59)	0.41
Ethnicity				
Wollof	30(58.8)	21(41.2)	1	
Mandinka	59(55.7)	47(44.3)	0.87(0.44-1.72)	0.71
Fula	46(61.3)	29(38.7)	1.11(0.53-2.29)	0.78
Others	70(56.9)	53(43.1)	0.92(0.47-1.79)	0.82
Marital status				
Single	19(51.4)	18(48.6)	1	
Married	186(58.5)	132(41.5)	1.33(0.67-2.64)	0.41
Occupation				
Trader	43(55.8)	34(44.2)	1	
Civil servant	10(52.6)	9(47.4)	0.87(0.32-2.40)	0.80
Student	3(50.0)	3(50.0)	0.79(0.14-4.16)	0.78
Unemployed	149(58.9)	104(41.1)	1.13(0.67-1.89)	0.64
Parity				
Nulliparous(1)	47(66.2)	24(33.8)	1	
Multiparous(2-4)	110(55.3)	89(44.7)	0.63(0.35-1.11)	0.11
Grand multiparous(≥5)	48(56.5)	37(43.5)	0.66(0.34-1.27)	0.22
Family type				
Single parent	28(65.1)	15(34.9)	2.39(1.12-5.08)	**0.02**
Monogamous	138(61.9)	85(38.1)	2.08(1.26-3.42)	**0.004**
Polygamous	39(43.8)	50(56.2)	1	

***p-value ≤0.05**

Family type

The result revealed that 65.1% (28/43) of single-parent family type had their children incompletely vaccinated, 61.9% (138/223) children of monogamous family type had incomplete vaccination, and 43.8% (39/89) of polygamous family type had their children incompletely vaccinated. The findings show that the odds of being incompletely vaccinated among children who are from a single-family type was twice compared to children who are from a polygamous family type (cOR=2.39, [95% CI=1.12-5.08]). Also, children whose caregivers belong to a monogamous family type were 2.08 times the odds of having incomplete vaccination compared to children of caregivers from a polygamous family type (cOR=2.08, [95%CI=1.26-3.42]). (Table 4.4)

4.3.2 Caregivers knowledge on vaccination and vaccine-preventable diseases associated with incomplete vaccination

Awareness of diseases for which vaccines are available

The bivariate analysis of caregiver awareness of diseases for which vaccines are available was found to be a predictor of incomplete vaccination. The results showed that 74.6% (153/246) of caregivers were not aware of the diseases for which vaccines are available in the EPI schedule and 47.7% (52/109) of caregivers were aware of the diseases for which vaccines are available in the EPI schedule had their children incompletely vaccinated. However, caregivers who were not aware of the diseases for which vaccines are available had 1.80 times the odds of incompletely vaccinating their children than mothers or caregivers who know the diseases for which vaccines are available in the immunization schedule (cOR=1.80, 95% [CI=1.14-2.84]). (Table 4.5)

Age at which a child graduate from routine immunization

About 66.3% (106/160) of caregivers who were not aware of the age at which the child completes immunization had their children incompletely vaccinated whilst, 50.8% (99/195) of caregivers who know the age to complete vaccination had their children incompletely vaccinated. The results in the bivariate analysis suggest that caregivers who do not know the age at which the child graduates from immunization increase by 90.0% the odds of their children having incompletion vaccination than caregivers who know the age at which the child graduates from immunization and was statistically significant at p-value=0.003. (cOR=1.90, 95%[CI=1.23-2.93]).

Table 4.5: Association between caregiver knowledge on vaccination and VPDs and incomplete vaccination among children aged 24-35 months

Characteristics	Vaccination status		cOR(95% CI)	P-value
	Incomplete (%)	Complete (%)		
Awareness of diseases for which vaccines are available				
Yes	52(47.7)	57(52.3)	1	
No	153(62.2)	93(37.8)	1.80(1.14-2.84)	**0.01**
Mention at least three(3) diseases for which vaccines are available				
Yes	11(42.3)	15(57.7)	1	
No	194(59.0)	135(41.0)	1.95(0.87-4.39)	0.10
Mention at least three(3) vaccines in the routine EPI schedule				
Yes	4(40.0)	6(60.0)	1	
No	201(58.3)	144(41.7)	2.09(0.58- 7.55)	0.26
Age at which a child graduate from routine immunization				
Know the age	99(50.8)	96(49.2)	1	
Don't know	106(66.3)	54(33.7)	1.90(1.23-2.93)	**0.003**

P-value ≤0.05

4.3.3 Child characteristics associated with incomplete vaccination

Age of child (months)

The findings at bivariate analysis showed that 47.9% (34/71) of children between the ages of 28-31 had incomplete vaccination whilst, 61.5% (99/161) of children between the ages of 32-35 had incomplete vaccination. The odds of being incompletely vaccinated among children between 28-31 months of age also reduces by 43.0% compared to children who are between the ages of 32-32 months of age (cOR=0.57, 95% [CI=0.32-1.01]).

Birth order

Bivariate analysis between birth order and incomplete vaccination was performed in this study. Birth order was significantly associated with incomplete vaccination. The result revealed that 48.2% (40/83) children of birth order three were incompletely vaccinated, while 66.3% (59/89) children of birth order one were incompletely vaccinated. Children who belong to birth order three had a 53.0% reduction in their odds of being incompletely vaccinated compared to children who belong to birth order one. The findings suggest that as a mother's parity increases the chances of incomplete vaccination also rise. The study found no significant relationship between the sex of child (cOR=0.73, 95% [CI=0.47-1.11]), and orphan (cOR=4.22, 95% [CI=0.84-21.25]) with incomplete vaccination (Table 4.6).

Table 4.6: Association between child characteristics and incomplete vaccination among children aged 24-35 months

Variable	Vaccination status			
	Incomplete (%)	**Complete(%)**	**cOR (95%CI)**	**Pvalue**
Age of child (months)				
24-27	72 (58.5)	51(41.5)	0.88(0.54-1.42)	0.61
28-31	34(47.9)	37(52.1)	0.57(0.32-1.01)	**0.05**
32-35	99(61.5)	62(38.5)	1	
Sex of child				
Male	117(61.3)	74(38.7)	1	
Female	88(53.7)	76(46.3)	0.73(0.47- 1.11)	0.15
Birth order				
1	59(66.3)	30(33.7)	1	
2	42(58.3)	30(41.7)	0.71(0.37-1.35)	0.30
3	40(48.2)	43(51.8)	0.47(0.25-0.87)	**0.02**
4 and above	64(57.7)	47(42.3)	0.69(0.38-1.23)	0.21
Orphan				
Yes	203(58.5)	144(41.5)	1	
No	2(25.0)	6(75.0)	0.23(0.04-1.18)	0.08

***p-value ≤0.05**

4.3.4 Healthcare-related factors associated with incomplete vaccination

Means of travel

An association between means of traveling to the health facility and incomplete vaccination at bivariate analysis was established. The result revealed that 50.6% (83/164) of caregivers who travel by car had their children incompletely vaccinated, while 63.9% (122/191) of caregivers who walked to the clinic had their children incompletely vaccinated. Children of caregivers who walked to the health facility had a 72.0% increase in getting their children incompletely vaccinated compared to children of caregivers who used a car as a means of travel to the health facility for vaccination services (cOR=1.72, 95% CI: 1.12-2.64).

Table 4.7: Association between healthcare-related factors and incomplete vaccination among children aged 24-35 months

Variable	Vaccination status		cOR(95% CI)	P-Value
	Incomplete(%)	Complete(%)		
Travel time to the vaccination center				
≤30 mins	155(56.6)	119(43.4)	1	
30-59 mins	43(62.3)	26(37.7)	1.26(0.73-2.18)	0.38
> 60 mins	7(58.3)	5(41.7)	1.07(0.33-3.47)	0.90
Means of travel				
Car	83(50.6)	81(49.4)	1	
Walking	122(63.9)	69(36.1)	1.72(1.12-2.64)	**0.01**
Waiting time				
≤30 mins	28(48.3)	30(51.7)	1	
30-59 mins	38(55.9)	30(44.1)	1.35(0.67-2.74)	0.39
>60 mins	139(60.7)	90(39.3)	1.65(0.92-2.95)	0.08
Ever replaced child's Infant welfare card				
Yes	4(33.3)	8(66.7)	1	
No	201(58.6)	142(41.4)	2.83(0.83-9.58)	0.09
Mode of replacement				
Never replaced	201(98.5)	142(96.7)		
Replaced for free	1(25.0)	3(75.0)	0.23(0.02-2.28)	0.21
Paid for replacement	3(37.5)	5(62.5)	0.42(0.09-1.80)	0.25

p-value ≤0.05

4.4 Factors associated with incomplete vaccination among children aged 24-35 months

Factors that remained significantly associated with incomplete vaccination were the family type (p-value=0.01) awareness of the diseases for which vaccines are available (p-value=0.05), the age at which a child graduate from routine immunization (p=0.03), and means of travel to the health facility (p=0.01).

The first factor that remained statistically significant after controlling for potential confounders was the family type to which the child belongs. Children of caregivers who belong to the monogamous family type had a decreased odd of being incompletely vaccinated by 90.0% compared to children of caregivers who belong to a polygamous family type (aOR=1.90, 95% CI: 1.12-3.22). The second factor that remained significant was the caregiver's awareness of the diseases in the EPI schedule. The odds of caregivers who do not know the diseases in the routine EPI schedule had an increased odds of 1.62 times of having their children incompletely vaccinated compared to caregivers who know the diseases in the routine EPI schedule

(aOR =1.62, 95% [CI=0 .99-2.64]) after correcting for other confounders.

The third factor that remained significant after adjusting for the confounder was the caregivers' awareness of the age at which a child graduate from routine immunization services. The odds of incomplete vaccination among children whose caregivers do not know of the age at which a child graduate from routine immunization increase by 66.0% compared to children whose caregivers know the age at which the child graduate from routine immunization (aOR=1.66, 95%CI= 1.04-2.64). However, caregiver knowledge on the diseases for which vaccines are available in the routine immunization schedule was not statistically significant at p-value=0.08. (Table 4.8)

Means of traveling to the facility were also found to be statistically significant in the multiple logistic regression models. Incomplete vaccination among children whose caregivers walked to the clinic increases by 78.0% compared to children whose caregivers used cars as a means of travel to the clinic (aOR=1.78, 95% CI=1.11-2.84) after adjusting for confounding factors. (Table, 4.8)

Table 4.8: Factors associated with incomplete vaccination among children 24-35 months.

Variable	Vaccination status		Crude Odd Ratio		Adjusted Odd Ratio	
	Incomplete (%)	Complete (%)	95% CI	P value	95% CI	P value
Caregiver's age						
15-24	57(71.3)	23(28.7)	1		1	
25-34	100(51.0)	96(49.0)	0.42(0.24-0.73)	**0.002**	0.56(0.29- 1.08)	0.09
35-44	43(60.6)	28(39.4)	0.61(0.31-1.22)	0.16	0.63(0.27-1.44)	0.28
45+	5(62.5)	3(37.5)	0.67(0.14-3.04)	0.60	0.98(0.19-5.12)	0.99
Family type						
Single parent	28(65.1)	15(34.9)	2.39(1.12-5.08)	**0.02**	1.83(0.80-4.16)	0.15
Monogamous	138(61.9)	85(38.1)	2.08(1.26-3.42)	**0.004**	1.90(1.12-3.22)	**0.01**
Polygamous	39(43.8)	50(56.2)	1		1	
Awareness of diseases for which vaccines are available						
Yes	52(47.7)	57(52.3)	1		1	
No	153(62.2)	93(37.8)	1.80(1.14-2.84)	**0.01**	1.62(0.99-2.64)	**0.05**
Age at which a child graduate from routine immunization						
Know the age	99(50.8)	96(49.2)	1		1	
Do not know	106(66.3)	54(33.7)	1.90(1.23-2.93)	**0.003**	1.66(1.04-2.64)	**0.03**
Age of the child						
24-27	72 (58.5)	51(41.5)	0.88(0.54-1.42)	0.61	0.90(0.54-1.50)	0.69
28-31	34(47.9)	37(52.1)	0.57(0.32-1.01)	**0.05**	0.60(0.33-1.09)	0.96
32-35	99(61.5)	62(38.5)	1		1	
Birth order						
1	59(66.3)	30(33.7)	1		1	
2	42(58.3)	30(41.7)	0.71(0.37-1.35)	0.30	0.83(0.40-1.72)	0.63
3	40(48.2)	43(51.8)	0.47(0.25-0.87)	**0.01**	0.63(0.31-1.31)	0.22
4 and above	64(57.7)	47(42.3)	0.69(0.38-1.23)	0.21	0.93(0.44-1.93)	0.85
Means of travel						
Car	83(50.6)	81(49.4)	1		1	
Walking	122(63.9)	69(36.1)	1.72(1.12-2.64)	**0.01**	1.78(1.11-2.84)	**0.01**

P-value ≤0.05

CHAPTER FIVE

DISCUSSION

There are few published data on incomplete vaccination among children in The Gambia. Previous surveys have shown that the vaccination completion rate was low among children in the administrative areas (Gambia Bureau of Statistics, 2019). However, factors influencing incomplete vaccination among children are not clear or explored in administrative areas. Several studies have documented socio-demographic factors like mother's marital status, educational status, occupation maternal employment status (Hu et al., 2017), child characteristics for example birth order (Phadnis et al., 2015), and healthcare-related factors like long waiting hours influence incomplete vaccination (Magodi et al., 2019).

Thus, knowing the factors influencing incomplete vaccination among children will form a basis to improve the vaccination in the area and the country at large. The study aims to determine the prevalence and factors associated with incomplete vaccination among children aged 24-35 months in Kanifing Municipality.

5.1 Prevalence of incomplete vaccination among children

Despite high vaccination coverage in the country, in this study, the overall prevalence of incomplete vaccination was 57.7% indicating that a significant proportion of children dropout from vaccination within the study area. The finding suggests that a high proportion of children who received their birth dose did not complete their vaccinations at the time of the study.

A review of vaccination coverage in thirteen (13) West African countries revealed that three countries had more than 50.0% prevalence of incomplete vaccination namely Bennin (53.3%), Guinea (53.0%), and Nigeria (54.9%) (Kazungu & Adetifa, 2017b).

These findings were a little below the 57.7% of incomplete vaccination among children in the Kanifing Municipality. One of the potential explanations for high incomplete vaccination could be due to the long vaccine stock out of Inactivated Polio Vaccine (IPV) and Polio vaccine in the country which was one of the reasons mentioned by respondents in this study. Our findings contrasted from other studies carried out in Northwest Ethiopia, Ghana, and Nepal which reported incomplete vaccination of 24.3%, 16.7%, and 13.0% respectively (Yismaw et al., 2019b) (Sally & Kenu, 2017) (Manandhar et al., 2018).

There are varying differences in the prevalence of incomplete vaccination in many parts of the world including The Gambia. This may be due to the geographical location and the operational plan in the delivery of immunization services. In the Gambia, immunization services are conducted both fixed/static and outreach clinics. Most of the health facilities are concentrated in the urban areas of the country with a high number of vaccination points. Despite the high number of health facilities, there is still a problem of incomplete vaccination. This may be attributed to the time factor due to the rising cost of living in the urban areas as many are engaged in business and petty trading to meet their daily needs. Previous studies in the Gambia stated that the low vaccination coverage and delayed vaccination are higher in the urban and peri-urban areas (Sowe & Johansson, 2019) (Miyahara et al., 2020).

In Togo, a study found 36.2% of incomplete immunization among children between 1-5 years of age at the time of the survey (Landoh et al., 2016). Also in an Indian study reported an incomplete vaccination of 31.4% among children below five years (Phadnis et al., 2015). Similar studies also reported an incomplete vaccination of 26.0% among children 12-23 months of age (Shrestha et al., 2016). These findings on incomplete vaccination are below 57.7% which was revealed by this study. The higher disparity in proportions between these studies could be due to the age differences as they have been assessed vaccination at a lower than two years as compared to our study.

The trend of incomplete vaccination is somewhat similar in many regions including the Gambia. A study in Indonesia reported that unimmunized children account for 68.5% of the total children enrolled in the study (Herliana & Douiri, 2017). This showed that a vast majority of children did not receive a single dose of vaccines in the recommended schedule of the country at the time of the study. In our study, all the children received the birth doses (BCG, Hepatitis B, and Polio 0). This may suggest that most of the children in the municipality receive at least one or more doses of vaccines in the routine vaccination schedule. Also, in India study reported that incomplete vaccination was found to be 37.1% (Agrawal et al., 2019). In Senegal, a study found out that incomplete vaccination was 29.0% among children 12-23 months of age (Sarker, Akram, Ali, Chowdhury, et al., 2019).

These findings show that incomplete vaccination is a problem in many countries. However, the causes of the high prevalence of incomplete vaccination in this study need further exploration. This difference could be due to the long stock out of the Inactivated Polio Vaccine (IPV) and Polio vaccine. Vaccine stock out is also a predictor of incomplete vaccination and this was highlighted by caregivers as one of the reasons for incomplete vaccination.

5.2 Socio-demographic factors of caregivers that affect incomplete vaccination

Studies have shown that maternal age was a determinant of incomplete vaccination. The age of the caregiver or mother may influence her decision to attend regular clinics knowing the importance of vaccination and previous experience in attending clinics. Younger mothers may not know the recommended vaccination schedules and may skip the vaccination schedules or miss some vaccine doses at the recommended times. In this study, about a quarter of the caregivers/mothers were below 24 years of age and not employed. A study in Senegal reported that children of mothers who were <20 years have higher odds of incompletely vaccinated compared to children of mothers of 35 years and more (Sarker, Akram, Ali, Chowdhury, et al., 2019).

In comparison to the earlier claims, this study however affirms with another study in Senegal evidence from a demographic and health survey 2010-2011 found no association between maternal age at birth and incomplete vaccination (Abdou et al., 2017). Another study in Bangladesh found out that the odds of incomplete vaccination among children whose mothers were <20 years was 3.21 times compared to children whose mothers were >35 years of age (aOR=3.21, 95%CI:1.02-10.13) (Sheikh et al., 2018).

Concerning the education level of the caregiver, several studies have indicated as a factor for incomplete vaccination. The educational level of the caregiver leads to the utilization of immunization services which contributes to regular attendance of the clinic. Geweniger and Abbas, (2020) found that primary and secondary education of a caregiver was a contributing factor to full immunization coverage. The author further stated the importance of vaccination is fully understood through maternal education contributing to the choice of health care services in attaining optimal health (Geweniger & Abbas, 2020).

Similarly, previous studies in Bangladesh and India showed a relationship between maternal education and incomplete vaccination (Sarker, Akram, Ali, & Sultana, 2019) (Aggarwal et al., 2012). The 2011 and 2016 Ethiopia Demographic Health Survey showed that children whose mothers had secondary and above education had a decreased odds of incomplete vaccination compared to children of mothers who had no education (Debie et al., 2020). However, this study found no association between the education level of caregivers and incomplete vaccination.

Studies have shown the marital status of a caregiver as a factor associated with incomplete vaccination. The marital status of a caregiver may determine the moral and financial support that may be rendered by the family members for the welfare of the child. Married women may have the needed support unlike unmarried women to attend clinics regularly. Some social and cultural factors especially in Islamic settings, children born out of wedlock may be disadvantaged to attend clinics due to the stigma and discrimination. A Ghanaian study reported that children whose mothers were married had a 71.0% reduction of fully immunized compared to children whose mothers were unmarried or single (Adokiya et al., 2017). However, our study did not agree with the result of the study hence, there was no association between the marital status of a mother and incomplete vaccination.

Occupation of the caregiver was also documented as a factor for incomplete vaccination. This study, however, found that occupation was not a factor that influences incomplete vaccination both in the bivariate and multiple regression models. Studies found that households with stable occupations and good incomes may increase their utilization of health care services (Hu et al., 2013). However, this may also depend on the individuals earning, perception, and the importance attached towards immunization.

In The Gambia, a study reported that children of professional mothers had high immunization coverage. However, the author further highlighted that professional mothers may have good knowledge on the importance of vaccination, be empowered by the family, and the ability to employ maids to take care of children and other household chores (Sowe & Johansson, 2019). Bbaale, (2013) reported that children whose mother's job was farming had lower chances of receiving the three doses of DPT with an 8.0% reduction ($p<0.05$) compared to children whose mothers had white-collar jobs (Bbaale, 2013).

The religion of a caregiver has been documented by studies as a factor related to incomplete vaccination. In the Gambia, the majority of the population are Muslims. However, most Christians are residing in the urban areas especially Kanifing Municipality. Our findings showed no association between the religion of a caregiver and incomplete vaccination. A recent study in Ethiopia reported that Muslim children have greater odds of having incomplete vaccination compared to children from the Christian religion (Geweniger & Abbas, 2020).

These findings could be due to the beliefs of some Muslims or regions that viewed vaccination as a western ideology deterring many children from getting vaccinated. This study, however, disagrees with a study in Nigerian and revealed that the odds of incomplete vaccination were higher among children whose caregivers were Christian compared to children whose caregivers were Muslims (McGavin et al., 2018). In another cross-sectional study in India reported that the odds of having incomplete vaccination were higher among children who were from a Muslim family (Devasenapathy et al., 2016).

In this recent study, the family type of children was significantly associated with incomplete vaccination in the bivariate analysis (cOR=2.08, 95% CI: 1.26-3.42) p=0.004 and multiple regression analysis (aOR=1.90, 95% [CI=1.12-3.22]). The odd of incomplete vaccination among children of caregivers from a monogamous family type was 1.90 times compared to children whose caregivers were from a polygamous family type. It is however not surprising to see that monogamous families have a higher chance of incomplete vaccination in The Gambia. The possible reason could be that the mother may not have the time due to domestic work. Also, both parents could be employed and may not have the time to take the child to the clinic on working days as most of the clinics do not offer immunization services during the weekend.

5.3 Caregiver knowledge on vaccination

Despite the increased access to health care services with a high number of health care centers both public and private in Kanifing Municipality, there is still a considerable number of caregivers who did not know the diseases in the routine vaccination schedule. The reasons could be due to the limited time for health care workers to interact with clients, limited pre-clinic health talks, and high client flow during vaccination sessions especially base/fixed clinics. Women who have good health-seeking behavior may have adequate knowledge of vaccination and vaccine schedules through their interactions with health care providers.

A cross-sectional community-based survey in Ethiopia found out that children of caretakers with low knowledge about vaccination had an increased odds of having their children incompletely vaccinated compared to those with high knowledge on vaccination (Ababu et al., 2017). The awareness of caregivers on the importance of vaccination encourages regular clinic attendance.

The findings of this study confirm the earlier claims that knowledge of the caregiver contributes to the child vaccination status. The finding showed that caregivers who are not aware of the diseases for which vaccines are available in the EPI schedule had 62.0% chances of having their children incompletely vaccinated compared to those who are aware of the diseases for which vaccines are available in the EPI schedule. This was statistically significant both at the bivariate and multiple logistic regression analyses for this study. On the other hand, a Ugandan study found no association between knowledge of mothers on vaccine-preventable diseases and full vaccination status (Vonasek et al., 2016).

The association between the age at which a child graduates from the immunization schedule and incomplete vaccination was significant in this study at multiple logistic regression analyses (aOR= 1.66, 95% [CI=1.04-2.64]). Children of caregivers who do not know the age at which a child graduates from immunization had a 66.0% chance of having incomplete vaccination reference to children of caregivers who are aware of the age at which a child graduate from immunization. The possible explanation could be the mothers or caregivers do not attend clinics regularly or healthcare providers do not conduct pre-clinic health talks at the vaccination points to raise the awareness of mothers on vaccination. This might have contributed to the high knowledge gap on vaccination within the municipality.

The results are in line with a study in Central Ethiopia. Evidence from the study found a decrease in odds of incomplete vaccination among children of mothers who know the age at which a child completes immunization compared to those who do not know the age at which a child completes immunization (Etana & Deressa, 2012).

In other parts of Ethiopia (Southern Ethiopia), a study also reported that caregivers who are aware of the age at which a child graduate from immunization had lower odds of having incomplete vaccination compared to those who do not know the age at which a child should graduate from immunization (Hailu et al., 2019).

5.4 Reasons for incomplete vaccination among children

Caregivers stated several reasons for incomplete vaccination among children. These factors were cross-cutting at all levels which include individual, community, and health facility-related factors. In this recent study, the major contributing factors for incomplete vaccination that were mentioned by the caregivers were the caregiver too busy (30.4%), vaccine stock out (22.4%), and the caregiver does not know the reason for the child missing the vaccine dose (22.4%). However, other factors were also highlighted which include the attitude of the health worker, child sick, caregiver traveled, the side effect of vaccination, and mother pregnancy. These factors highlighted are not surprising especially for caregivers too busy. This might be due to the busy schedule as the municipality is the hub for business and other economic activities where the largest and the busiest market (Serekunda) is located.

Our findings agree with a study in southwest Uganda and their study found out that reasons for incomplete vaccination travel or financial problems(18.0%), fear of side effects (44.0%), vaccine shortages (3.0%), laziness (44.0%), discouragement from husband or family (11.0%), crowds or long waits (7.0%), too busy (5.0%), disrespectful health staff (4.0%) and don’t know (11.0%) (Vonasek et al., 2016). Studies done in India reported that lack of information and obstacles as the major reasons for incomplete vaccination or unvaccinated among 283 children (Aggarwal et al., 2012).

Counseling of caregivers on the return to the clinics and the importance of vaccination may improve the uptake of vaccination services even those in the hard-to-reach areas. Although, these studies were carried out in low and middle-income countries with similar socioeconomic statuses, however, the regions where the studies were conducted differ considerably in terms of population, access, and availability of health care services. Caregivers whose children did not complete their vaccination gave reasons such as unawareness of vaccination schedule and completion (2.3%), unknowing to return for succeeding vaccination (2.3%), side effect (2.1%), an inconvenient time for vaccination (1.8%), the child sick (0.3%), and vaccine stock out (1.8%) (Abebe et al., 2019).

Evidence from a Bangladesh study indicated that child unwell (14.3%), parent negative attitude towards immunization (64.3%), and lack o time (21.4%) were the reasons for partial or non-immunization among children (Adhikary et al., 2015). These findings are similar to this study as some of the factors are either individual level, community level, or healthcare-related. Discussing issues surrounding vaccination with caregivers will help in mitigating some of the problems related to incomplete vaccination. For example, fear of side effects, unawareness of vaccine schedule and completion, child sick, etc may be averted if there are regular pre-clinics health talks. Unless these factors are approached holistically, the trend of incomplete vaccination may continue depriving children of getting vaccine doses at the required time interval.

5.4 Child characteristics factors that affect incomplete vaccination

Considering the period it takes for a child to graduate from immunization, there are high chances that if a caregiver attends the clinic regularly the child might receive all the vaccines before they graduate from immunization. However, this has been a challenge in many regions and a significant proportion of children drop from routine vaccination early depriving them of completing the vaccination schedule.

The age of the child has been argued as a predictor of incomplete vaccination among children. In this present study, the child's age was not found as a factor influencing incomplete vaccination at the multiple logistic regression analysis. Similarly, a study in Ghana observed no relationship between the age of a child and incomplete vaccination (Adokiya et al., 2017). A recent study in Bangladesh reported that children aged 48-59 months had lower odds of incomplete vaccination compared to children aged 12-24 months (Sarker, Akram, Ali, & Sultana, 2019). Children may drop from immunization early especially if the caregivers are not guided by the health care workers on the schedule as many assume that the child completes vaccination after two to three successive visits without receiving the vaccination.

The birth order has been found by studies as a predictor of incomplete vaccination. A systematic review of articles reported that in Kenya being a firstborn child had 2.15 times the odds of incomplete vaccination compared to others (Tauil et al., 2016). A cross-sectional study carried out in Sierra Leone revealed that children born second or later had increased odds of incomplete vaccination with pentavalent series compared to those who are firstborn (Feldstein et al., 2020).

Calhoun et al. (2014) did not support the previous claims that birth order is a predictor for incomplete vaccination (Calhoun et al., 2014). However, our study agrees with this finding and did not find any association between the birth order of a child and incomplete vaccination. Hailu et al, (2019), in their study, reported that being a female child had a 36.0% reduction of incomplete vaccination compared to a male child (Hailu et al., 2019). The odds of incomplete vaccination were higher among female children compared to male children. In contrast to these claims this study, however, shows that the sex of a child has no relationship with incomplete vaccination and is also consistent with a study in India (Devasenapathy et al., 2016).

Children whose parents are not alive may be disadvantaged in terms of the required care and support needed at the family level and to utilize immunization services. However, our study found no correlation between orphan status and incomplete vaccination. This finding confirmed with a study by Calhoun et al. also found out no correlation between the orphan status of a child and incomplete vaccination (Calhoun et al., 2014).

5.5 Healthcare-related factors that affect incomplete vaccination

Travel time to the vaccination center has also been found as a predictor for incomplete vaccination. The time, energy, and resources it takes to reach the clinic may contribute to incomplete vaccination. However, a caregiver may continue attending the clinic knowing fully the importance of vaccination despite the long travel hours. A cross-sectional study of 249 caretakers/ mothers in Bangladesh reported that having correct vaccination outcomes was higher among children of caregivers who had a walking time of ≤30 minutes compared to those who had a walking time of more than 30 minutes (Adhikary et al., 2015).

A study conducted in China reported that travel time to the vaccination site was a determinant for immunization status among children. Children whose caregivers' travel time was more than 40 minutes had a 62.0% increase in the odds of incomplete vaccination compared to children whose caregivers traveled less than 20 minutes (Id et al., 2018). The above claims are inconsistent with our findings, hence no association was found between the travel time to reach the facility and incomplete vaccination.

Surprisingly, this study found out that incomplete vaccination among children of caregivers who walked to the clinic increased by 78.0% compared to children of caregivers who used a car as a means of travel to the clinic. The finding was significant at multiple regression analyses (aOR=1.78, 95% [CI=1.11-2.84]). It is believed that caregiver who uses car may likely get their children completely vaccinated due to less time and energy to reach the vaccination points. However, this could be attributed to the caregiver's willingness to attend the monthly vaccination clinic, the distance of the clinic, and the support from family members. However, this finding disagrees with the findings of a study in The Gambia found out that delay in receiving any vaccines increases by 45.0% among children whose caregivers used public transport as a means of travel to the clinic compared to children of caregivers who walk to the clinic (Odutola et al., 2015).

Waiting time at the clinic was not significantly associated with incomplete vaccination both at bivariate and multiple logistic regression analysis in this study. Our finding is similar to a study in Malaysia that observed no association between waiting time and defaulting from immunization (Azhar et al., 2012).

However, these findings are inconsistent with the Tanzanian study by (Magodi et al., 2019). They reported that children of caregivers who had long waited hours for vaccination services had higher odds of non-uptake of measles second dose compared to those who do not have long waiting hours (aOR:1.80, 95% [CI=1.08-3.00]) p<0.01. In Nigeria, a study reported that more than fifty percent of the participants agreed that waiting time at the immunization site was too long and contributes to low compliance which may lead to incomplete vaccination (Rahji & Ndikom, 2013). The clinic environment may not be conducive for the caregivers to spend long hours. Another reason could be the late start of the clinic or favoritism of family members or friends by health care workers.

Replacement of the Infant Welfare Card has not been highlighted in many studies as a factor of incomplete vaccination. Unavailability of IWC may deter children from attending clinics which may lead to incomplete vaccination. A recent cross-sectional study in Togo found out that children of caregivers without immunization cards were 3.5 times the odds of incomplete vaccination compared to children whose caregivers had immunization cards. The author further asserted that one of the barriers to immunization was financial constraints to afford immunization services (Zida-Compaore et al., 2019). Wagner, (2019) reported that lack of vaccination cards was mentioned by families as a deterrent factor for not receiving vaccination among children during clinic visits (Wagner, 2019). This study found out that 2.3% (8/355) of the caregivers had paid for the replacement of the Infant welfare card. However, the study found no association between the replacement of IWC and incomplete vaccination.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

The findings of this study found out that incomplete vaccination was high among children aged 24-35 months in Kanifing municipality. Of the total factors assessed four(4) factors remained statistically significant for this study. Factors found to be associated with incomplete vaccination among children 24-35 months were children of caregivers who belong to monogamous family type, caregivers who are not aware of diseases for which vaccines are available, caregivers who do not know the age at which a child graduate from immunization, and caregivers who walked to the clinic.

6.1 Recommendations

From the findings of this study, the following recommendations were made;

Ministry of Health/ Expanded Programme on Immunization

1. Should ensure timely and regular supply of vaccines
2. Conduct a catch-up campaign for vaccines that were out of stock
3. Should strengthen collaboration with the Directorate of Health Education and Promotion to include immunization activities in their programs
4. Revisit the operational plan for vaccination to ease access within the community

Regional Health Directorate

1. Engage community members and influential leaders on the importance of vaccinating children below 5 years of age in preventing childhood illness.
2. The immunization operation officer should develop a plan for free radio programs

Health Facility Staff

1. Intensify health education programs during clinics.
2. Should vaccinate children that are due for vaccination regardless of their scheduled date or not.
3. Encourage male participation in Reproductive and Child Health without queuing at immunization clinics.

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APPENDICES

QUESTIONNAIRE

UNIVERSITY OF GHANA

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

Factors Associated with Incomplete Childhood Vaccination among Children Aged 24-35 months in Kanifing Municipality, The Gambia, 2020.

Code: …….

Date of Interview: ……/……/……...

Cluster NO: ……

Interviewers Name: ……...

Telephone Number of respondent: ……

Section 1: Socio-demographic factors of caregivers		
NO	QUESTION	SKIP
1	Caregiver relationship with the child 1. Father 2. Mother 3. Others…….	
2	How old are you?	
3	Have you ever attended school? 1 Yes 0 No	NO ⇓ 5
4	Highest level attended. 1 None 2 Primary 3 Secondary 4 Tertiary	
5	Mother's current marital status. 1 Single 2 Married 3 Divorced 4 Widowed	
6	Current religion? 1 Christian 2 Muslim	
7	Parity of the mother 1. Nulliparous (1 child) 2. Multiparous (2-4 children) 3. Grand multiparous (≥5 children)	
8	What is the mother tongue or native language? 1 Wollof 2 Mandinka 3 Jola 4 Fula 5 Serahule 6 Other language (specify)_____ 7. Non-Gambian	
9	What is your present occupation? 1 Trader 2 Civil Servant 3 Student 4 Unemployed	

10	What is the family setting? 1. Single parent 2. Monogamous 3. Polygamous									
Section 2: Child characteristics										
11	Child's age DOB……../……../……. Age: …….									
12	-Transfer dates of vaccination from IWC -if vaccination was given but no date recorded, write "00"	DATE OF IMMUNIZATION								
		D	D	M	M	Y	E	A	R	
	BCG					2	0	1		
	Hep B					2	0	1		
	Polio 0					2	0	1		
	Polio 1					2	0	1		
	Penta 1					2	0	1		
	Pneumo 1					2	0	1		
	Rota Virus 1					2	0	1		
	Polio 2					2	0	1		
	Penta 2					2	0	1		
	Pneumo 2					2	0	1		
	Rota Virus 2					2	0	1		
	Polio 3					2	0	1		
	Penta 3					2	0	1		
	Pneumo 3					2	0	1		
	Injectable Polio Vaccine(IPV					2	0	1		
	Polio 4					2	0	1		

	Yellow Fever					2	0	1		
	Measles &Rubella 1					2	0	1		
	Men A					2	0	1		
	Polio Booster 5					2	0	1		
	Measles & Rubella 2					2	0	1		
	DPT Booster					2	0	1		
	Confirm whether the child is:	1 Completely vaccinated 0 Incompletely vaccinated								
13	20 If a child missed a vaccine dose (See Q12), what are the reason(s) for not receiving the vaccine dose. 1. The attitude of the health care provider 2. The side effect of vaccination 3. Vaccine stock out 4. Not aware of the date 5. No information for the next schedule 6. Others…….. 7. Don't know									
14	The rank or birth order the child belongs to? 1. 1 2. 2 3. 3 4. 4 and above									
15	Sex of the child? 1 Male 2 Female									
16	Are both parents alive? 1 Yes 0 No									
	Section 3: Caregiver knowledge on vaccination									
17	Do you know diseases for which vaccines are available in the routine EPI schedule? 1. Yes 0. No									NO ⇓ 19

18	If yes, mention at least three diseases 1……. 2…… 3…….	
19	Mention at least three vaccines in the EPI schedule? 1 …….. 2 ……. 3 ……. 4 …….	
20	At what age should a child graduate from routine vaccination? 1. Age ……. 0. Don't know	
	Section 4: Health care-related factors	
21	On average, how many minutes does it take you from home to the vaccination center? 1. < 30 mins 2. 30-59 mins 3. >60 mins	
22	What are the means of getting to the health facility? 1 Walking 2 Vehicle	
23	What is the average waiting time at the facility? 1. <30 mins 2. 30-59 mins 3. >60 mins	
24	Did you ever replace the child Infant Welfare Card? 1 Yes 0 No	
25	If yes, how did you replace the new card? 1. None 2. Renewal(paid) 3. Renewal(free)	

PARTICIPANT INFORMATION SHEET

Study Title: Factors Associated with Incomplete Childhood Vaccination among Children aged 24 –35 months, Kanifing Municipality, The Gambia, 2020.

Principal Investigator: (Baba Ceesay: University of Ghana, School of Public Health Email**:** ceesaybmaa@gmail.com / +220 2579023/ 5335455

Sponsor: WAHO & Ghana Field Epidemiology and Laboratory Training Program (GFELTP)

What is informed consent?

You are invited to take part in a research study. The research study is been undertaken in the partial fulfillment of the Master of Philosophy in Applied Epidemiology and Disease Control. The research is done to gather information on incomplete childhood vaccination and associated factors among children aged 24-35 months. The research study is not the same as receiving normal routine vaccination or medical care at a health facility. Routine infant vaccination helps to prevent your child from vaccine-preventable diseases. The study will help to identify the underlying factors of incomplete vaccination among children to help in future decision-making about immunization in the country.

Procedures

A total of 382 mothers or caregivers whose children are between the ages of 24-35 months. If we need any further information, you will be contacted through a telephone call. The child infant welfare card will be used to extract immunization information. If your child misses a vaccine dose, you will be referred to the nearby health center or outreach clinic that offer immunization service.

Potential harm or discomfort in the study

The study does not involve vaccinating a child or collection of samples and there is no harm or risk expected. However, it may be the first time to meet the interviewer and I assume that you may not feel comfortable sharing some personal information. In the course of the interview, you may probably not know the answer to the questions. You are free to answer questions to the best of your ability.

Possible benefits

Participants in this study will not have any direct benefit. Mothers/ caregivers whose children missed a vaccine dose will be asked to visit a nearby health center or outreach for vaccination. Nonetheless, the findings will help to improve the routine infant vaccination in Kanifing Municipality and the country at large.

Participation

You are free to "accept" or "decline" from the study. You can accept and change your mind for any reason. Withdrawal from the study will not affect your rights and your child from getting medical care and routine vaccination at the health center. Participation in the study is voluntary and you can ask questions. The interviewer will ensure that you understand what the study entails before you take part. The information will be explained to you in a language that you can understand. If you "accept" to participate in the study, you will need to sign or thumbprint a consent form indicating that you accepted to be part of the study. The interviewer will provide you a copy of the consent form.

Compensation

You and your child will not be compensated for taking part in the study.

Confidentiality

The principal investigator will ensure that information collected about you and your child in the study remains confidential. You will be allocated with a unique numeric identifier and you and your child's personal information will only be available to the study team members.

Who should you contact if you have questions?

In case of concerns or questions, you may reach Mr. Baba Ceesay, Principal Investigator. Email: ceesaybmaa@gmail.com /Mobile: (+220) 2579023/ 5335455

This study has been reviewed by the Gambia Government/Medical Research Council (MRC) Joint Ethics Committee. The Ethics Committee protects your rights and wellbeing and has permitted it to take place.

INFORMED CONSENT FORM

Participant Identification Number: ……

☐ I have read the written information **OR**

☐ I have had the information explained to me by a study research assistant in a language that I understand and I

- confirm that my choice to participate is entirely voluntarily,
- confirm that I have had the opportunity to ask questions about this study and I am happy with the answers that have been provided,
- understand that I allow access to the information about me by persons described in the information sheet,
- had received enough time to think about whether I want to take part in this study,
- agree to take part in this study.

Participant's signature/ thumbprint* ☐ _____
Date (dd/mmm/yyyy)

The printed name of Interviewer _____

I attest that I have explained the study information accurately in _____ to, and was understood to the best of my knowledge by, the participant and that he/she has freely given consent to participate *in the presence of the above named impartial witness (where applicable).

Signature of the person obtaining consent _____ _____
Date: (dd/mmm/yyyy)

** Only required if the participant is unable to read or write.*

A copy of this informed consent document has been provided to the participant.