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Factors Affecting Completion of Childhood Immunization in North West Nigeria

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Abstract

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Abstract

North West Nigeria has the lowest vaccination rate of the geopolitical regions of the country. The purpose of this cross-sectional study was to examine associations between the parents'/caregivers' biological, cultural, and socioeconomic factors and the completion or noncompletion of routine immunization schedules. Andersen's behavioral model provided the framework for the study. Data were obtained from the 2013 National Demographic Health Survey. Descriptive statistics were calculated for all variables. Chi-square tests were used for categorical predictor variables, simple logistic regression models were used for the age variable, and multiple linear regression models were used for the biological, cultural, and socioeconomic variables to assess the relative importance of factors within each category. Findings indicated a statistically significant association between 4 factors (education, wealth index, religious affiliation, and cost of health care) and completion of immunization schedules. Findings may be used to improve the likelihood of immunization of children in North West Nigeria and reduce the levels of childhood morbidity and mortality. Policy makers and immunization programmers can strengthen social services such as women's education, income generation, especially in the agricultural sector and other culturally sensitive interventions with community collaboration to bring the required social change.

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Dedication

To my late father whom I cherished so much, Alh. Umar Alhassan Mangari (Chiroma) of blessed memory, who died while I was attending a course at Galili Institute in Israel in 2011. May Allah forgive him and pray that Aljannatul Firdausi is his final abode.

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Chapter 1: Introduction to the Study

The World Health Organization (WHO, 2009) stated that immunization is one of the most important public health interventions and cost-effective strategies to reduce child mortality and morbidity associated with childhood infectious diseases. Immunization is also a good strategy to reach vulnerable populations (WHO, 2009). Immunization is reported to prevent an estimated 2 to 3 million deaths each year worldwide (WHO, 2009). The year 2014 marked the 40th anniversary of the WHO's Expanded Program on Immunization (EPI), which was established to ensure equitable access to routine immunization (RI) services (CDC, 2015). The WHO (2009) has stated that "vaccines have the power not only to save, but also to transform lives – giving children a chance to grow up healthy, go to school, and improve their life prospects" (WHO, 2009). Strong RI was among the strategies for the Global Polio Eradication Initiative, which further underscored the importance of childhood immunization in preventing infant and childhood morbidity, mortality, and disabilities (WHO, 2009).

Children and infants in North West Nigeria are more likely to die than children in any other region of Nigeria, based on neonatal, postneonatal, infant, childhood and under-5 mortality rates (National Population Commission Nigeria [NPCN] & ICF Macro, 2013). Infant mortality is 43% higher in rural areas (86 deaths per 1,000 live births) than in urban areas (60 deaths per 1,000 live births), and the urban-rural difference is more prominent in the under-5 mortality category (NPCN & ICF Macro, 2013). Regional differences range from as low as 90 deaths per 1,000 live births in South West Nigeria to as high as 185 deaths per 1,000 live births in North West Nigeria. According to the

NPCN and ICF Macro (2013), mortality rates are significantly higher among male children than female children for all categories of mortalities.

Nigeria and four other countries (India, Democratic Republic of Congo, Pakistan, and China), which make up about one third of the world's population, accounted for half of the overall number of under-5 deaths worldwide in 2010 (WHO, 2015). In Nigeria, about 700,000 children died before their fifth birthday (Riedmann, 2010). Providing safe and effective vaccines reduces the high burden of communicable diseases in African countries and helps to meet the health-related millennium development goals (WHO, 2015). Vaccine-preventable diseases contribute significantly to morbidity and mortality; an estimated 4 million people die each year from diseases for which vaccines are available (WHO, 2015). Pneumonia and diarrhea disease account for approximately 34% of the global 10.4 million deaths among children less than 5 years of age (WHO, 2015). With effective immunization, many of these deaths could be prevented. Globally, invasive pneumococcal disease has recently been shown to cause the deaths of 826,000 children aged 1 to 59 months, while rotaviruses are the most common cause of severe diarrheal disease in young children (WHO, 2015). According to the WHO (2015), an estimated 527,000 children under 5 years, most of whom live in low-income countries, die each year from vaccine-preventable rotavirus infections.

Other vaccine-preventable diseases include meningococcal meningitis and septicemia caused by various serogroups of Neisseria meningitides, which cause epidemics with excessive morbidity and mortality among children and young adults even where adequate medical services are available in countries located in the African

meningitis belt (WHO, 2015). In 2017, Nigeria reported a severe epidemic of meningococcal meningitis with a total 1407 suspected cases (epid. week 11) and a case fatality rate (CFR) of 15% from 40 LGAs in 5 states since December 2016 (WHO, 2017). This was similar to an outbreak experienced in 1996, with 109,580 recorded cases and 11,717 deaths, giving a case CFR of 10.7% overall (Mohammed et al., 2000). Yellow fever, a viral disease that caused major epidemics in Africa and the Americas in the past, is now a serious public health issue again, despite the availability of a vaccine for 60 years (WHO, 2008).

Despite the comprehensive WHO/United Nations Children's Fund (UNICEF) measles mortality-reduction strategy and the measles initiative, a partnership of international organizations supporting measles mortality reduction in Africa, and despite the global measles mortality reduction, measles remains an important cause of death in children under 5 years in some sub-Saharan countries (Grais et al., 2007). The inability to give at least a dose of measles vaccine remains the principal reason for high measles mortality (Grais et al., 2007). Immunization appears to be a highly effective public health intervention that has the capacity to drastically reduce the disease burden, disability, and death from vaccine-preventable diseases as well as reduce economic waste especially in developing countries (WHO, 2009).

In light of the need to reduce the high morbidity and mortality rate among children, especially those under 5 years, from vaccine-preventable diseases, the present study addressed the factors affecting completion of childhood immunization in North West Nigeria. The findings from this study may help political leaders and health program

managers develop policies and interventions to improve the lives of vulnerable populations.

Background

Despite the global advances in universal immunization and oral rehydration therapy for diarrheal disease, and the endowment of Nigeria with human and natural resources, childhood mortality is still extremely high. Despite the implementation of a primary health care plan designed to help improve immunization rates in Nigeria, immunization coverage remains low (Ngowu, Larson, & Min, 2008). Abdulraheem and Onajole (2011) reported on reasons for incomplete vaccination and factors for missed opportunities among Nigerian children less than one year of age in Awe local government area (LGA), Nasarawa State, through a cross-sectional survey conducted in 85 villages in all the 10 administrative wards of the LGA between January and June, 2008. Less than half (37.2%) of the mothers/caregivers finished RI schedules for their children by 9 months of age. The main reasons given by the mothers for partial immunization included parents' disagreement, objection, or apprehension about the safety of immunization (38.8%), long trekking distance to the service point (17.5%), and waiting for a long time at the health facility (15.2%) (Abdulraheem & Onajole**,** 2011).

Belachew (2012) in a similar study in Ethiopia found that complete immunization coverage among children ages 12 to 23 months remained low and that maternal health care use and knowledge of mothers regarding the age to begin and finish vaccinations are the main factors associated with complete immunization coverage. Beckie et al. (2014) reported high coverage in the urban district of Enugu, South East Nigeria, in a hospital

study on vaccination coverage and its determinants in children ages 11 to 23 months. The cross-sectional study targeted caregivers and their children attending children's outpatient clinics in Enugu metropolis. The results indicated that of 351 subjects studied, 84.9% (298) were fully immunized according to the national immunization schedule by both cards and history of vaccination (Beckie et al., 2014). The conclusion was that vaccination coverage among the study population was reasonably high (Beckie et al., 2014). Factors such as government employment, child delivered in a government facility, and the knowledge of the caregiver/parents of the age when RI should start and be completed were the independent forecasters of the high vaccination coverage noted in this study, suggesting the need to extend the awareness and health education efforts to private and other hospitals to improve and sustain RI coverage nationwide (Beckie et al., 2014).

Maternal knowledge and educational status and raising the knowledge level of mothers and increasing maternal literacy level are necessary to advance immunization coverage, and that children from mothers with higher levels of education, who were delivered in hospitals, who live in urban areas, and whose mothers work outside the home, have significantly higher rates of completed basic vaccinations (Funmilayo, 2013; Gidado et al., 2014; Ushie, Fayehun, & Ugal, 2014). Saleena et al. (2014) reported that considerable barriers to enhancing coverage still exist, including vaccine stock outs and shortages of other supplies.

Problem Statement

In Nigeria, the EPI was developed based on the WHO's guidelines. A child is considered fully vaccinated if he or she has received bacille Calmette-Guerin (BCG) vaccination against tuberculosis; three doses of vaccine to prevent diphtheria, pertussis, and tetanus; at least three doses of polio vaccines; a dose of measles vaccine; and a yellow fever vaccine before the first birthday (NCPN & ICF Macro, 2014). The North West region of Nigeria has the lowest vaccination coverage compared to the other five geopolitical regions of the country, as evidenced by 52% of children fully immunized in the South East and South West compared to only 10% in the North West. Despite the North West region being ranked second in terms of availability of public health resources such as health facilities and Primary Health Care workers (Health Reform Foundation of Nigeria, 2007), there is lower coverage of all antigens in the region compared to other regions in the country (NPCN & ICF MACRO, 2014).

Several small-sample hospital-based studies have been conducted in Nigeria on coverage of routine antigens; however, there is a paucity of data from community-based studies with appropriate sampling technique and large sample size in the North West region (Gidado et al., 2014). There are also data gaps on the association between the parents'/caregivers' cultural factors such as their ability to take decisions independently, religious affiliation, and tribe/ethnicity, and the completion or noncompletion of routine immunization schedules. The current study also addressed the association between the parents'/caregivers' place of residence (rural/urban), distance from the immunization routine service point, the cost of transport, session plan, and cost of immunization

services, and the completion or noncompletion of RI. Findings may provide a better understand of the factors that determine how parents make health decisions for and about their children in the context of diseases with high levels of morbidity and mortality.

Purpose of the Study

The 2013 NDHS included a nationally representative sample of nearly 40,000, a large enough number to ensure the external validity and generalizability of findings drawn from it. I used the 2013 NDHS raw data with a view toward identifying the reasons for the poor completion rates of RI schedules in the North West. I examined sociocultural and other factors influencing completion of RI schedules. This study included cross-sectional data to examine the associations between parental, biological, socioeconomic, cultural, and health system factors and the use of immunization services and completion of immunization schedules.

Research Questions and Hypotheses

RQ1: Do the parents'/caregivers' socioeconomic characteristics (income levels and educational level) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o1A: There is no statistically significant association between parental/caregivers' educational level and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a1A: There is a statistically significant association between parents'/caregivers' educational level and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o1B: There is no statistically significant association between parents'/caregivers' income levels and the use of immunization services as measured by completion or noncompletion of immunization schedules

H_a1B: There is a statistically significant association between parents'/caregivers' income levels and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ2: Do the parents'/caregivers' biological characteristics (age, sex, parity) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o2A: There is no statistically significant association between parents'/caregivers' age and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2A: There is a statistically significant association between parents'/caregivers' age and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o2B: There is no statistically significant association between parents'/caregivers' sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2B: There is a statistically significant association between parents'/caregivers' sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o2C: There is no statistically significant association between parents'/caregivers' parity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2C: There is a statistically significant association between parents'/caregivers' parity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ3: Do the parents'/caregivers' cultural factors (ability to take decisions independently, religious affiliation, and tribe/ethnicity) have an association with completion or noncompletion of RI schedules in North West Nigeria?

H_o3A: There is no statistically significant association between parents'/caregivers' ability to take decisions independently and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3A: There is statistically significant association between parents'/caregivers' ability to take decisions independently and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o3B: There is no statistically significant association between parents'/caregivers' religious affiliation and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3B: There is a statistically significant association between parents'/caregivers' religious affiliation and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o3C: There is no statistically significant association between parents'/caregivers' tribe/ethnicity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3C: There is a statistically significant association between parents'/caregivers' tribe/ethnicity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ4: Are there associations between the parents'/caregivers' place of residence (rural/urban), distance from the routine immunization service point, cost of transport, and cost of immunization services and completion or noncompletion of RI in North West Nigeria?

H_o4A: There is no statistically significant association between parents'/caregivers' place of residence (rural/urban) and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4A: There is a statistically significant association between parents'/caregivers' place of residence (rural/urban) and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o4B: There is no statistically significant association between parents'/caregivers' distance to the routine immunization service point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4B: There is a statistically significant association between parents'/caregivers' distance to the routine immunization service point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o4C: There is no statistically significant association between parents'/caregivers' cost of transport to the immunization point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4C: There is a statistically significant association between parents'/caregivers' cost of transport to the immunization point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o4D: There is no statistically significant association between parents'/caregivers' cost of use of immunization services and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4D: There is a statistically significant association between parents'/caregivers' cost of use of immunization services and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ5: Do the children's biological characteristics (sex and birth order) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o5A: There is no statistically significant association between children's sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a5A: There is a statistically significant association between children's sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o5B: There is no statistically significant association between children's birth order and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a5B: There is a statistically significant association between children's birth order and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Theoretical Framework

According to Trochim (2006), Theory is what goes on in the head of the researcher or what the researcher is thinking in his head, while observation is what goes on in the real world where data are collected. Theories help in guiding researchers to come up with research questions and problem statements through the findings of analysis of data and conclusions, while theoretical frameworks provide the rationale for the study and also enable the readers to understand the perspective of the researcher and support the fact that the study is backed by established theories and empirical facts from credible studies (Trochim, 2006). I used Andersen's behavioral model to frame this study.

Andersen's behavioral model was created to empirically test hypotheses about inequality of access to health services in the United States (Willis, 1998). The Andersen model addresses the concern that some populations, specifically people from ethnic minority groups, people who live in inner cities, and people who live in rural areas, who receive less health care provision than the rest of the population (Phillips et al., 1998). Andersen's model views access to services as a result of decisions made by individuals, which are constrained by their position in society and the availability of health care

services (Phillips et al., 1998). The Andersen model is useful because of its flexibility in allowing researchers to choose independent variables related to their specific hypotheses, such as hypotheses regarding social inequalities. According to Phillips et al. (1998) the Andersen model (see Figure 1) has become one of the most widely used frameworks to predict health care use since its inception more than 40 years ago.

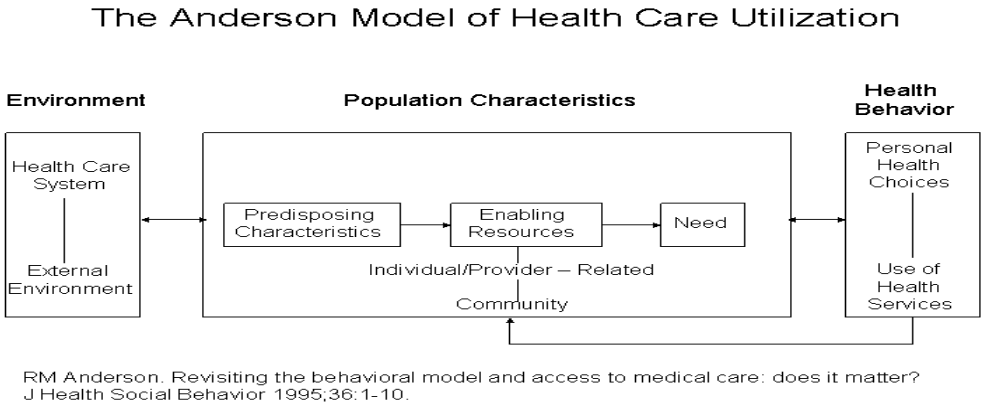

Figure 1. Andersen model of health care utilization.

The Andersen model encompasses three sets of predictive characteristics or factors: predisposing, enabling, and need factors. The predisposing factors are based on the argument that a family's tendency to use health services can be predicted from a set of personal characteristics that precede the disease and are categorized into the family composition, social structure, and health beliefs (Willis, 1998). Specific variables include age, sex, family size, ethnicity, and social class. These indicate the position of the family in a society, which could influence family members' lifestyle and physical and social environments (Phillips et al., 1998).

The Andersen model assumes that a sequence of factors determines the utilization of health services and explains the differences in the utilization of health care services behavior, which are bio-social and demographic (Andersen & Newman, 1973). In the context of this study, the Andersen model implies that biological characteristics (age, sex, parity, and birth order), socioeconomic characteristics (place of residence, closeness to the RI services, income levels, and educational level of respondents) and cultural factors (ability to take decisions independently, religious affiliation, and tribe/ethnicity) will predispose some parents/caregivers to use or not use immunization services. At the level of the community, these factors will also depend on the influence of aggregate communal values, cultural and societal beliefs, and political or organizational viewpoint. There is usually an expectation of approved behavior in different societies based on religion or tribe from parents/caregivers, and this expectation is expected to shape the attitudes of caregivers/parents toward health care system/immunization services utilization. Caregivers/parents who have a positive attitude toward RI services and who believe in its effectiveness/usefulness are more likely to utilize immunization services and complete the schedules (Andersen & Newman, 1973).

The enabling factors are based on the argument that even when the family has a predisposition to use health services, there must be financial enabling factors at the individual and family/community level to enable them to access/afford the services. Such enabling factors may include material resources such as income or family resources, having health insurance, and the availability of affordable health services (Andersen & Newman, 1973). Where a person does not have the ability to access/afford the services, a

predisposition alone will not translate into utilization (Andersen, 1995). For a health service to be utilized, there must first be a need for the service. There are two types of need factor: illness variables and response variables (Andersen, 1968). Not only must the family recognize that there is a sickness or disease, but they must also respond appropriately to access services by professionals (Andersen & Newman, 1973).

Nature of the Study

The study included a quantitative cross-sectional study design using secondary data to look at the relationship between socioeconomic, biologic, cultural, and health system factors and use of RI services as measured by completing and not completing RI schedules. The DHS has been periodically conducted in more than 70 nations since 1984 (Rutstein & Rojas, 2013). Permission to access the DHS data for Nigeria was obtained from ORC Macro and ICF International based in Calverton, Maryland, United States. Currently, the database is housed in the domain called MEASURES DHS+ and generally supported by the United States Agency for International Development (USAID). Additionally, permission of the institutional review board (IRB) of Walden University to use the DHS data was obtained prior to the study.

Assumptions

I assumed that the states in the North West region, having received tremendous support for childhood immunization activities/services as part of the Global Polio Eradication Initiative (GPEI) since its inception in 1998, should have adequate resources to meet the demands of parents seeking immunization for their children. This assumption was based on the knowledge that RI is one of the four key components the GPEI was

hinged on. RI services have received a lot of support over the period of the program implementation, both directly through providing funding and indirectly through multiple pieces of training of the GPEI participants who are also providing RI services as part of their primary assignments outside the polio campaigns.

Some initiatives have been carried out with the sole aim of boosting RI coverage in certain areas that the polio program identified as poorly covered. There has been an improvement in RI services in this region as a result of all of the above; however, I believed there are still challenges in the utilization of immunization services especially when it comes to the completion or noncompletion of RI schedules. I also assumed that completion of the immunization schedule is desirable despite the lack of data showing that completion is associated with lower morbidity or mortality, or cost savings, or other desired health outcomes, in this population. Finally, I assumed that if significant obstacles to completion were removed, the completion rates would increase. Recognizing those obstacles is an essential step toward addressing them.

Scope and Delimitations

This study addressed poor RI coverage in the North West region of Nigeria with a view toward understanding the associations between parental, biological, socioeconomic, cultural, and health system characteristics/factors, and utilization of immunization services and behavior toward completion of immunization schedules. I used the Andersen model of health care utilization as the theoretical framework. The findings from this study were generalizable to the population of the entire North West region because the sample was large and included the entire area.

Limitations

Because the study included secondary data and was cross-sectional in design, I was able to establish associations between the dependent and independent variables, but not causality. Another limitation was that because DHS data include information at the individual level, they are not an accurate reflection of community variables; however, it is possible to make inferences about the impact of community-based factors on individual associations (Smith et al., 2011). The use of secondary data also prevents researchers from controlling for confounders that were identified in previous studies, but were not considered during the primary data collection stage (Smith et al., 2011).

Significance

Using the data from the 2013 NDHS, I examined factors that may influence the use of RI services in the North West region of Nigeria. Factors included socioeconomic (income levels and educational level of respondents), biological (age, sex), and cultural (ability to take decisions independently, religious affiliation, tribe/ethnicity). Finding may be used to develop social mobilization interventions to target caregivers, religious leaders, and other stakeholders who have the potential to improve access to and utilization of health services and promote positive health outcomes in the completion of RI and reduction of infant/childhood morbidity and mortality. Identifying the association between caregivers' independence of decision-making, socioeconomic or cultural and biological characteristics, and the way of using RI services may influence completion of immunization schedules of children in the North West region with its multireligious and multitribal populations. Findings may help policymakers in modifying population-

specific interventions to improve access and utilization of health services and RI. The improvement in the completion of immunization schedules may reduce infant/childhood morbidity and mortality.

The North West region has been lacking in data on the factors that influence poor compliance with RI schedules when compared with other regions of Nigeria. The NDHS data had not been used for analysis of this nature, and this study presented an opportunity to analyze these factors. Findings may be used to raise awareness of the factors responsible for noncompletion of RI schedules in the North West.

Chapter 2: Literature Review

Immunization remains one of the most important public health interventions and cost-effective strategies to reduce child mortality and morbidity associated with childhood infectious diseases, but despite amazing progress in reaching more children over the years, many children are still not getting to complete their schedules of routine immunization before their first year of life (WHO, 2009).

Background

Despite the significant fall in the child mortality even among poor-income nations, the situation in sub-Saharan Africa has not changed much, and the continent is home to 41% of the estimated 10.8 million children who die yearly worldwide. Another 34% occur in South Asia. Six countries (Nigeria, China, Pakistan, India, the Democratic Republic of the Congo, and Ethiopia), which made up one third of the world population, account for 50% of the global childhood deaths, with Nigeria ranking second globally and 17th in under-5 mortality (Antai, 2009). Many studies have shown that routine immunization coverage in Nigeria is among the lowest worldwide and the country is one of 10 with coverage for routine antigens below 50% (Antai, 2009).

Efforts have been made to understand the reasons for the poor completion of immunization among Nigerians, especially in the southern regions of Nigeria (Antai, 2009). In the Bungudu local government area (LGA) of Zamfara state, Northern Nigeria, Antai (2009) identified the need for further research on community-level factors that will guide intervention at the community to help in improving RI coverage. Another study in Zamfara state indicated maternal knowledge and educational status as major factors in

immunization coverage (Gidado et al., 2014). Understanding the factors that influence the completion of routine immunization schedules in the North West region was a gap that needed to be filled, as none of the available literature provided specific information for the region. Gidado et al. tried to provide some information; however, the sample was inadequate and lacked geographical representation from other states in the region to give the findings the required external validity to generalize to all states in the region. In Zamfara state, Bungudu LGA is rural and has a small population, so it does not provide the external validity that can allow generalization to the entire state.

This section of the study is a review of the currently available peer-reviewed literature on the factors that may influence the completion or noncompletion of routine immunization schedules in the North West region. Literature that addresses factors influencing routine immunization coverage in other areas is also be included with a view toward learning from other countries' and Nigerian regions' experiences. I also review the global, African, Nigerian, regional, state, and LGA routine immunization systems, their performance over the years, and their challenges and prospects. Finally, I address the burden of childhood diseases as a consequence of poor routine immunization coverage or noncompletion of immunization schedules for children under 5 years in the North West and in Nigeria overall.

Literature Search Strategy

The literature search was conducted using different databases in the Walden University library such as CINAHL Plus, MEDLINE Sources, ISI web of science, SAGE, Social Science Direct, Nursing and Allied Health, PUBMED, and EBSCOhost. Websites

visited in the course of the search were the WHO, United Nations Population Fund (UNFPA), UNICEF and other United Nations organizations, and the U.S. Centers for Disease Control and Prevention (CDC). I also used the Google Scholar search engine. Many local sources on the subject of RI completion or coverage were searched for additional articles, abstracts, and publications from the Nigerian Federal Ministry of Health, the National Primary Health Care Development Agency, the Nigerian Center for Disease Control and Prevention, Health Reform Foundation of Nigeria, and the National Population Commission (Nigeria) and ICF Macro.

The key words used in the search were *factors affecting immunization coverage*, *completing immunization schedule*, *routine immunization*, *routine immunization schedule*, *North West*, *socioeconomic characteristics*, and *biological characteristics*. The articles reviewed were mostly published within the past 5 years, though a few were between 5 and 10 years old. A few that were more than 10 years old were included to give some historical perspective and to illustrate the paucity of literature on community-based studies, especially in Northern Nigeria. During the search over 200 articles were identified.

Theoretical Foundation

The Andersen behavioral model for utilization of health care was the theory of choice for this study; this theory was designed to test the hypothesis of inequality of access to health care services in the United States. According to Andersen and Newman (1973), the model addresses concerns of some groups, especially minority ethnic groups and other groups that live in inner cities and rural communities, who receive inadequate

health care compared to the rest of the population. This model has become one of the most widely used theories in predicting the use of health care services worldwide and is based on three characteristics: predisposing factors, enabling factors, and need factors. The enabling factors are bio-socio-demographic characteristics of individuals that exist prior to their illness. In the context of the current study, social structures (education, occupation, ethnicity, social networks, social interactions, and culture), health beliefs (attitudes, values, and knowledge) that people have about and toward the health care system, and demographic factors (age and gender) may predispose parental/caregivers to use or not use health care services, including RI services, which will affect the completion of the RI schedule positively or negatively.

The Andersen model provides for predisposing factors at the community level that are acknowledged to affect the use of health services (Andersen & Newman, 1973). These factors, linked to the community level, consist of the demographic profile of the community, their collective values, and their cultural beliefs and political perspectives. The cultural characteristics of men and women in a society include stereotypical behavior of each gender in that community, tribe, or religion that shapes a parent's attitude to RI and the use of health services generally. Parents or caregivers who have an appropriate understanding, including positive attitudes and behaviors regarding the usefulness and efficacy of health care services or RI, would be predicted to be more likely to use these services (Andersen & Newman, 1973).

Enabling factors relate to the individual's and community's ability to afford services, either in the form of health insurance, personal income earning such as periodic

income from salary or other sources, the extent and quality of social relationships, and the availability of the health resources within geographical regions (Andersen & Newman, 1973). Need factors are based on either perceived or evaluated need. Perceived need is based on the how individuals view their general health and functional state and their personal experiences from previous illnesses. Perceived need is the basis on which a decision will be made whether the symptoms are of sufficient magnitude to warrant seeking professional help. Evaluated need is based on medical investigations including laboratory and clinical judgments of the examining physician to decide the health need of the individual patient. For the purpose of this study, perceived need was used because the data source did not collect data on evaluated need (see Andersen & Newman, 1973).

The Andersen model is particularly suitable for this study because it takes into account the factors and characteristics of society at different levels and how these factors influence the way individuals and communities seek health care services, including RI services. These factors impact parents'/caregivers' behavior towards completion or noncompeting of immunization schedules (Andersen & Newman, 1973). The 2013 NDHS included questions regarding culturally sensitive factors that influence the use of immunization and other health services. The survey results provided valuable insight into the cultural dimensions that impact caregivers'/parents' ability to access and utilize immunization and other health services across diverse socioeconomic, religious, and tribal groups in a multi-ethnic and multi-religious country like Nigeria (NPCN & ICF Macro, 2014).

The Andersen model's theoretical framework is based on how both socioeconomic and demographic variables influence access and utilization of immunization and other health services, either positively or negatively. The Andersen model was a highly suitable choice to explore the research questions posed in this study. This study produced data that allow for deeper understanding of the factors that affect caregivers'/parents' ability to complete immunization schedules for their children and may help communities develop effective local interventions to improve adherence to immunization schedules.

Background of Nigeria

Geography

Nigeria is located on the west coast of Africa, covering a land mass of approximately 923,768 square kilometers stretching from the Gulf of Guinea on the Atlantic coast in the south to the fringes of the Sahara Desert in the north. It shares common borders with the Republic of Niger and Chad to the north and Cameroon and Benin to the east and west respectively; it is bounded to the south by the Atlantic Ocean.

Nigeria is characterized by two landforms topographically: lowlands and highlands. The uplands have elevations between 600 to 1,300 meters in the North Central and East highlands, while the lowlands often have elevations of less than 20 meters in the coastal areas. The lowlands start from the Sokoto to Borno plains in the northern part of the country, and in the southern states, they stretch to the coastal lowlands of the western geopolitical zone, and to the east up to the Cross River basin (NPCN & ICF Macro, 2014).

Population Distribution and Size

According to the National Population Commission, Nigeria is the most populous country in Africa, accounting for one-fifth of the continent's population. Nigeria's population is not distributed evenly across the country. While large areas such as Niger Valley, the Chad Basin, and the grassland plains are sparsely populated, the average population density for the country in 2006 was estimated at 150 people per square kilometer (NPCN & ICF Macro, 2014). The most densely populated states are Lagos (2,607 people per square kilometer), followed by Anambra (868 people per square kilometer), and Imo (758 people per square kilometer). Kano is the most densely populated state in the north with an average density of 442 people per square kilometer (NPCN & ICF Macro, 2014), and accordingly, two thirds of Nigeria's population live in rural areas.

Political Atmosphere

Nigeria functions on a federal system of government consisting of federal, state and local governments (LGAs). It has 36 states and federal capital territory (FCT) and 774 LGAs shared across the 36 states and FCT. The states are further grouped into six geopolitical zones (North West, South West, North Central, South-South, South East, and North East). At all levels, there are elected executives and legislatures that are independently responsible for administrative affairs according to the federal constitution. According to the National Population Commission, Nigeria has over 350 ethnic groups NPCN & ICF Macro, 2009). The geopolitical zones were historically dominated by certain tribes which form the basis for the grouping. In the South-South zone the Kalbiri

Ijaw, Itsekiri, and Ibibio form the predominant tribes; the North Central zone is mainly made up of the Nupe, Ebira, Idoma, Tivs, Igala, Angas, and Gwari; the Southwest is predominantly Yoruba; the North East is largely made up of Kanuri & Fulani with other tribes like the Marghi, Babur, Mumuye, and Jukun; Igbo dominate the South East; and North West zone is predominantly Hausa and Fulani, which because of their homogeneity are called Hausa-Fulani. Nigeria is a secular state with freedom of worship; the two main religions are Christianity and Islam. The North is predominantly inhabited by people of the Islamic faith, with some Christians; the South, on the other hand, is predominantly inhabited by Christians with some Muslims (NPCN & ICF Macro, 2009). All these ethnic and religious factors have a direct bearing on what is going on in the various geopolitical zones or regions. Cultural and religious differences shape the health-seeking behavior and attitudes towards health care services, including immunization. Hence the need to understand the various differences and the potential for impact on the completion or noncompletion of immunization schedules.

Economic Development

Prior to independence, agriculture was the mainstay of the Nigerian economy. It provided employment to more than 90% of the teeming population and also raw materials to industry and for export to secure foreign exchange. Over the years, following the discovery of petroleum, agriculture gave way as the major contributor to the Nigerian economy, with petroleum as the export commodity (NPCN & ICF Macro, 2014). Nigeria's gross domestic product (GDP) stood at $262.6 billion in 2013 according to the World Bank, and further analysis by sector indicates that agriculture contributes 39% to

the total GDP, as compared with 40 percent in 2011. In the same way, the 18% and 14% that industry and crude oil contribute to GDP were lower than the 2011 contributions of 19% and 15%, respectively. The contributions of industrial sector components, of solid minerals and manufacturing, were only 0.4% and 4%, respectively (NPCN & ICF Macro, 2014).

Consequent upon the contraction of the oil industry, the Nigerian government recognized the significance of privatization in economic restructuring, and liberalized, deregulated, and privatized many of the sectors of the economy. The most recent such change has been in the power sector, after the telecommunication and the petroleum downstream sectors. It is believed that this will boost the economy in the near future, especially when economic policy reforms are added to the combined investments in physical infrastructure, human capital development, and the setting up of macroeconomic stability and good governance.

Health Care System

The responsibility for the management of health systems is shared among the federal, state, and local governments of Nigeria. The federal government is charged with the responsibility of providing policy guidelines and overall technical guidance to the states and the LGAs, in addition to running the tertiary health institutions which comprise teaching hospitals, federal medical centers in states without teaching hospitals, and other national specialized hospitals (i.e. national orthopedics hospitals, psychiatric hospitals, eye centers, ear centers, and laboratories).

The states are responsible for monitoring and supervision, as well as providing technical and policy guidance to the LGAs, in addition to the running of the secondary health facilities to provide health care services through the general and specialist hospitals (Health Reform Foundation of Nigeria, 2007). The LGAs are in control of primary health care (PHC) centers and provide services at this level of care, including maternal and child health care. At this level, there are various services being provided ranging from curative care, to routine immunization (preventive) and health promotion activities, depending on the facility and its available healthcare staff.

Despite the strategic position of Nigeria in the African continent for its economic strength, and sophistication of its government oversight structure, its health care system has suffered major setbacks and the nation is seriously underserved in the healthcare sphere. There are inadequacies in all aspects of the system including trained personnel, health facilities, and medical equipment, especially in rural areas. Health care services are still fragmented, poorly coordinated, and lack resources such as drugs and supplies Inadequate and decaying infrastructure, unequal distribution of scarce resources and access to care, and unacceptable quality of care (despite the various reforms that have been put forward by the Nigerian government) are significant issues in the health care system. However, most of the federal reform measures are yet to be implemented at the LGA and State levels where the impacts are expected to be felt. This lack of implementation could partly be due to lack of clarity in the responsibilities among the three tiers of government (Osain, 2011).

Expanded Program on Immunization

The World Health Organization (WHO) started the global effort to use vaccination as a public health intervention in 1974 when it launched the EPI. Since then, immunization has remained one of the most cost-effective public health interventions for reducing global child morbidity and mortality (Machingaidze, Wiysonge, & Hussey, 2015). The EPI program is a blueprint of how to manage the technical and managerial functions required to routinely vaccinate children with a limited number of vaccines, providing protection against diphtheria, tetanus, whooping cough, measles, polio, and tuberculosis, and to prevent maternal and neonatal tetanus by vaccinating women of childbearing age with tetanus toxoid (Shen, Fields, & McQuestion, 2014).

The original intent of EPI was to deliver multiple vaccines to all children through a simple schedule of child health visits (Shen, Fields, & McQuestion, 2014). This was challenging because at that time the health systems in most poor and developing countries were frail and in some cases nonexistent (Shen, Fields, & McQuestion, 2014). Vaccine coverage levels were less than 5%, until around 1990 when most of the poor countries had institutionalized immunization programs based on the EPI blueprint, and by 1991, the global target of vaccinating 80% of the world's children was declared to have been met, likely saving millions of lives (Shen, Fields, & McQuestion, 2014). These successes were attributed to the building of the capacities and capabilities of these countries through the EPI blueprint that was developed at the inception of the program (Shen et al., 2014).

The cost of vaccination in the developing world has grown from less than one United States Dollar (USD) in 2001 to about $21 for boys and $35 for girls in 2014, as increasingly expensive vaccines are being introduced into national immunization programs, and vaccines for girls, such human papillomavirus vaccines, are being introduced more widely (Shen, Fields, & McQuestion, 2014).To address these and other challenges, additional efforts are needed to strengthen 8 critical components of RI: policy, standards, and guidelines; governance, organization, and management; human resources; vaccine, cold chain, and logistics management; service delivery; communication and community partnerships; data generation and use; and sustainable financing, though these may not affect the rates of vaccination among boys and girls (Shen et al., 2014). Countries are expected to ad0apt the available WHO global-level policies, standards, and guidelines to develop their own structures to provide overall guidance to their countries' immunization activities. In the majority of nations, the national program of immunization provides leadership and a wide range of other functions as part of its role in building strong governance, organization, and management (Shen et al., 2014).

There is a growing need for a highly trained health workforce as a result of the increasing complexity of immunization services caused in part by the rising number of vaccines given to a child and the growing populations of children who require these services. The quality of the health workforce has become more critical in the face of the increasing cost of vaccines, making competent handling and oversight of limited and expensive stocks a key issue. Despite the growing demand for skills in the health

workforce, the same basic method of vaccination training is still in use that was in place 30 years ago (Shen et al., 2014). Vaccines, cold chain, and logistics management have become increasingly important with the growing number of new vaccines for disease prevention, eradication of existing outbreaks, and frequent mass campaigns that require additional storage equipment, finance, and expertise in the management of the entire system. Communication and community partnerships are central to the EPI activities and the use of immunization services, especially to enlighten and mobilize the community to support immunization (Shen, Fields, & McQuestion, 2014). In practice, this requires the support of the health workforce and other trustworthy persons to ensure that parents or caregivers are kept informed of where and when, as well as how many times, they are required to bring children for vaccination. Health personnel remains the most cited source of health information including key details about immunization. (Shen, Fields, & McQuestion, 2014).

The role of quality data in guiding policymakers to make informed programmatic decisions cannot be overemphasized. Data are usually obtained from vaccine coverage reports, either by periodic population-based surveys such as NDHS and Mixed Indicator Cluster Surveys, or by routine administrative reports (Shen et al., 2014).

EPI in Africa

The World Health Organization (WHO) started the global effort to use vaccination as a public health intervention in 1974 when it launched the EPI. Since then, immunization has remained one of the most cost-effective public health interventions for reducing global child morbidity and mortality (Machingaidze, Wiysonge, & Hussey,

2015). There have been several efforts over the years to increase EPI coverage globally, such as the Global Alliance for Vaccines and Immunization, universal childhood immunization; millennium development goals (MDGs); Global Immunization Vision and Strategy; and most recently, the Global Vaccine Action Plan (Machingaidze et al., 2015). These efforts, combined with specific regional efforts, such as the WHO African regional office EPI strategic plans of action, implemented in the periods 2001-2005 and 2006-2009, and the Reaching Every District approach, plus individual national EPI efforts, have raised global immunization coverage. For example, three doses of the diphtheria-tetanus-pertussis (DTP3) vaccine at 12 months of age rose from 5% coverage in 1974 to 85% in 2010. Despite this global progress, sub-Saharan Africa attained only 77% DTP3 coverage by 2010 (Machingaidze et al., 2015; WHO, 2015).

There has been substantial progress in the performance of the EPI in Africa since its launch in 1974, though inter and intra-country differences exist. The introduction of meningococcal group A, Haemophilus influenza type B, and hepatitis B vaccines across the continent indicate development and growth in the right direction. On the other hand, according to national immunization coverage scorecards for 2014 (Machingaidze et al., 2015; WHO, 2015), polio and measles outbreaks as well as high vaccine dropout rates across the continent are indicators of failures in the EPI system that require evidence-based remedial interventions. There is an urgent need to come up with strategies to improve the immunization system, strengthening poor infrastructure, addressing a lack of qualified manpower, and finding ways to provide more affordable and appropriate vaccines at all times. Increased financial and political commitment by African leaders is

necessary if Africa is to sustain the gains made in EPI and improve upon them in the African region (Machingaidze et al., 2015; WHO, 2015).

In 2014, 129 countries, accounting for 66% of the 194 WHO Member States, attained the coverage target of ≥ 90% for DTP3 at the national level. Of these, 119 nation states had sustained this coverage for the last 3 years and 109 of them for the last 5 years. Additionally, by 2014, DTP3 coverage in 35 nations was below 80%, compared to 32 in 2013, and 30 in 2011. Of those 35 countries with coverage below 80% in 2014, 27 were already below this threshold in 2013 and 8 were above 80% in 2013, including 2 for which the coverage rate was above 90% (WHO, 2015). Nineteen countries never surpassed this 80% threshold at any time since 2010, five countries had DTP3 coverage below 80% in 2013 but succeeded in raising it above the 80% threshold 2014, and only one reached a rate of 90%. In 2014, 18.7 million children, compared to 18.8 million in 2013 and 19.2 million in 2011, were estimated not to have received three doses of DTP-containing vaccines. Nigeria's coverage stands at the 75% within the same period.

Nigerian Immunization and Vaccine Development

Nigeria introduced EPI in 1978 with the aim of providing routine immunization to children under two years of age, and saw some initial but recurrent successes with the highest level in the early 1990s, when Nigeria achieved childhood immunization coverage of 81.5% (Ophori, Tula, Azih, Okojie, & Ikpo, 2014). However, since that period of success, Nigeria has seen slow but sure and consistent falls in immunization coverage. By 1996, national coverage had dropped to less than 30% for all antigens and decreased further to 12.9% in 2003, which was also consistent with the 2003 national

immunization coverage survey findings. The downward fall in coverage of all antigens seems to have been linked with poor government political will and commitment resulting in failure of the fulfillment of EPI policies as reflected in over-centralization in the management of EPI at the federal level of governance and vaccine shortages and other administrative problems (Ophori et al., 2014). The government came up with a program to revitalize and sustain the immunization system in 1999, in synergy with the polio eradication program, leading to the establishment of the National Program on Immunization (NPI). The focus of the NPI is on providing support to the states and LGAs in the implementation of immunization programs (WHO Regional Office for Africa, n.d.)

In Nigeria, WHO is providing technical support to authorities at federal, state, local government, and ward levels in the strengthening and implementation of the Reaching Every Ward (REW) strategy (WHO Regional Office for Africa, n.d.). This followed the signing of a memorandum of understanding between WHO and the Government of Nigeria, under which WHO will provide technical support for health workers at all levels. The support of WHO, along with other development partners, has greatly contributed to increased access and utilization of routine immunization services in the form of improved coverage (WHO Regional Office for Africa, n.d.).

In a study in Bungudu, Zamfara state, North West Nigeria (Gidado et al., 2014), on determinants of routine immunization coverage, it was found that five factors were significantly associated with full immunization coverage; these included satisfactory level of knowledge on RI, having at least secondary education, receiving ante-natal care (ANC), having received information on RI 12 months preceding the study, and delivery

at health facility by mothers. Among these factors, having a satisfactory level of knowledge on RI and at least attaining secondary education were the only independent determinants of full immunization after performing logistic regression (Gidado et al., 2014). However, it was also the case that this study, through community-based, was limited by geographical scope and acknowledged the fact that if it had been conducted even in the entire state, the result could have been different; hence the result cannot be generalized to the North West zone.

Additionally this study did not take into account the role of socioeconomic status (place of residence, closeness to the routine immunization services, income levels, and educational level of respondents) of parents/caregivers, apart from their level of education, their biological characteristics (age, sex, parity, birth order), cultural factors (ability to take decision independently, religious affiliation, and tribe/ethnicity), place of residence (rural/urban), distance and cost of transport, session plan and cost of immunization services.

Abdulraheem and Onajole (2011) looked at the reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children in Awe Nasarawa state. They found that the major reasons for noncompletion of vaccination among rural children were the concerns among parents on the safety of the immunization, long distance walk to the service point, and long waiting time at health facilities (Abdulraheem & Onajole, 2011). However, Abdulraheem and Onajole did not find any significant differences with respect to vaccination completeness due to factors such as mothers' age, marital status, schooling level and gender of the child, though one of the

limitations of the study was the fact that the sample population was from a homogenous rural community and participants were mainly poor women and children. This might have resulted in an underestimation of the role of socio-demographic factors such as educational levels, gender and marital status (Abdulraheem & Onajole, 2011). Again this study also lacked geographical spread and the sample size was not representative and can only apply to the community where the study was conducted.

Rahji and Ndikom (2013) conducted a similar study in Ibadan, during which they attempted to identify factors influencing compliance with the immunization regimen among nursing mothers in Moniya Community. They found the health workers' attitude, long waiting for time, and cost of immunization were factors hindering compliance with immunization schedules (Rahji & Ndikom, 2013). Age, occupation, education, religion and time spent at the centers also were found to have a significant relationship with compliance with immunization regimen (Rahji & Ndikom, 2013).

Finally, Tagbo et al. (2014) conducted a hospital study in Enugu on vaccination coverage and its determinants in children aged 11 - 23 months in an urban district of Nigeria concluded that vaccination coverage was associated with high maternal education, government employment, delivery of a child in a government hospital, and knowledge of the age at which a child should start and complete routine vaccinations were independent predictors of high vaccination coverage. One of the limitations of this study was that it was hospital-based, and was only conducted in an urban setting and so cannot be a complete reflection of what is happening at the community level.

Education Level of Parents/Caregivers

In a study in peri-urban area of Kenya on immunization coverage and its determinants among children aged 12-23 months, maternal education was found to be one of the factors that were significantly associated with immunization coverage (Maina, Karanja, & Kombich, 2013), this finding was corroborated by similar studies in Bungudu LGA of Zamfara State Nigeria (Gidado et al., 2014), a study of correlate of complete immunization in East African countries (Canavan, Sipsma, Kassie, & Bradley, 2014), and Uganda on the factors influencing childhood immunization that indicate possessing at least a secondary education remained as single independent determinant of full immunization coverage (Bbaale, 2015), and Angola on factors associated with vaccination coverage in children < 5 years (Tagbo et al., 2014; De Oliveira, Martinez, & Rocha, 2014, Tagbo et al., 2014). These findings were in contrast to Etana and Deressa's (2012) study on factors associated with complete immunization coverage in children aged 12-23 months in Ambo Woreda, Central Ethiopia in which they found that mother's educational status had no significant association with the completion of immunization among children 12-23 months.

In Kaptembwo, the proportion of fully immunized children of mothers/guardians who had accomplished secondary school education and above was 81.6% which is higher than those who had accomplished primary school education (76.7%) and even those with no formal education (42.9%) (Maina et al., 2013). Prior studies have also revealed a significant association between immunization coverage and living in an area with high levels of maternal/guardian education (Maina et al., 2013). The literature that attributes

maternal educational level as a predictor of full immunization coverage attributes this to changes that accompany maternal education, such as attitudes, traditions, and beliefs, increased autonomy and control over household resources, which enhance health care seeking and demand childhood immunization (Bbaale, 2015). In addition higher education will increase parental awareness, especially on health issues and facilitate individual's increased access to services, information, and the capacities to interact with professionals and health care services in contrast, belonging to less educated groups with limited social inclusion, hence lacks basic information and increases the likelihood of not keeping to the vaccination scheme (De Oliveira et al., 2014).

Income Level of Parents/Caregivers

The level of family income has been associated with immunization coverage by many; however, there are various studies that looked at the role of parents/mothers income level in relation to the completion of immunization schedules in different countries and communities. And the findings from these studies have shown various scenarios that have left some gaps in the literature. In a study on the factors influencing compliance with immunization regimen among mothers in Moniya Community Ibadan, Nigeria (Rahji & Ndikom, 2013), and similar study on the reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children indicates that children of parents of lower socioeconomic background have reported poor completion of their immunization regimen than children of parents of higher socioeconomic background (Abdulraheem & Onajole, 2011). This is consistent with the findings in a study on the factors influencing full immunization coverage among 12-13

months in Ethiopia, using 2011 DHS data as evidence, which shows that children of the wealthy families are more likely to complete their immunization regimen that their counterpart from the poor families (Lakew, Bekele, & Biadgilign, 2015). While children of mothers in the lower socioeconomic cadres in their working places are more likely not to complete their immunizations, since they need to seek permissions to be away from their places of work, hence making it more difficult to take their children for complete immunization (Antai, 2009).

In a similar study on a nationwide register-based study on human papillomavirus (HPV) vaccine uptake in the school-based immunization program in Norway to find if the parental education and income matter, it was found that overall maternal income is positively associated with HPV vaccine initiation, while education was negatively associated with initiation of HPV vaccination (Bbaale, 2015). Paternal income and education showed similar, but weaker, associations. The association with parental education was restricted to girls with low-income parents. More than 94% of all girls who initiate the HPV-vaccination series complete the schedule and receive all three doses as recommended. Parental socioeconomic status had little influence on completion of the three-dose series (Bbaale, 2015).

However, in Uganda, the finding was in contrast to the findings of the studies in Nigeria. While in Nigeria, mothers'/parents' income is significant in the completion of an immunization regimen, this was not significant in influencing completion of immunization regimen in Uganda for the simple fact that immunization is universal in Uganda (Bbaale, 2015). Though Bbaale (2015) acknowledged the fact that similar

literature suggests the significance of wealth or income in completion immunization schedule, no literature reviews included studies in the Northwest geopolitical zone, which is distinctly different from all these study areas, socioeconomically, culturally, and educationally, hence the need for data to fill in this gap.

Delivery in a Health Facility

The role of health institutional delivery and its association with complete immunization coverage was reported in a study on the factors associated with complete immunization coverage in children aged 12–23 months in Ambo Woreda, Central Ethiopia (Etana & Deressa, 2012). The findings indicated that children delivered at health facilities were more likely to complete their immunization schedule than children delivered at home. This is also corroborated by a study on correlates of complete childhood vaccination in East African countries (Canavan et al., 2014; Lakew et al., 2015), that found the increased likelihood of complete vaccination status associated with getting a check-up within 2 months of birth in Burundi, Kenya, and Uganda, although not in the other countries (Canavan et al., 2014; Lakew et al., 2015). The explanation was that mothers that gave birth to the health facilities are more likely to be closer to the health facilities and their children might receive the first dose of vaccination after birth. In addition to its close relationship with the facility of delivery, there is statistically significance association between complete childhood immunization coverage and mothers utilization of antenatal care (ANC) services during pregnancy. Children born of mothers with a history of ANC follow-ups were observed to have 2.1 times likelihood of

completing their immunization schedules than those with no history of ANC follow-ups (Lakew et al., 2015).

Knowledge of Parents/Mothers of RI Services

Studies in many communities in Nigeria and other African countries have suggested that satisfactory maternal knowledge of RI is an independent determinant of immunization coverage. In a study in Bungudu LGA of Zamfara state (Gidado et al., 2014), on the determinants of routine immunization coverage, it was found that maternal knowledge of the benefit and schedule of RI services has a positive influence on the mother's decision to get her child fully immunized (Abdulraheem & Onajole, 2011; Gidado et al., 2014). This finding is consistent with the Ethiopian study which found that lack of awareness about immunization contributes to low coverage, and children of mothers that knew the age at which vaccination starts and finished are more likely to complete immunization compare to their counterparts whose mothers have no knowledge of the schedule of RI services (Etana & Deressa, 2012).

Distance of Parents/Caregivers From RI-Providing Facilities

Distance from a health facility was found to be an important predictor of full immunization; this is because it has an implication in accessing the health facilities where the services are offered. There are reports of studies that show that mothers that are domicile near where a health facility providing RI services is within a one-kilometer radius from their residence are more likely to fully immunize their children than those living in areas where there are no health facilities providing RI close to them (Rahman & Obaida-Nasrin, 2010).

Similar studies in developing countries suggest that walking or traveling time and distance are key factors that influence the utilization of healthcare services (Rahman & Obaida-Nasrin, 2010). In a study on the reasons for incomplete vaccination and factors for missed opportunities among rural children in Awe LGA of Nasarawa state Nigeria, found that long walking distances, as well as long waiting time at the facility, are key factors associated with poor completion of RI schedules (Abdulraheem & Onajole, 2011). Despite all the findings above there are still gaps in the literature as it affects the North West region of this country, these studies were not representative of the region, while Abdul Raheem study was in the North Central region that may have some similarities with the North West region, his study can only be generalized in Nasarawa state because it is not representative enough to be generalized to the entire Nigerian population. While the NDHS 2013 data is very representative and have adequate sample size as well randomization for the result to generalize on all the states, hence the need for this study to close this gap in the literature.

Role of Religious/Ethnic Affiliation of Parents/Mothers in Completion of RI Schedules

There are many studies and documentations that discuss the role played by the religious affiliations of the caregivers or mothers in ensuring their children complete RI schedules before their first birthday. Many of these studies were either conducted outside Nigeria or in the southern part of the country leaving the northern region where North West region belongs with little or no information of the subject matter. In a study on Ojo Local Government Area, Lagos State, Nigeria, Oyefara (2014) found that in addition to

other personal characteristics of women, religious affiliation, and ethnic background were statistically associated with full immunization status of their children. These findings were consistent with studies on the effect of maternal and provider characteristics on up-to-date immunization status aged 19 to 35 months, among Hispanics which is attributed to their strong cultural emphasis on the well-being of their children which strengthen their awareness on preventive care leading to high immunization coverage among the Hispanics (Kim, Frimpong, Rivers, & Kronenfeld, 2007).

Role of Women's Autonomy in Completion of Immunization Schedule

The term *women's autonomy* has been described by many researchers as the ability of a woman to take an independent decision about the family that either affects her or her children without any interference from the family. The word *autonomy* is used interchangeably with *volitional control* and *empowerment*. Bharati (2014) also reported similar definitions of *women's autonomy* by several researchers. According to Bharati, (2014) defined *autonomy* as the opportunities for women to receive education and to work outside the home, while Bharati (2014) quoted Miles-Doan who defined *autonomy* as a woman's position within household power relations such as her bargaining power. He also defined *autonomy* as control over the household and societal resources. Finally, Bharati (2014, quoted Jejeeboy and Sathar who stated that autonomy entails five interconnected elements, such as knowledge or experience acquired; decision-making power; physical autonomy which includes ability to go out freely without seeking permission based on need; emotional independence and economic and social sovereignty which includes right to use and control over resources. The overlapping of the definitions

and concept of women's autonomy has brought researchers recently, to begin to investigate the role of women autonomy on the status of their own health as well as the health of their children (Bharati, 2014).

In a study on the impact of women's autonomy, on their children's nutritional and immunization status as measured by the women's decision making power through four main parameters of decision making on her own health care, large household purchase, going to relatives or friend's house and spending the husband's earning (Bharati, 2014). These decision-making controls are directly or indirectly associated with the socioeconomic characteristics of the household and cultural conditions of the society, this is consistent with similar findings from another study in India and Nepal (Bharati, 2014; Desai & Johnson, 2002). Bharati (2014) also found that the proportion of independent decision making of women is very small when compared to the joint decision making with their husband, while the proportion of women who could not take any decision independently is very high among the Indian women (Bharati, 2014). Similarly, urban women have more decision-making powers as compared to their rural counterparts, while literate women have more autonomy than illiterate women, but on the use of husband's money, the illiterate women have almost twice the autonomy their counterparts that are more educated (Bharati, 2014).

These findings on the impact of women's autonomy on the health of their children as reported by Bharati, (2014) are consistent with findings from another study in India and Nepal on women's decision making and child health. Familial and social hierarchies, in which they found that women autonomy increases their use of emergency care or

preventive health care services including children's immunization and can influence even women that have less decision-making authority. While even women that are high powered when living in communities where women have less decision-making powers may have their powers significantly curtailed (Bharati, 2014). As a fall out of this effect, even doctors may refuse to treat emergency patients based on the sole decision of women in a highly male-controlled society (Bharati, 2014; Desai & Johnson, 2002). Similarly, Ebot (2015) and Singh, Haney, and Olorunsaiye (2013) found a positive relationship between women's autonomy and children's health outcomes including immunization status.

These studies were mainly conducted in the Asian continent with few or little studies in the sub-Saharan Africa and Nigeria in particular and even in Nigeria the data were mainly from the southern part of the country which is entirely distinct from the northern part of the country were North West region is located. The urgent need to understand the impact of women's autonomy on the children's immunization and their overall health status cannot be over-emphasized, hence the need for this study to fill in this literature gap.

Role of Maternal Age and Parity, Child's Sex, and Birth Order in Completion of Immunization Schedule

In a study on maternal determinants of immunization status of children aged 12-23 months in urban slums of Varanasi, India (Awasthi, Pandey, Singh, Kumar, & Singh, 2015), and a similar study on the factors affecting acceptance of complete immunization coverage of children under five years in rural Bangladesh (Rahman & Obaida-Nasrin,

2010), both found that maternal age, maternal employment status, maternal education, parity of mother, were the most important factors influencing complete immunization. They found that mothers with lower parity were more likely to have fully immunized children than mothers with higher parity with more children who may not have self-motivation to provide care for the most recent child. The study in rural Bangladesh (Rahman & Obaida-Nasrin, 2010), also found that age of the mother is statistically significant and that middle age mothers are more likely to get their children fully immunized than older women, this could be due to their accumulated knowledge of modern medicine and repeated messages on the importance of immunization services. The study (Rahman & Obaida-Nasrin, 2010), also found that sex discrimination plays a role in immunization coverage, with male children more likely to be fully immunized than females and mothers having received TT injection were also found to be one of the significant predictors of full immunization coverage for children (Rahman & Obaida-Nasrin, 2010).

In contrast to the findings in the these studies above, in a study on factors associated with vaccination coverage in children < 5 years in Angola, De Oliveira et al. (2014) showed no sex differences in vaccination coverage, and is also in line with a study conducted in Sao Luís, MA, Northeastern Brazil, in 2006, on factors associated with incomplete basic vaccination schedules. Again, these studies examined similar problems in regions of the world other than Nigeria; hence the need to understand the impact of these characteristics in relation to the completion of immunization schedule especially in

North West Nigeria where all health parameters are poorer compared to other regions in Nigeria.

Attitudes, Motivation, Performance, and Competence of Health Staff

Health staff who deal with mothers in an unfavorable, rude, and sometimes abusive manner were found to be associated with the mother's refusal for bringing children for vaccination or refusal to return to complete vaccination schedules even when they had already begun the schedule in Ethiopia, Zimbabwe, Niger, Kenya, Bangladesh, West Africa, Uganda, Benin, Nigeria and Syria (Favin, Steinglass, Fields, Banerjee, & Sawhney, 2012). There were many reports of health workers screaming at mothers who forgot to bring their children's immunization record cards, missed scheduled appointments, or children being dressed in a dirty cloth or presented as malnourished (Favin et al., 2012).

Summary and Conclusions

In Chapter 2, I explained the literature search strategies I used in this study to, including the numerous search engines, important search terms, and databases I used. The range of review and the literature searched was within the last five years for areas with adequate literature (2011-2016); however, in other areas with a paucity of data, the search extended beyond five years, up to ten years or more where the literature published on that area within the last five years was inadequate. I also elucidated the historical perspective and the current literature on the Andersen health care model as the conceptual framework that guides this study. This model is very useful in bringing out the factors that determine how and why community's health care seeking behavior are the way they are and will

guide programmers as well policymakers to make an appropriate decision on how to reach their targets or make policies that will help in addressing these factors positively. In this chapter, I also looked comprehensively at the most important themes of the literature review as such the socioeconomic, biological, religious/ethnic affiliations, vaccines stock out, personal attitude, and long waiting time as well as the role of women's autonomy.

The review revealed several studies conducted globally, including in Nigeria, on the subject matter; however, these studies are either hospital studies, or the populations are grossly inadequate to be representative and lack the external validity to be generalized to the populations. The studies that were conducted in Nigeria were mostly done in the southern part of the country with different socioeconomic, cultural/religious background from northern states this study focused on in addition to lack of external validity to apply to the northern states. Some similar studies in the north have encountered the same challenges of external validity, sample size, and study populations/locations. However, this particular study used data that was very representative and had the required external validity to generalize the findings. It was also a community-based study that covered large areas of the country (NPCN & ICF, 2014). It is these gaps that this study intended to fill. The study aimed to add to the existing literature, and possibly to help programmers and policymakers address the challenges to completion of RI schedules. The improvement in the RI schedule completion will lead to a reduction in morbidity and mortality among under-fives in the North West region and Nigeria/Africa at large.

In this chapter, I examined the Nigerian population structure and health system, including immunization which is the cornerstone of the primary health care system in

Nigeria. I also gave an overview of the economic development. In Chapter 3, I present the design of the study, instrumentation, sample, and analysis of data. I will also address and identify knowledge gaps and discuss ethical considerations and present a description of the variables in the study, as well as potential threats to validity.

Chapter 3: Research Method

The purpose of this study was to use 2013 NDHS data to examine the relationships between biological and cultural factors and completion rates of RI schedules in the North West region of Nigeria. The 2013 NDHS, conducted by the National Population Commission, was the fifth demographic and health survey conducted in Nigeria; previous surveys were conducted in 1990, 1999, 2003, and 2008 (NPCN & ICF, 2014). The cross-sectional survey addressed the associations between parental, biological, socioeconomic, cultural, and health system characteristics, as well as the use of immunization services and completion of immunization schedules. In Chapter 3, I present the research design and rationale, methodology used to answer the research questions, study population, sampling, and sampling procedures. I describe the recruitment of participants, their participation, data collection, instrumentation, operationalization of concepts, data analysis, threats to validity, and ethical procedures.

Research Design and Rationale

I used a quantitative, cross-sectional design including secondary data from the NDHS 2013 to examine the relationships between socioeconomic, biologic, cultural, and health system factors and use of RI services as measured by completion and noncompletion of RI schedules. The quantitative research method, unlike the qualitative approach, is based on accepting or rejecting a certain hypothesis. According to Creswell (2009), the quantitative approach is the most appropriate means of answering research questions addressing the differences or relationships among variables in a study. The quantitative approach has the advantage of including descriptive research processes that

offer reliable data on the association among variables under investigation, which allows for forecasting of future outcomes. Another advantage is that the quantitative method produces numerical data and permits the control of extraneous variables within the analytical process. The wider applicability, coupled with the provision of numerical descriptions of trends and opinions, as well as measured levels of occurrence of an event, was the rationale for the selection of a cross-sectional survey design in this quantitative study (see Creswell, 2009).

Methodology

Types and Sources of Data

The study data were obtained from the 2013 NDHS. The NDHS was conducted with the ICF International providing financial and technical support through the USAID-funded MEASURE DHS program, which is designed to support developing countries to collect data on fertility, family planning, and maternal and child health (NPCN & ICF MACRO, 2014). Financial support for the survey was provided by USAID, the United Kingdom Department for International Development through PATHS2, and the UNFPA (NPCN & ICF MACRO, 2014). The overall aim of this program is to increase technical capacities of countries to use facts for the development of their policies. NDHS 2013 was a cross-sectional survey intended to provide data on important indicators for the population that cut across all the MDGs at the level of all 36 states, the FCT, and at the national level (NPCN & ICF Macro, 2014). I obtained raw data files from MEASURES DHS+ after gaining permission from ORC Macro and ICF International, which are the

custodians of the data (NPCN & ICF, 2014), and after obtaining the approval of the Walden University IRB.

Sample Size and Recruitment of Participants

The 2013 NDHS sample was nationally representative and covered the entire population residing in noninstitutional residential units in the country. The NPCN provided the list of EAs for the 2006 population census of the Federal Republic of Nigeria that was used as a sampling frame for 2013 NDHS. Enumerators with field experience were recruited with the support of the NDHS technical team for the field work. The recruitment of field staff was done through written examination and an oral interview focusing on major languages that were used as the media of communication during the field work. Many of the recruited staff had experience working on the previous NDHS surveys, and nearly all of the recruited personnel had a minimum of ordinary national diplomas, national certificates of education, or higher national diplomas or were university graduates; a limited number had master's degrees.

The recruited staff came from the 36 states of the country and the Federal Capital Territory, the seat of the government. All of the 316 enumerators went through a training organized by the NPC for a period of weeks in January and February 2013 at the Administrative Staff College of Nigeria (ASCON) in Topo Badagry (Lagos). To ensure uniformity in the information, the training was carried out concurrently in six classrooms at ASCON, with roughly 50 enumerators per classroom. The technical team members, who were trained during the pretest and the training of trainers, were assigned to the classrooms.

The training involved presentations, interviews, field work, and exercises, and trainers were moved from one class to another to ensure uniformity of the information passed. Retraining was conducted for those who did not perform well after a test and did not measure up to DHS standard requirement, while the trainers included the ICF DHS country manager and members of the technical team. Also, a special training was conducted for field editors and supervisors.

Nigeria is divided into 36 states and the FCT. Administratively, all states are further split up into local government areas (LGAs), and every LGA is divided into smaller sections. During the 2006 population census, each locality was subdivided into census enumeration areas (EAs). The primary sampling unit, referred to as a *cluster* in the 2013 NDHS, is defined on the basis of EAs from the 2006 EA census frame. The sample for the 2013 NDHS was carefully chosen using a stratified three-stage cluster design consisting of 904 clusters, 532 in rural areas, and 372 in urban areas. A representative sample of 40,680 households was selected for the survey, with a minimum target of 943 completed interviews per state.

Mapping exercises and a complete listing of all households were done for each cluster from December 2012 to January 2013, giving the lists of households as the sampling frame for the selection of households, and all regular households were listed. The enumerators were trained to calculate the geo-coordinates of the 2013 NDHS samples clusters using global positioning system receivers. A fixed sample covering 45 households was selected per cluster.

> All women age 15-49 that were either permanent residents of the households in the 2013 NDHS sample or visitors present in the households on the night before the survey were qualified to be interviewed. In a subsample of half of the households, all men age 15-49 who were either permanent residents of the households in the sample or visitors present in the households on the night before the survey were eligible to be interviewed. (NPCN & ICF Macro, 2014, p.7).

Also, a subsample of one eligible woman in each household was selected at random to be questioned regarding domestic violence. A response rate of 98% was reported for the 2013 NDHS survey, compared to 97% for the 2008 NDHS exercise (NPCN & ICF Macro, 2014).

Power Analysis

Power is the probability of finding statistically significant differences where such differences truly exist. Power is directly associated with type II error, which is the potential to fail to reject the null hypothesis when a difference truly exists. Power depends on the sample size, effect size, and alpha level. All other factors being equal, the larger the sample size of the study, the larger the statistical power. Statistically, power is expressed as one minus beta, and therefore type II error is expressed as beta.

G*Power statistical software (Version 3.1.9.2, 2016) was used to calculate the estimated required sample size. The assumptions used were immunization schedule completion rates of 80% and 85% for primiparas and multiparas, respectively, alpha of 0.05, and study power of 80%. The primipara/multipara variable was chosen arbitrarily from among the planned study comparisons for the power analysis because the study

design does not presuppose that anyone predictor is more important than the others, or that any predictor will be more unbalanced proportionally than any of the others. The outcome of the calculation gives a required sample size of 750 in each parity category and a total sample size of 1,500. The overall the sample size from the NDHS is 40, 680 households surveyed; it is probable that this sample size is adequate to provide confidence in the results of the comparisons of completion rates among any of the variables of interest.

DHS Data Collection Tools Validation

Over the last thirty years, the DHS questionnaire has been standardized across the 70 nations that participate in DHS surveys (NPCN & ICF Macro, 2014). During this time, the DHS questionnaires have undergone a series of reviews before each cycle of the DHS survey, culminating in four reviews so far (1984, 1988, 1992, and 1997). These reviews were all conducted under the direct supervision of the USAID to allow them to take into account feedback from field officers, data analysis groups, and key partners, including UNFPA, the WHO, UNICEF and the World Bank (Rutstein & Rojas, 2013).

In all the cases of the review of the data collection tools, a pilot study is conducted before the wider application of the tools of the national survey and the findings from the pilot are used to ensure concordance among interrogators and repeatability through different areas of the world (Rutstein & Rojas, 2013). Each successive review has addressed the challenges and gaps identified in the preceding segments and has improved the accomplishment of DHS goals for similar data within and between diverse nation-states across all regions globally (Rutstein & Rojas, 2013).

DHS Data Storage, Structure, and Protection

The DHS believes that widespread access to survey data by responsible researchers has huge benefits for the countries concerned and the international community in general (Rutstein & Rojas, 2013). Hence, the DHS' guiding principle is to release survey data to researchers after the main survey report is published, usually within 12 months after the end of fieldwork. DHS retains a data archive, with datasets accessible on the Internet through a method of electronic registration (Rutstein & Rojas, 2013). A standard recodes file that facilitates the use of DHS data is created through the reformatting of each dataset; this file standardizes the variable names, location, and value categories across countries and constructs many of the commonly used variables such as age in five-year groups. Because DHS surveys collect a massive amount of information on different types of households and groups, this standard recodes file has a particular advantage to cross-country analysis (Rutstein & Rojas, 2013).

Special software packages are used by the DHS, including the Integrated System for Survey Analysis (ISSA), to process its surveys. A package like ISSA is specifically aimed to meet complex survey data processing needs of studies like DHS and one of its fundamental features is its capacity to handle hierarchical files. ISSA has been used at DHS in all steps of data processing with no need for another package or computer language. Additionally, ISSA provides a mechanism to export data to the statistical packages SPSS, SAS, and STATA. In order to align with the guidelines of secondary data, all identifiers that will link the primary participants to the study have been removed (Rutstein & Rojas, 2013).

Data Abstraction

The 2013 NDHS was conducted under very close supervision; teams and interviewers had adequate time to clearly explain areas with ambiguity to the trainees before proceeding to their respective states of assignment for the fieldwork. Each of the 36 Nigerian states plus the FCT had a team of interviewers for the 2013 NDHS fieldwork, and each team was comprised of a supervisor, a field editor, and four interviewers that were females, two male interviewers, and two drivers. The fieldwork occurred from February 15, 2013 through the end of May, 2013, except for two states of Kano and Lagos that completed their field activities during June, 2013. Data quality was ensured through the use of the technical team and trainers as quality controllers during the field activities. Data quality was also monitored through field checking of tables generated simultaneously with data processing procedures, which helped detect problems and alert the field teams as the data entry progressed.

Periodically, the technical and trainer teams brainstormed on-the-ground issues at the Abuja level and visited states and areas with issues that required immediate corrective actions. There was also additional support in terms of monitoring the fieldwork by representatives of ICF, PATHS2, UNFPA, USAID, and the NPC. Despite all the successes recorded, the teams encountered challenges such as restricted working hours and security threats in the northern states, particularly North East and North West, to the extent that the survey could not be completed in some clusters in Borno, Nasarawa, Plateau, and Yobe states.

The 2013 NDHS data processing commenced concurrently with the fieldwork, data generated were edited immediately in the field by the field editors, crosschecked by supervisors, and immediately transmitted to the Abuja data processing center for processing. At the Abuja level, 26 specially-trained data personnel entered the data immediately. Using the CSPro computer package, the data entry was done twice to prevent errors and to allow for 100% verification and comparison. Finally, a secondary data edition was conducted in July, 2013, while in August, 2013, the data processing expert from ICF conducted the final cleaning of the data.

Study Variables

The independent variables of the study are: age, parity, religious, cultural and affiliation, place of residence (rural/urban), cost of transportation, educational level and women's autonomy in the society, and the dependent variable is the completion or noncompletion of the immunization schedule.

The 2013 NDHS was grounded on a sample population of 40,680 of women aged between 15-49 years carefully chosen using a stratified three-stage cluster designed consisting of 904 clusters, 532 in rural areas and 372 in urban areas (NPCN & ICF Macro, 2014). The coding of the raw data was the first step to facilitate the analysis of data. Women's parity was categorized according to number of deliveries, with first delivery as a primipara, deliveries between 2-4 as multipara and ≥ 5 deliveries as grand multipara and coded as 0, 1, and 2 respectively. Age was categorized into < 20 years (code 0), 20-34 years (code 1) and ≥ 35 years (code 2).

The autonomy of women was categorized as follows. The women who answered in the affirmative to the fact that they independently decide on when to go out without seeking permission, are gainfully engaged, and that all decisions linked to health are made by her alone or together with others family members were coded as 1 (full sovereignty), whereas those who answered yes to only one or two variables of independence were coded 2 (some degree of autonomy) and those with no as their answer to all three variables for measuring autonomy were coded 0 (no autonomy). Religious belief was coded according to dominant religions of the country, with code 0 for Christians, code 1 for Muslims, and code 2 for traditional religion. The ethnic identity of women were coded as 1 for Fulani, 2 for Igbo, 3 for Yoruba, 4 for Hausa, and 5 for others ethnic nationalities that comprise the remaining 364 ethnic nationalities in the country (NPCN & ICF Macro, 2014). Marital status of women was coded as 1 for never married, 2 for living together, 3 for married, 4 for widowed, and 5 for divorced/separated.

Learning (educational) accomplishment was coded with 1 representing those without formal evidence of attending school, 2 for those that attained a Primary level, 3 for post-primary (secondary) level, and 4 for tertiary (post-secondary) levels. The level of income was coded as 1 for the poorest, 2 for the poor, 3 for the middle, 4 for the rich and 5 for the richest, based on the individual annual income earnings, and this was simply divided into five individual groups of 20% each based on their income. Place of residence was coded as 1 for rural settlement, and 2 for urban settlement. The geopolitical region of residence was coded as North West (code 1), South West (code 2), South East (code 3), North East (code 4), South South (code 5) and North Central (code 6). Parents or mothers

that answered *yes* or *no* to distances as the main hindrance for accessing immunization services were coded as 0 and 1 correspondingly. The dependent variable, completion of the immunization schedule, was coded 0 or 1 for noncompletion or completion.

Dependent/Outcome Variable Definitions

The dependent variable is completion or noncompletion of the immunization schedule. A child is considered to have fully completed the immunization schedule if he/she has received BCG vaccination against tuberculosis, three doses of vaccine to prevent against diphtheria, pertussis, and tetanus and at least three doses of polio vaccines, a dose of measles and now yellow fever vaccine before the first birthday (NPCN & ICF Macro, 2014). And a child is considered not to have completed the immunization schedule if he/she has failed to achieve all of the above milestones before the first birthday. Another way this can be looked at is to use the coverage completion categories used by Nigeria's National Primary Health Care Agency (NPHCDA). The NPHCDA categorizes coverage into less than 50%, 50% to 80%, and above 80% coverage for a state or region.

Data Analysis Plan

Using weighted data from the 2013 Nigerian DHS, data were analyzed using SPSS Version 21. Descriptive statistics (means and standard deviations, or frequencies and percents, as appropriate) were calculated for all variables. These data were reviewed to check for outliers, missing data, and "cells" with low frequencies that might hinder stable statistical analysis. Simple/unadjusted associations were next assessed using Chi-square tests for the categorical predictor variables and simple logistic regression models

for the age variable. (Age was analyzed as both a continuous and a categorical predictor in early analyses to ensure that a meaningful association was not obscured by the process of categorization.) Multiple regression models were next built for each of the variable categories – biological, cultural, and socioeconomic – to assess the relative importance of factors within each category.

All statistically significant predictors of RI completion from the univariate analyses were next entered into a multiple logistic regression model. A backward stepwise process was then used to remove non-significant variables until a parsimonious model was achieved. Backward stepwise model building begins with all potential predictor variables in the model and tests the statistical effect of dropping each one in turn. When no more variables can be dropped without a reduction in the quality of fit, the remaining model is considered parsimonious. Some statistically non-significant predictor variables were considered for retention in the final (non-parsimonious) regression model based on their scientific importance as determined by other published studies.

Research Questions and Hypotheses

RQ1: Do the parents'/caregivers' socioeconomic characteristics (income levels and educational level) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o1A: There is no statistically significant association between parental/caregivers' educational level and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a1A: There is a statistically significant association between parents'/caregivers' educational level and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o1B: There is no statistically significant association between parents'/caregivers' income levels and the use of immunization services as measured by completion or noncompletion of immunization schedules

H_a1B: There is a statistically significant association between parents'/caregivers' income levels and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ2: Do the parents'/caregivers' biological characteristics (age, sex, parity) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o2A: There is no statistically significant association between parents'/caregivers' age and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2A: There is a statistically significant association between parents'/caregivers' age and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o2B: There is no statistically significant association between parents'/caregivers' sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2B: There is a statistically significant association between parents'/caregivers' sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o2C: There is no statistically significant association between parents'/caregivers' parity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2C: There is a statistically significant association between parents'/caregivers' parity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ3: Do the parents'/caregivers' cultural factors (ability to take decisions independently, religious affiliation, and tribe/ethnicity) have an association with completion or noncompletion of RI schedules in North West Nigeria?

H_o3A: There is no statistically significant association between parents'/caregivers' ability to take decisions independently and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3A: There is statistically significant association between parents'/caregivers' ability to take decisions independently and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o3B: There is no statistically significant association between parents'/caregivers' religious affiliation and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3B: There is a statistically significant association between parents'/caregivers' religious affiliation and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o3C: There is no statistically significant association between parents'/caregivers' tribe/ethnicity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3C: There is a statistically significant association between parents'/caregivers' tribe/ethnicity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ4: Are there associations between the parents'/caregivers' place of residence (rural/urban), distance from the routine immunization service point, cost of transport, and cost of immunization services and completion or noncompletion of RI in North West Nigeria?

H_o4A: There is no statistically significant association between parents'/caregivers' place of residence (rural/urban) and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4A: There is a statistically significant association between parents'/caregivers' place of residence (rural/urban) and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o4B: There is no statistically significant association between parents'/caregivers' distance to the routine immunization service point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4B: There is a statistically significant association between parents'/caregivers' distance to the routine immunization service point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o4C: There is no statistically significant association between parents'/caregivers' cost of transport to the immunization point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4C: There is a statistically significant association between parents'/caregivers' cost of transport to the immunization point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o4D: There is no statistically significant association between parents'/caregivers' cost of use of immunization services and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4D: There is a statistically significant association between parents'/caregivers' cost of use of immunization services and the use of immunization services as measured by completion or noncompletion of immunization schedules.

RQ5: Do the children's biological characteristics (sex and birth order) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o5A: There is no statistically significant association between children's sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a5A: There is a statistically significant association between children's sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_o5B: There is no statistically significant association between children's birth order and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a5B: There is a statistically significant association between children's birth order and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Ethical Procedures

The NDHS 2013 was conducted under the direct supervision and coordination of Nigeria's National Population Commission in a joint partnership. The United States of America Institutional Review Board approved the proposal and the study procedure (protocol) was independently reviewed and approved by Nigeria's National Health Research Ethics Committee (NPCN & ICF Macro, 2009). The USAID was the major partner; ICF International, a United States-based private consultancy firm, played a supporting role alongside other partners such as the Future Institute, Johns Hopkins University Program for Appropriate Technology in Health (PATH), CAMRIS, and Blue Raster (ICF International, 2014). The authorization to access the 2013 NDHS data was sought from the custodians of the data, ORC Macro and ICF International, based in Calverton Maryland, USA (USAID & ICF Macro, 2006). This database is currently housed in the domain called MEASURES DHS+ and supported by the USAID.

Permission to carry out this study using the 2013 DHS data was obtained from the Institutional Review Board (IRB) of Walden University (approval number 09-06-17-0353030).

Summary

This quantitative cross-sectional study was designed to explore the factors affecting completion of childhood immunization schedule in North West region, Nigeria, and was intended to generate data on important indicators for the population that cut across all the MDGs at the level of all 36 Nigerian states, the FCT, and the national level (NPCN & ICF Macro, 2014). I sourced the data for this study primarily from the 2013 NDHS data, which was conducted with the ICF International providing financial and technical support through the USAID-funded MEASURE DHS program, which is designed to support developing countries to collect data on fertility, family planning, and maternal and child health (NPCN & ICF Macro, 2014).

In this chapter, I gave a detailed description of the research design and rationale and the methodology used in this research. In the chapter, I summarized the study population, sample size, sampling procedure, operational variables, procedure for participants' recruitment and data collection, instrumentation, and ethical considerations. In Chapter 4, I present the study results, along with a description of the collected data and procedures for analysis.

Chapter 4: Results

Using the 2013 NDHS data, I examined the relationships between parental, biological, socioeconomic, cultural, and geographical factors, and cost of immunization service and the use of immunization services as measured by completion or noncompletion of immunization schedules. The study design was cross-sectional descriptive using the 2013 NDHS data, which included over 40,000 participants. The 2013 NDHS was nationally representative and covered all populations living in non-institutional dwellings in the country and the findings from this study can be generalized to the entire country because of the validity of the sample population. A total of 31,482 observations were recorded; 9,906 observations were from the North West region were the study focused.

Data Collection

Missing Data

There were 9,906 observations in the North West region and these were included in the analysis; 11.6% of the data on the educational level variable was missing, 0.7% of the data on distance to immunization site was missing, 0.7% of the variable cost of health care services data was missing, and 11% of data on the variable birth order of the child was missing. All missing data were excluded from the analysis. The remaining variables had complete data with no missing records.

Biological Characteristics of the Parents/Caregivers

Parents/caregivers in the age group of 20-34 years constituted 67.5% of the respondents, compared to the 26.0% for those 35 years and above and 6.5% of parents

below 20 years (see Figure 2). Parents in the age bracket of 20-30 years had the highest completion rate of 8.8% of the immunization schedule, above those in the 20-years age group (2.4%) and the over-35 years age group (7.9%) (See Table 1).

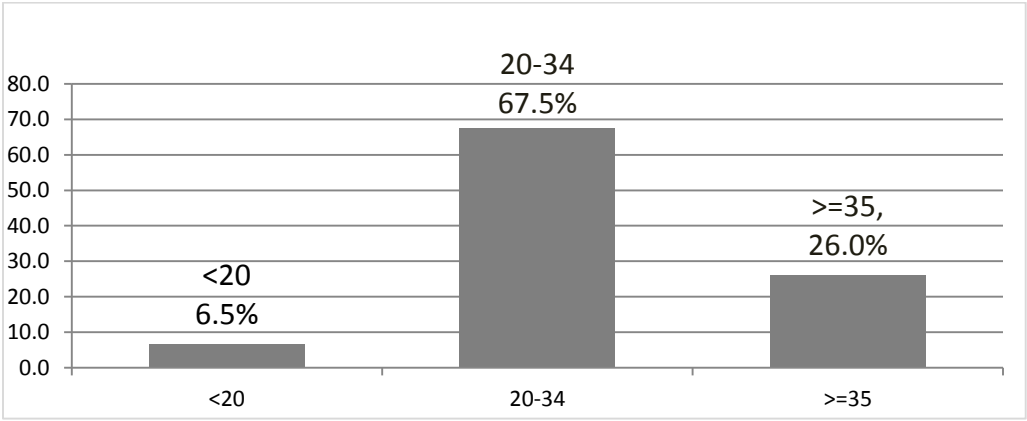

Figure 2. Age distribution of respondents.

Table 1

Biological Characteristic of Respondents

Independent variables		Immunization			
Characteristic	Frequency of noncompleters (%)	Frequency of completers (%)	Total	Chi-square	p-value
Age					
< 20	654 (97.6)	16 (2.4)	670	34.367	0.000
20 <35	6483 (92.1)	629 (8.8)	7112		
>=35	2485 (92.1)	213 (7.9)	2698		
Parity					
First delivery	939 (91.6)	86 (8.4)	1025	20.163	0.000
Multipara	4004 (90.5)	422 (9.5)	4426		
Grand multipara	4678 (93.0)	352 (7.0)	5030		

Multipara women (2-4 deliveries) constituted 41.9% of the sampled women, while grand multipara women constituted 48.7% of the sampled women; however, the

multipara women had higher coverage of 9.5% than the grand multiparas of 7.0% despite the higher proportion of grand multipara women in the sample.

Socioeconomic Characteristics of Parents/Caregivers

Although the proportion of women with highest education constituted only 1.2% of all the women sampled, compared to 77.4% of women with no education, women with highest education had the highest rate of completion of immunization schedule of their children (45.6%) compared to 3.4% of those without education. Data indicated that the percentage of children who had completed their immunization schedules increased with parental educational level, even when the women had only primary education.

In a similar way, the richest constitute only 5.5% of the total sampled respondents when compared with the poorest which account for the bulk of the total sampled 38.0%, the richest however account for 36.9% of sampled women that had their children completed immunization schedules as against 1.2% of the poorest category that completed immunization. This shows an increasing trend of proportions of the number of children completing their immunization schedule with improving economic status of the women, as shown in Figure 3 and Table 2.

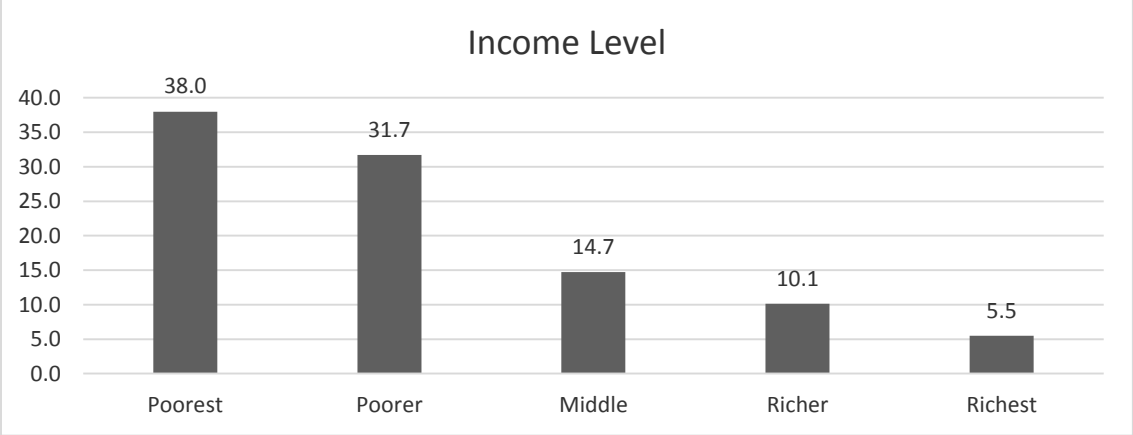

Figure 3. Distribution of parents/care givers by income level.

Table 2

Socioeconomic Characteristic of Respondents

Independent variables	Immunization				
	Frequency of noncompleters (%)	Frequency of completers (%)	Total	Chi-square	p-value
Highest education level					
No education	7720 (96.6)	272 (3.4)	7992	1357.635	0.000
Primary	1112 (85.6)	187 (14.4)	1299		
Secondary	716 (63.0)	337 (32.0)	1053		
Higher	74 (54.4)	62 (45.6)	136		
Wealth index					
Poorest	3854 (98.8)	45 (1.2)	3899	1448.123	0.000
Poorer	3129 (96.1)	127 (3.9)	3256		
Middle	1411 (88.7)	180 (11.3)	1591		
Richer	841 (75.0)	280 (25.0)	1121		
Richest	387 (63.1)	226 (36.9)	613		

Cultural Characteristics of Parents/Caregivers

Religion was one of the key variables of the study to determine factors affecting completion/noncompletion of immunization schedules. Christians accounted for 3.8% of the parents/caregivers, compared to 93.3% Muslims and 0.8% of traditionalist religion. Christians had a completion rate of 46.8% compared to the Muslims (6.0%) and traditional religion (1.3%). Children of Christian mothers were 8 times more likely to have completed their immunization schedule, as shown in Table 3.

Table 3

Cultural Characteristic of Respondents

Independent variables	Immunization				
	Frequency of noncompleters (%)	Frequency of completers (%)	Total	Chi-square	p-value
Autonomy					
No	174 (95.1)	9 (4.9)	183	191.261	0.000
Yes	793 (80.3)	194 (19.7)	987		
Some autonomy	8655 (93.0)	656 (7.0)	9311		
Religion					
Christian	223 (53.2)	196 (46.8)	419	945.186	0.000
Muslim	9155 (94.0)	589 (6.0)	9744		
Traditionalist	77 (98.7)	1 (1.3)	78		
Ethnicity/ Tribe					
Fulani	3 (100)	0 (0)	3	512.906	0.000
Igbo/Ibo	28 (37.3)	47 (62.7)	75		
Yoruba	28 (53.8)	24 (46.2)	52		
Hausa	8094 (93.7)	548 (6.3)	8642		
Other	1468 (85.9)	240 (14.1)	1708		

The Hausa ethnic was the largest group in the sample, accounting for 83.0% of the total women sampled (see Figure 4). Fulani, Igbo/Ibo, and Yoruba constituted 1.2%

of the total sample, while other Nigerian tribes constituted just 15.8% of the sample. Despite this significant difference in the proportions between the Hausa and other ethnic groups, only 6.3% of Hausa participants surveyed completed immunization schedules. Though the Igbo/Ibo group made up only a small proportion of the total sample, they showed a 62.7% rate of completing immunization schedules, followed by Yoruba ethnic groups at 46.2% as shown in figure 4 below.

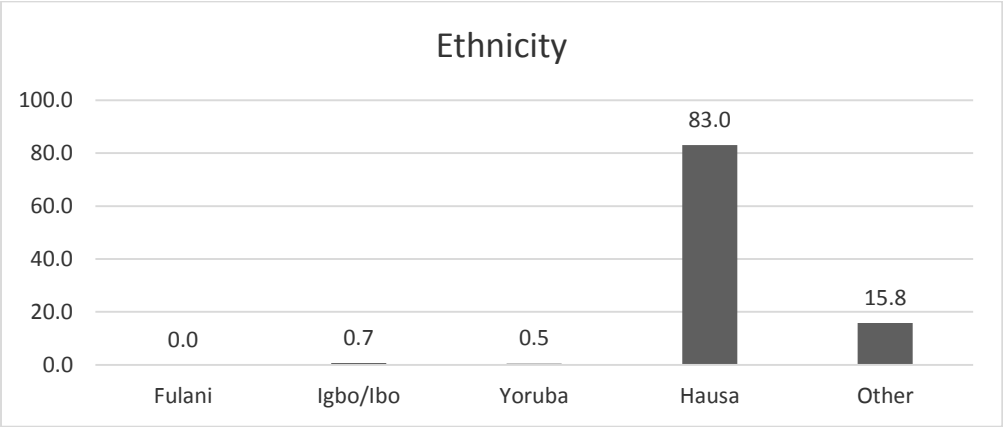

Figure 4. Distribution of parents/caregivers by ethnic affiliation

For the purpose of this study, women's autonomy is defined as the ability of a woman to take a decision either alone or along with some family members; women who do not take part in decisions that affect them are defined as having no autonomy. In this study, 89.2% of the sampled women were shown to have some autonomy, while 9.2% reported full autonomy and 1.7% attested to no autonomy in decision making. Only 7% of those with some autonomy had completed the schedule of immunization for their children as compared to 19.7% of those with full autonomy, as shown in Table 4.

Table 4

Cultural Characteristic of Respondents

Independent variables	Immunization				
Characteristic	Frequency of noncompleters (%)	Frequency of completers (%)	Total	Chi-square	p-value
Type of place of residence					
Urban	1938 (78.1)	542 (21.9)	2480	805.561	0.000
Rural	7684 (96.0)	317 (4.0)	8001		
Cost of healthcare					
No	5472 (95.6)	249 (4.4)	5721	7.593	0.006
Yes	250 (99.2)	2 (0.8)	252		
Distance (transport)					
No	5068 (95.4)	245 (4.6)	5313	20.034	0.000
Yes	655 (99.1)	6 (0.9)	661		

Place of Residence, Distance from the Routine Immunization Service, Cost of Transport, and Cost of Immunization Service

77.5% of the parents/caregivers were domiciled in rural areas, while 22.5% lived in urban areas, however, in terms of completion of immunization schedule, those in the rural areas despite their number showed 4.0% completion, while those in the urban areas had a 21.9% completion rate, a rate 5 times higher than those in the rural areas.

As for predictive variable distance (transport) to the immunization services point, 88.8% of the sampled parents constitute those that responded *no* to distance as hindrance to completion immunization as compared to 11.2% that responded *yes* to distance as a hindrance, while in terms of completion or noncompletion of immunization schedules, 4.6% of those that said *no* to distance as hindrance completed their children's immunization schedules while 0.9% that attributed distance as a hindrance actually completed their children's schedules.

When asked about the cost of immunization services, 95.9% of respondents said the cost of services was not a hindrance, while 4.1% of respondents said the cost of immunization services was a hindrance to completion of immunization services. However, in terms of completion or noncompletion, 4.4% of those that said *no* to the high cost of immunization completed their immunization schedules for their wards as compared to 0.8% of those that responded *yes* to the high cost of immunization service. Cost of health care services among the parents/caregivers are constraints to completion of immunization schedules of children among parents/caregivers.

Biological Characteristics of the Children

The distribution of the sex of the children among the sampled parents/caregivers were almost equal (49.8% males, and 50.2% females); similarly, in terms of completion rate as per the chi-square analysis, 8.2% of the males and 8.2% female of children had completed their immunization schedules with indication of absence of any significant difference in their completion rate as attested by significance of 0.890 which much higher than the p-value of 0.05.

The birth order of a child as seen from the chi-squared test as a very significant determinant of completion or noncompletion of the child's immunization schedule by the parent/caregivers. The completion rate of immunization decreased with increasing number of birth order, meaning the earliest child was more likely to complete their immunization schedule than the subsequent child as attested by the significance of 0.000 which is less than the p-value of 0.05. The rate of completion of immunization schedules decreased with increasing parity after the fourth delivery and drastically decreased as the birth order reached the 9th birth and below, suggesting an association, as shown in Table 5.

Table 5

Distribution of Children's Sex and Birth Order

Independent variables		Immunization			
Characteristic	Frequency of noncompleters (%)	Frequency of completers (%)	Total	Chi-square	p-value
Sex of child					
Male	4739 (91.8)	421 (8.2)	5160	.019	0.890
Female	4882 (91.8)	438 (8.2)	5320		
Birth order					
1 – 4 Birth	5101 (92.8)	396 (7.2)	5497	23.009	0.000
5 – 8 Birth	3203 (94.8)	177 (5.2)	3380		
9 – 12 Birth	948 (95.9)	41 (4.1)	989		
> 12 Birth	39 (97.5)	1 (2.5)	40		

Hypothesis Testing: Factors Associated with Completion on Noncompletion of Immunization

Each of the five research questions and their hypotheses were tested to determine if there is significant association between the independent and dependent variables using bivariate chi-square, simple logistic regression models, and multivariate logistic regression while controlling for covariates to ensure that the association identified is true as a result of the association between the predictive (independent) and outcome (dependent) variables and not as a result of the covariates.

Research Question 1

RQ1: Do the parents'/caregivers' socioeconomic characteristics (income levels and educational level) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o1A: There is no statistically significant association between parental/caregivers' educational level and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a1A: There is a statistically significant association between parents'/caregivers' educational level and the use of immunization services as measured by completion or noncompletion of immunization schedules.

The results showed that education level was a significant predictor of immunization schedule in North Western Nigeria ($\chi 2 = 1831.781$, $p = .000$) by indicating the UOR = 1.855; (CI 1.413, 2.341) for primary school; UOR = 2.526 (CI 1.816, 3.301) for secondary school; and UOR = 1.680 (CI 1.054, 2.508) for high school respectively

(see Table 6). This means, participant with primary, secondary and high education certificates are 1.816 times, 1.680 times and 2.508 times more likely to complete their routine immunization than a participant with no education. Moreover, based on the Multiple Logistic Regression using Backward Stepwise Method one can see that the relationship between higher education and routine immunization has improved or increases on primary and secondary after controlling for the compounding variables in the model. For instance, the Adjusted Odds Ratio (AOR) derived from the multiple logistic regression model for higher education levels were AOR = 1.953 (CI 1.529, 2.493) for primary school and AOR = 2.576 (CI 1.936, 3.428) for secondary school. However, the result slightly reduced on high school category by indicating the AOR = 1.603 (CI .755, 3.406) as per Table 6. The possible explanation to this variation is probably the small number of those participants with higher education, as compared to the number of mothers within the primary and secondary educational group, or the level of education does not really matter; what really matters is that the girls/mothers have completed minimum basic educational qualifications.

Table 6

Regression Results for Education Level

	Simple logistic regression				Multivariate logistic regressior			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Education levels								
No education								
Primary	1.855	.001*	1.413	2.341	1.953	.001*	1.529	2.493
Secondary	2.526	.001*	1.816	3.301	2.576	.001*	1.936	3.428
Higher	1.680	.002*	1.054	2.508	1.603	.220	.755	3.406
Cox and Snell R^2 = .123; Nagelkerke R^2 = .195								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: wealth, age, parity, autonomy, religion, residence, cost of health care, and birth order.

H_o1B: There is no statistically significant association between parents'/caregivers' income levels and the use of immunization services as measured by completion or noncompletion of immunization schedules

H_a1B: There is a statistically significant association between parents'/caregivers' income levels and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Income level was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 3563.804$, $p = .000$). The odds of completing the routine immunization schedules among respondents increased with increasing

income; poorer respondents were 3 times more likely to complete their children's immunization schedules (UOR = 3.107; 95% CI: 2.651 - 3.642), while the odds of completion among middle income (UOR = 3.755; 95% CI: 2.737 - 5.152), and richest (UOR = 3.586; 95% CI: 2.854 - 6.595) caregivers are 4 times higher than the poorest caregivers. In the same vein, the odds of completing immunization schedules among children of the richest (UOR = 4.701; 95% CI: 3.150 - 7.545) parents are 5 times higher than their counterparts of the poorest parents in North Western Nigeria. These results suggested that increasing income is a factor that influences completion of immunization schedules in this part of Nigeria, and remained significant even after controlling for covariates in all the categories as seen in the table above indicating completion of schedules among poorer (AOR = 3.251; 95% CI: 2.855 - 4.063), middle (AOR = 3.908; 95% CI: 3.940 - 6.043), richer (AOR = 4.503; 95% CI: 3.096 - 6.548), and richest (AOR = 5.545; 95% CI: 3.347 - 9.187) income respondents, respectively. It also shows that, the more the economic power of the parents /caregivers increases, the more likelihood of completing immunization schedules of their children increases. The 2013 NDHS included no particular question on personal income, but DHS used the available information on the assets of the family of the participating parents/caregivers, such as quantity/quality of food consumed, cars, television and house ownership, and other assets to categorize the family/individual into a specific wealth index category (poorest, poorer, middle, richer, and richest). Results are shown in Table 7.

Table 7

Regression Results for Income Level

	Simple logistic regression				Multivariate logistic regressior			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Wealth index								
Poorest		.000						
Poorer	3.107	.001*	2.651	3.642	3.251	.001*	2.855	4.063
Middle	3.755	.001*	2.737	5.152	3.908	.001*	3.940	6.034
Richer	3.586	.001*	2.854	6.595	4.503	.001*	3.096	6.548
Richest	4.701	.001*	3.150	7.006	5.545	.001*	3.347	9.187
Cox and Snell R^2 = .117; Nagelkerke R^2 = .186								

**p* is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, age, parity, autonomy, religion, ethnicity, residence, cost of health care, and birth order.

Research Question 2

RQ2: Do the parents'/caregivers' biological characteristics (age, sex, parity) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o2A: There is no statistically significant association between parents'/caregivers' age and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2A: There is a statistically significant association between parents'/caregivers' age and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Age was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 76.311$, $p = .000$). The odds of completing routine immunization schedules was higher among respondents ages 20-34 years in North Western Nigeria (UOR = 3.260; CI 1.864 - 5.699) and was more than 3 times when compared to children of mothers aged <20 years; in the same vein, the odds of completion among those of age groups ≥ 35 years with a p-value of .001, (UOR = 2.858; CI 1.607 – 5.081) was 2 times than of under 20 years, but less than those in the age category of 20-34 years. However, even after controlling for the covariates, both age groups remained very significant in influencing completion immunization schedules (AOR = 3.580; CI 1.112 - 11.526) for 20 - 34 years and (AOR = 3.268; CI 1.104 - 9.674) for ≥ 35 years respectively (see Table 8).

Table 8

Regression Results for Parents'/Caregivers' Age

	Simple logistic regression				Multivariate logistic regression			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Age								
< 20 years		.000						
20-34 years	3.260	.001*	1.864	5.699	3.580	.001*	1.112	11.526
≥ 35 years	2.858	.001*	1.607	5.081	3.268	.001*	1.104	9.674
Cox and Snell R^2 = .004; Nagelkerke R^2 = .007								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, parity, autonomy, religion, cost of health care, and birth order.

H_o2B: There is no statistically significant association between parents'/caregivers' sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2B: There is a statistically significant association between parents'/caregivers' sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

The sex of the household was a significant predictor of completion immunization ($\chi 2 = 154.872$, $p = .000$). Simple logistics regression suggested a significant association; however, after controlling for covariates in multiple logistic regression, the association of sex of the household head did not remain significant (see Table 9). Hence, sex is not

statistically significant in influencing completion of immunization schedule in the North West zone of Nigeria.

Table 9

Regression Results for Parents'/Caregivers' Sex

	Simple logistic regression				Multivariate logistic regressio			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Sex of household								
Female								
Male	1.739	.001*	1.598	1.892	1.306	.111	.940	1.813
Cox and Snell R^2 = .005; Nagelkerke R^2 = .009								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, parity, autonomy, religion, cost of health care, and birth order.

H_o2C: There is no statistically significant association between parents'/caregivers' parity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a2C: There is a statistically significant association between parents'/caregivers' parity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Parity was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 175.129$, $p = .000$). The odds of completing immunization schedules among children of grand multipara in North Western Nigeria

were (UOR = 1.401; CI 1.209 - 1.625) was almost 2 times higher than multipara and priming mothers by multiple logistic regression, there was no significant association between multipara and completion of immunization schedule (UOR = 1.213 CI .948, 1.552). However, after adjusting for covariates (AOR = 1.787; CI 1.083 - 2.950) the association of grand multipara on completion of immunization schedule remained significant, while that of multipara remained statistically insignificant as in the UOR (see Table 10).

Table 10

Regression Results for Parents'/Caregivers' Parity

	Simple logistic regression				Multivariate logistic regressior			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Parity								
Primipara								
Multipara	1.293	.125	.948	1.552	1.296	.163	.901	1.866
Grand multipara	1.401	.001*	1.209	1.625	1.787	.023*	1.083	2.950
Cox and Snell R^2 = .002; Nagelkerke R^2 = .004								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, autonomy, religion, residence, cost of health care, and birth order.

Research Question 3

RQ3: Do the parents'/caregivers' cultural factors (ability to take decisions independently, religious affiliation, and tribe/ethnicity) have an association with completion or noncompletion of RI schedules in North West Nigeria?

H_o3A: There is no statistically significant association between parents'/caregivers' ability to take decisions independently and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3A: There is statistically significant association between parents'/caregivers' ability to take decisions independently and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Autonomy was a significant predictor of completion of routine immunization schedules in North West Nigeria ($\chi 2 = 756.040$, $p = .000$). The odds of completing routine immunization schedules among respondents who have full autonomy in North Western Nigeria were (UOR = 2.102; CI 1.798 - 2.458) 3 times more likely than respondents with some autonomy (UOR = .851; CI .731 - .991). However, after controlling for the covariate, the association between full autonomy and some autonomy in predicting the immunization schedule completion failed to remain significant (see Table 11).

Table 11

Regression Results for Parents'/Caregivers' Ability to Make Decisions Independently

	Simple logistic regression				Multivariate logistic regressic			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Autonomy								
No								
Yes	2.102	.001*	1.798	2.458	1.311	.372	.723	2.377
Some autonomy	.851	.038*	.731	.991	1.066	.825	.607	1.872
Cox and Snell R^2 = .026; Nagelkerke R^2 = .041								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, parity, religion, residence, cost of health care, and birth order.

H_o3B: There is no statistically significant association between parents'/caregivers' religious affiliation and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3B: There is a statistically significant association between parents'/caregivers' religious affiliation and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Religion was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 2100.000$, $p = .000$). The odds of completing routine immunization schedules among children of Muslim respondents (UOR = .224; CI .210 - .240) was 2 time much higher than among the children of Traditionalist religion

followers by simple logistics regression. However, after adjusting for covariates, the odds of those of Muslim faith remained significant (AOR =. 412; CI .312 - .545), while that of the traditional religious respondents failed to remain significant (see Table 12).

Table 12

Regression Results for Parents'/Caregivers' Religion

	Simple logistic regression				Multivariate logistic regressio			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Religion								
Christian								
Muslim	.224	.001*	.210	.240	.412	.001*	.312	.545
Traditionalist	.165	.001*	.105	.257	.246	.008*	.087	.698
Cox and Snell R^2 = .077; Nagelkerke R^2 = .125								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, parity, autonomy, ethnicity, residence, cost of health care, and birth order.

H_o3C: There is no statistically significant association between parents'/caregivers' tribe/ethnicity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a3C: There is a statistically significant association between parents'/caregivers' tribe/ethnicity and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Ethnicity was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 2319.320$, $p = .000$). The odds of completing the routine immunization schedules among Fulani/Igbo/Ibo in North Western Nigeria was statistically significant except for the Hausa tribes which did not show any significance. However after controlling for covariates, none of the tribes shows any level of significance in prediction of completion immunization schedules of their children based on their tribes (see Table 13).

Table 13

Regression Results for Parents'/Caregivers' Ethnicity

	Simple logistic regression				Multivariate logistic regressio			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Ethnicity								
Others								
Fulani	2.501	.021*	1.146	5.459	3.054	.295	.377	24.731
Igbo	2.199	.048*	1.007	4.799	2.390	.419	.289	19.773
Yoruba	.274	.001*	.126	.600	1.322	.790	.169	10.317
Hausa	.965	.929	.443	2.102	1.669	.624	.215	12.937

Cox and Snell $R^2 = .078$; Nagelkerke $R^2 = .124$

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, sex of household, parity, autonomy, religion, residence, transportation, cost of health care, sex of the child, and birth order.

Research Question 4

RQ4: Are there associations between the parents'/caregivers' place of residence (rural/urban), distance from the routine immunization service point, cost of transport, and cost of immunization services and completion or noncompletion of RI in North West Nigeria?

H_o4A: There is no statistically significant association between parents'/caregivers' place of residence (rural/urban) and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4A: There is a statistically significant association between parents'/caregivers' place of residence (rural/urban) and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Type of residence was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 1372.839$, $p = .000$). The odds of completing routine immunization schedules among urban residence (UOR = .324; CI .306 - .344) is significant after unadjusted logistics regression, heralding the likely hood of access and knowledge of available services, however, after controlling for covariates, the association failed to remain statistically significant (see Table 14).

Table 14

Regression Results for Parents'/Caregivers' Place of Residence

	Simple logistic regression				Multivariate logistic regressic			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Place of residence								
Rural								
Urban	.324	.001*	.306	.344	1.012	.930	.779	1.315
Cox and Snell R^2 = .047; Nagelkerke R^2 = .074								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, sex of household, parity, autonomy, religion, ethnicity, transportation, cost of health care, sex of the child, and birth order.

H_o4B: There is no statistically significant association between parents'/caregivers' distance to the routine immunization service point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4B: There is a statistically significant association between parents'/caregivers' distance to the routine immunization service point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Distance (transport) to immunization service point was not a significant predictor of completion of routine immunization schedules in North Western Nigeria (p-value =.194). The odds of completing immunization schedules among respondents reporting the distance to the facility is not too far and that reporting the facility is too far, UOR and

AOR were not significant (see Table 15); hence, distance was not an important factor in influencing the parent's decision for the completion or noncompletion of the child's immunization schedule.

Table 15

Regression Results for Parents'/Caregivers' Distance to Immunization Service

	Simple logistic regression				Multivariate logistic regressio			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Distance								
No								
Yes	.894	.192	.756	1.058	.818	.183	.610	1.099
Cox and Snell R^2 = .000; Nagelkerke R^2 = .000								

*p is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, parity, autonomy, religion, cost of health care, and birth order.

H_o4C: There is no statistically significant association between parents'/caregivers' cost of transport to the immunization point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4C: There is a statistically significant association between parents'/caregivers' cost of transport to the immunization point and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Cost of services was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 11.525$, $p = .001$). The odds of

completing the routine immunization schedules among respondents reporting the cost of health care services not too expensive were (UOR = 6.030; CI 1.432 - 25.383) 6.0 times higher than those respondents reporting the cost of services is too much. However, after controlling for covariates, although the association remained significant (AOR = 1.995; CI 1.549 - 2.569), the strength of the association decreased approximately 4 fold (see Table 16).

Table 16

Regression Results for Parents'/Caregivers' Cost of Service

	Simple logistic regression				Multivariate logistic regressior			
			95% C.I. for UOR				95% C.I. for AOR	
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Cost of service								
No								
Yes	6.063	.014*	1.432	25.383	1.995	.001*	1.549	2.569
Cox and Snell R^2 = .002; Nagelkerke R^2 = .007								

**p* is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, parity, autonomy, religion, residence, and birth order.

H_o4D: There is no statistically significant association between parents'/caregivers' cost of use of immunization services and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a4D: There is a statistically significant association between parents'/caregivers' cost of use of immunization services and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Research Question 5

RQ5: Do the children's biological characteristics (sex and birth order) have an association with the completion or noncompletion of RI schedules in North West Nigeria?

H_o5A: There is no statistically significant association between children's sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a5A: There is a statistically significant association between children's sex and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Sex of child was not a significant predictor of completion of routine immunization schedules in North Western Nigeria (p-value =.879). The odds of completing immunization schedules among both sexes, even after the UOR and AOR were not significant; hence, sex of a child was not an important factor in influencing the parent's decision for the completion or noncompletion of the child's immunization schedule (see Table 17).

Table 17

Regression Results for Children's Sex

	Simple logistic regression				Multivariate logistic regressio			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Sex of child								
Female								
Male	.989	.879	.860	1.137	1.017	.852	.850	1.217
Cox and Snell R^2 = .000; Nagelkerke R^2 = .000								

**p* is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, parity, autonomy, religion, ethnicity, residence, cost of health care, and birth order.

H_o5B: There is no statistically significant association between children's birth order and the use of immunization services as measured by completion or noncompletion of immunization schedules.

H_a5B: There is a statistically significant association between children's birth order and the use of immunization services as measured by completion or noncompletion of immunization schedules.

Birth order was a significant predictor of completion of routine immunization schedules in North Western Nigeria ($\chi 2 = 247.439$, $p = .000$). There was a significant association completion of immunization schedules and birth order for groups between 1 – 4 birth (UOR = .664; CI .620 - .710) and birth order group of 5-8 birth (OR = .432; CI .369, - .505); however, the result indicated that there was no significant effect for 9-12

birth order (see Table 18). While after multiple logistic regression controlling for covariates, the significance associations for birth orders 1-4 remained (AOR = .363; CI .130- 1.014), while birth orders of 5-8 (AOR = .412; CI .164 - 1.036), which was insignificant. There were shown to be increasing odds of completion of immunization schedules as the birth order increases up to a certain the fourth birth child.

Table 18

Regression Results for Children's Birth Order

	Simple logistic regression				Multivariate logistic regressic			
		95% C.I. for UOR				95% C.I. for AOR		
Variable	UOR	*P*	Lower limit	Upper limit	AOR	*P*	Lower limit	Upper limit
Birth order								
> 12 birth								
1-4 birth	.665	.001*	.620	.710	.363	.053	.130	1.014
5-8 birth	.432	.001*	.369	.505	.412	.060	.164	1.036
9-12 birth	.443	.030*	.212	.925	.413	.066	.161	1.060
Cox and Snell R^2 = .009; Nagelkerke R^2 = .014								

**p* is significant at the 0.05 level.

Note. Variables adjusted in the model: highest education, wealth index, age, sex of household, parity, autonomy, religion, ethnicity, residence, transportation, cost of health care, and sex of the child.

Completion of Immunization After Adjusting for Covariates

In order to forecast which of the characteristics or factors of the Andersen health behavior model adopted in this study among the predisposing, enabling, and need factors that best fits with completion of immunization schedule completion in the northwestern

zone of Nigeria, a multiple logistics regression was conducted with only variables that were found to have significant association statistically with completion of immunization schedules from Pearson Chi-square statistics and multivariate logistic regression for one predictor variable at a time against the completion of immunization or variables that are known to have influence from prior research studies, while adjusting for confounders (see Table 19). This type of approach was used by Antai (2009) using the NDHS data for 2003 to find out how religious affiliation influences none, partial and complete childhood immunization (Antai, 2009).

Table 19

Predictive Model on the Completion of Immunization Schedule After Adjusting for Covariates

Model fits information					Pseudo R – square		
Model	-2 log likelihood	Chi-square	Df	*P*	Cox & Snell	Nagelkerke	Hosmer & Lemeshow test
Constant	885.603	2119.532					
Final model	10774.022	2119.532	9	.001*	.116	.220	.063

**p* is significant at the 0.05 level.

Using the same approach of analysis, Fapohunda & Orobaron (2014) in the study to determine factors associated with women who deliver without any form of assistance from a skilled health worker, traditional birth attendants or family member in Sokoto, Nigeria using the 2008 NDHS data. The factors that show association with completion of immunization schedules are education level, wealth index, cost of health care and religion. Consequently, the multivariate logistic regression model consisting of four

categorical predictive variables were found to have a significant association with completion of immunization schedules based on bivariate Person Chi-Square and Simple Logistic Regression analysis (see Table 20). In this regard, the Omnibus Tests of Model Coefficients illustrates the multivariate logistic regression model.

The results of the multivariate regression analysis as a whole (which included education level, wealth index, cost of healthcare and religion) were statistically significant ($\chi 3$ (9, N = 9906) = 2119.532, p = .000). This indicated that the model was able to distinguish between participants who completed and those who have not completed immunization schedules based on all predictor variables entered into the regression equation. The result of the Multivariate Logistic Regression Model indicated that between 11.6% (Cox & Snell R square = .116) and 22.0% (Nagelkerke R squared = .220) of the variance in the completion of immunization schedules was explained by all predictor variables in the model, and correctly classified 93.8% of cases. Also, the Hosmer and Lemeshow goodness of fit test indicated the model is useful and can be maintained based on the p-value .05 (.063).

Moreover, the multivariate logistic regression analysis showed that there is a significant relationship between education level, wealth index, cost of healthcare, and religion with the completion of immunization schedules. This indicated that the independent variables (education level, wealth index, cost of healthcare, and religion) were significant predictors of completion of immunization schedules.

Table 20

Multiple Regression Model of Routine Immunization (Final Model)

Variables	B	S.E.	Wald	df	*P*	OR	95% C.I. for EXP(B) Lower limit	95% C.I. for EXP(B) Upper limit
Education level			99.942	3	.000			
No education								
Primary	.894	.120	55.595	1	.000	2.444	1.933	3.092
Secondary	1.210	.133	83.206	1	.000	3.353	2.586	4.349
High education	.992	.373	.7060	1	.008	2.697	1.297	5.608
Wealth index			87.327	4	.000			
Poorest								
Poorer	.813	.159	26.234	1	.000	2.254	1.651	3.076
Middle	1.258	.163	59.573	1	.000	3.520	2.557	4.845
Richer	1.468	.179	67.433	1	.000	4.342	3.058	6.164
Richest	1.665	.234	50.701	1	.000	5.286	3.343	8.360
Religion			28.079	2	.000			
Christian								
Muslim	-.298	.128	5.431	1	.020	.743	.578	.954
Traditionalist	-.643	.123	27.496	1	.000	.526	.414	.669
Cost of healthcare								
No								
Yes	-.383	.195	3.860	1	.049	.682	.466	.999
Constant	-3.617	.167	467.673	1	.000	.027		

a. Variable(s) entered on step 1: education level, wealth index, religion, cost of healthcare.
Note. B: Unstandardized coefficient; S.E.: Standard error; df: Degree of freedom; *p:* p-value; C.I.: confidence interval; OR: odd ratio.

The final model was comprised of the four variables (education level, wealth index, cost of healthcare and religion) that shows consistent significant association even after controlling for covariates in the adjusted model as per the table above by their unadjusted and adjusted odds ratios as well as the significance levels (p-values).

Conclusion

While I rejected most of the null hypotheses for most of the independent variables of the research questions, four of the independent variables (education level, wealth index, religion, and cost of healthcare) demonstrated a significant statistical association with completion of immunization schedules after adjusting for covariates.

Summary

In Chapter 4, I presented the study results that includes the biological, sociocultural, economic as well health system characteristics of the parents/caregivers in this study including biological characteristics of the children in some instances. Several statistical analyses were done to answer the research questions/hypothesis that includes frequency and descriptive statistics on all the variables in the study with a view to understanding the presence of significant or lack of association between the predictive variables and the outcome variables as per the research questions/hypothesis.

Individual research questions were subjected to logistics regression analysis and chi-square test, and from the findings, only a few of the predictive variables (education level, wealth index, cost of healthcare and religion) have significant association with the outcome variables after controlling for covariates, the rest have no significant association in prediction of completion or noncompletion of routine immunization schedule as an

outcome variable with a significance which much higher than p-value of 0.05. However, some of the variables that show some level of significant associations with simple logistics regression could not remain significant after controlling for covariates in a multivariate logistics regression. In Chapter 5, I present the interpretation and discussion of the findings of the study along with its limitations, conclusions, recommendations and the implications of the findings for positive social change in the society and areas for further studies.

Chapter 5: Discussion, Conclusions, and Recommendations

This study on the factors affecting completion of immunization schedules was aimed at identifying factors that influence or are responsible for the parents'/caregivers' completion of the routine immunization schedules of their children. I selected the Andersen health care utilization model as the framework for the study; this model describes the utilization of health care based on three important factors: predisposing factors, enabling factors, and need factors. Andersen's behavioral model was created to empirically test hypotheses about inequality of access to health services in the USA (Willis, 1998). In Chapter 5, I interpret the results from the study based on previous research. I also include recommendations for further study, implications for social change, and a conclusion.

Interpretation of the Findings

This study addressed the socioeconomic characteristics of the parents/caregivers in relation to completion or noncompletion of immunization schedules of their children with the view toward determining whether there was a significant statistical association.

Education Level of Parents/Caregivers

I found that the education level of the parents/caregivers was significantly associated with completion of immunization schedules of their children, as shown by the increasing likelihood of completion with increasing education level. The likelihood of completion of immunization schedule among the parents with primary education was almost twice that of those with no education, while that of children of parents who completed secondary education was 3 times higher than those with no education. The

likelihood of completion of immunization schedule among children of mothers with higher education was significantly higher than among those with no education, but was slightly lower than among mothers who had completed secondary and primary education. This may have resulted from the smaller number of participants in the sample who had completed higher education. This finding could also mean that whether mothers/caregivers were educated was what mattered in influencing their decision to ensure completion of their children's immunization schedules, rather than what level of education they attained. According to these findings, encouraging girls to complete their basic education may increase the likelihood of their children completing their immunization schedules in the affected communities.

The findings from this study were consistent with those from similar studies in African countries, a study in peri-urban of Kenya, and also in Zamfara State Nigeria on immunization coverage and its determinants among children (Gidado et al., 2014; Maina et al., 2013) indicated that maternal education was significantly associated with immunization coverage. Evidence from demographic health surveys also indicated that immunization coverage was higher for children whose mothers had higher education (DHS, 2013). Findings from the current study were further corroborated by a study of complete immunization in East African countries (Canavan et al., 2014). A study in Uganda on the factors influencing completion of immunization schedules indicated that having at least a secondary education was the most important determinant of full immunization coverage, and children whose mothers had postsecondary education were twice as likely to be fully immunized compared to mothers who had only primary

education (Bbaale, 2015). In contrast, a study in Ethiopia did not indicate any significant association between mothers' education level and completion of immunization among children 12-23 months (Etana & Deressa, 2012), this may be because the study group were outside the traditional RI age groups of under one year.

The literature suggested that maternal education level is a determinant of full immunization coverage as result of positive attitudinal, traditions, and belief changes that go along with maternal education, as well increased autonomy and control over household resources, which enhances health care seeking behavior and demand for childhood immunization (Bbaale, 2015). Although less educated women have less access to basic health information and are more likely not to complete immunization of their children, in comparison to more educated mothers who have better access to health information, increased access to services, information, and health care professionals will likely increase the likelihood of keeping the immunization schedule of their children up to date (De Oliveira et al., 2014)

Income Level of Parents/Caregivers

The DHS does not include a question on personal income, but addresses information on family assets of participating parents/caregivers, such as quantity/quality of food consumed, vehicles, television and house ownership, and other assets to categorize the family/individual into a specific wealth index category (poorest, poor, middle, richer, and richest). Economic level of parents/caregivers was found to be an important factor in influencing the completion of immunization in North West Nigeria. The findings from this study indicated the likelihood of completing immunization

schedules among children of respondent's increases with increasing level of income of parents/caregivers. The findings from this study were consistent with those from studies in Nigeria and in Norway on the uptake of human papilloma vaccines, in which researchers found that higher income level positively influenced completion of immunization (Feiring B, et al, 2014). However, similar studies in Uganda did not indicate any association between higher income of parents/caregivers and completion of immunization schedules (Bbaale, 2015).

Biological Characteristics of Parents/Caregivers

According to the findings from this study, age is an important predictor of immunization schedules completion in North West Nigeria. The likelihood of completing immunization schedules among children of parents/caregivers in the age group 20-34 years was 3 times higher than parents/caregivers in the age group <20 years, and 2 times higher than those in the >=35 years. This suggests that children of parents/caregivers who are younger than 20 years are less likely to complete their immunization schedule than children of parents/caregivers in the <20 and >=35 years age groups. Overall, children of parents/caregivers in the 20-34 years bracket had higher chances of completing their immunization schedules than those in <20 and >=35 years age groups.

The findings from this study were consistent with findings from a study on maternal determinants of immunization status of children ages 12–23 months in urban slums of Varanasi, India (Awasthi et al., 2015). Current study findings were also consistent with a similar study on the factors affecting acceptance of complete immunization coverage of children under 5 years in rural Bangladesh (Rahman &

Obaida-Nasrin, 2010). Both studies indicated that maternal age was one of the most important factors influencing complete immunization. The study in rural Bangladesh, in addition (Awasthi et al., 2015; Rahman & Obaida-Nasrin, 2010) found that children of middle age mothers are more likely to be fully immunized than their counterparts of older mothers. This may be due to mothers' accumulated knowledge of the modern health care system and memory of repeated messages on the importance of immunization services over time. Younger parents/caregivers may not have the same sense of responsibility as their older counterparts, or younger parents/caregivers may rely on their older family members for decision-making or approval (Rahman & Obaida-Nasrin, 2010).

Parity of Parents/Caregivers

According to the findings of this study, parity is a significant predictor of completion of routine immunization schedules in North-Western Nigeria, as evidenced by the increasing odds of completing immunization schedules by the children of grand multipara mother/care giver, which was almost twice that of children of multipara and priming para. There was no significant association between multipara and completion of immunizations schedules even after controlling for covariates, while the association with grand multipara remained significant even after adjusting for covariates. However, this finding is in contrasts with the findings from studies in rural Bangladesh and in urban slums of Varanasi, India, on maternal determinants of the immunization status of children aged 12–23 and factors affecting acceptance of complete immunization coverage of children under five years. These studies found that parity along with other factors is very important determinants of immunization schedule completion (Awasthi et al., 2015;

Rahman & Obaida-Nasrin, 2010). These studies found that women with lower parity were more likely to ensure their children to be fully immunized than mothers with higher parity with more children who may not have self-motivation to provide care for the most recent child (Awasthi et al., 2015; Rahman & Obaida-Nasrin, 2010). Additionally, they may have a good number of living children than those with less parity and also have gained more experience in handling childhood diseases than those with less parity. One possible reason for this difference is that cultural values may hinder the younger women's ability to take a decision without their husband's express permission, and in most instances, the husband will have to seek permission from his mother before allowing his wife to go out even to hospitals. However, for the older mothers, they are more likely to have more freedom from their husbands/mothers in-law than the younger age groups, hence more likely to complete immunization of their children than the younger mothers. It is also possible that increasing parity might lead to increasing completion because mothers with more children have had more contact with the public health system thereby learning about the benefits of immunization. There is certainly a need for further studies to unearth the possible reasons for this deviation in this part of the country.

Gender of Household Head

Gender of the household head was not a significant predictor of completion of routine immunization schedules in North-Western Nigeria. Hence, the gender of the head of the household was not a significant influencer of completion of immunization schedules among parents/care givers in northwestern Nigeria. In view of the prevailing

culture of men being the heads of the household in northern Nigeria, the women may be more likely to value immunization than the men possibly because of the fact that women come into contact with health workers in health facilities whenever they attend clinics for antenatal care or for their children's illnesses, hence more exposed to public health system and learning more on about benefits of immunization.

Cultural Characteristics of Parents/Caregivers

The study findings demonstrated a lack of significant association between autonomy and the completion of routine immunization schedules in North-Western Nigeria, the initial association failed to remain significant after controlling for covariates, hence, not a significant factor in influencing the completion or otherwise of immunization schedules among the children of mothers with full autonomy when compared to their counterparts whose mothers have some autonomy. Autonomy has been described as the freedom of decision making of a woman independently on things that affect her or her children (Bharati, 2014).

The findings from this study are contrast to findings from other studies on the influence of mothers autonomy on the health of their children including immunization coverage (Bharati, 2014). There were studies from India and Nepal on women's decision making and child health: Familial and social hierarchies, in which they found increasing use of emergency or preventive health care services including children's immunization with increasing women's autonomy even among women with less autonomy (Bharati, 2014; Desai & Johnson, 2002). This finding was further corroborated by Ebot (2015),

who also found out a positive relationship between women's autonomy and children's health outcomes including immunization status (Ebot, 2015; Singh et al., 2013).

Parents'/Caregivers' Religious Affiliation

According to the findings from this study, religion is a significant predictor of completion of immunization schedules in North Western Nigeria; the odds of completing the routine immunization schedules among children of Muslim's parents in North Western Nigeria are higher than those children whose parents are of Traditional religion or Christian religious affiliations. The findings could probably be an indication of the availability of health services to this group of people as they reside in a location with scarce government presence. This is typical of states government in Nigeria to concentrate their developmental programs in the areas where their tribal people reside before looking elsewhere, which is also similar to the Muslim population residing in the southern part. This finding is consistent with findings from a study on Mothers' Characteristics and Immunization Status of Under-Five Children in Ojo Local Government Area, Lagos State, Nigeria, which found that in addition to other personal characteristics of women, religious affiliation background is statistically associated with full immunization status of their children (Oyefara, 2014).

Parents'/Caregivers' Ethnicity/Tribe

The study findings indicated that ethnicity is not a significant predictor of completion of routine immunization schedules in North West Nigeria. The findings showed that the odds of completing routine immunization schedules among children of Fulani, followed by Igbo/Ibo, and lastly of Yoruba ethnic groups in North Western

Nigeria were twice as high as those of the children of other ethnic groups/Hausas ethnic groups. However, this association did not remain significant after controlling for confounders; hence, ethnicity is not an important factor in determining completion or otherwise of immunization schedules of children among their parents. This is in complete disagreement with findings of a study in Lagos, Nigeria on the characteristics of mothers and under-five children's immunization status, which show that ethnic background and other personal characteristics of women are statistically associated with full immunization status of their children (Oyefara, 2014). It is also in disagreement with studies on the effect of maternal and provider characteristics on up-to-date immunization status aged 19 to 35 months, among Hispanics; this is ascribed to their strong cultural emphasis on the well-being of their children which strengthen their awareness on preventive care leading to high immunization coverage among the Hispanics (Kim et al., 2007).

Parents'/Caregivers' Place of Residence

The findings from this study indicated a lack of a statistically significant relationship between the immunization schedule completion among children of parents living in rural and urban areas and hence, place of residence is not a significant predictor of completion of routine immunization schedules in North West Nigeria. Prior to controlling for confounders, the odds of completing the routine immunization schedules among children of parents residing urban areas in North West Nigeria are 4 times higher than their counterparts whose parents are residing in rural areas, but this association failed to remain after controlling for confounders in the regression. These findings

showed a lack of association between the place of residence of the parents/care givers and immunization schedule completion, hence policymakers should pay more emphasis on factors that have proven to influence the completion of immunization schedules. This also emphasizes the value of education for girl child/women, economic status and cost of healthcare services in completion immunization schedules. It also suggests that parents/care givers, regardless of where they live or resides have equal access to the same health information of immunization, through radio, social media and health workers; hence, the lack of difference in completion or noncompletion of immunization schedule among the two groups.

These findings are in disagreement with Munthali's (2007) findings, which showed that the percentage of children from urban areas in Malawi who are fully vaccinated are much higher than their counterparts who reside in rural areas. Munthali reported the following vaccination rates: 81% in rural and 87% in urban areas in 1992; the corresponding percentages were 80% and 88% in 1996 and 69% and 79% in 2000. In 2004, 64% of the children in rural areas were fully vaccinated at the time of the survey, matched to 71% in the urban areas (Munthali, 2007). This difference between the findings in North West Nigeria and other countries could better be explained on the basis of what is defined as urban/rural or their access to electronic means of communication in these countries.

Parents'/Caregivers' Distance to Immunization Service

This study showed no statistically significant association between the distances to the immunization service point from where the parents/caregivers of the children reside

and the completion of the children's immunization schedules. Hence, distance is not a predictor of immunization schedule completion as shown by the odds of completing the routine immunization schedules among parents reporting the distance to the facility is not too far and among parents that report the facility is too far. For this reason, immunization programmers should pay more attention to other factors that have been found to influence mothers' behavior towards completion of their children's immunization schedules.

These findings are in contrast with studies other on the effect of distance from the immunization service providing health facilities, which found that those parents/caregivers that are domicile far away (usually >1km range) from these facilities are less likely to complete their children immunization schedules when compared to those parents/caregivers that live close to the health facilities providing immunizations services (Rahman & Obaida-Nasrin, 2010). Similarly, studies in developing countries suggest that walking or traveling time and distance are key factors that influence the utilization of health care services including immunization (Rahman & Obaida-Nasrin, 2010). In a study on the reasons for incomplete vaccination and factors for missed opportunities among rural children in Awe LGA of Nasarawa state Nigeria, found that long walking distances, as well as long waiting time at the facility, are key factors associated with poor completion of RI schedules (Abdulraheem & Onajole, 2011).

Parents'/Caregivers' Cost of Immunization Services

The cost of immunization services was a significant predictor of completion of routine immunization schedules in North West Nigeria according to findings from this study. This was attested by the odds of completing immunization schedules among

children of parents who reported the cost of health care services not too expensive which is 6 times higher than among those children whose parents reported the cost of services is too much. This indeed is suggestive of the fact that if the immunization service is expensive for the parents/caregivers, their children are less likely to complete immunization schedule of their children, hence cost of services is an important factor in prediction of completion or noncompletion of immunization schedules in the northwest zone.

Parents'/Caregivers' Cost of Transport to Immunization Services

The cost of transport to the immunization site was not evaluated in this study due to lack of appropriate variables to assess the association between the cost of transport and completion or noncompletion of immunization schedules in North West Nigeria. However, if one will relate the outcome of this variable to other similar variables like cost of services, one would expect that the cost of transport to the immunization site will have a similar impact to the cost of immunization services since both are issues of cost and to be borne by the parents (Rahman & Obaida-Nasrin, 2010). It is expected that the parents are likely going to behave the same way as they did to the cost of immunization services. Hence, higher cost of transport will negatively affect the completion rate of childhood immunization schedule.

Biological Sex of Child

Sex of child as not a significant predictor of completion of routine immunization schedules in North Western Nigeria according to the findings from this study; hence, the sex of a child is not an important factor in influencing the parent's decision for the

completion or noncompletion of the child's immunization schedule. This finding is consistent with findings from Angola in a study on factors associated with vaccination coverage in children < 5 years, in which the results showed no sex differences in vaccination coverage, and is also in correlation with findings from a study conducted in Sao Luís, MA, Northeastern Brazil, in 2006, on factors associated with incomplete basic vaccination schedules (De Oliveira et al., 2014). However the findings from this study is in complete contrast to another findings from a study in rural Bangladesh which found that sex discrimination plays an important role in immunization coverage, with male children more likely to be fully immunized than their females counterparts and mothers having received TT injection were also found to be one of the significant predictors of full immunization coverage for children (Rahman & Obaida-Nasrin, 2010). This speaks volumes to the attitudes, norms and values of the people. While in other studies caregivers seem to discriminate among their children due to the cultural practices/ educational backgrounds, in this study there seemed to be no discrimination among the children on the basis of sex.

Birth Order of Child

Birth order was a significant predictor of completion of routine immunization schedules in North-Western Nigeria, according to this study. The odds of completion of immunization schedule decreases after the 4th birth as the birth order increases the subsequent childbirth, hence birth order is an important factor influencing completion or noncompletion of immunization schedule in the Northwest region. The findings from this study are consistent with the result of a study on determinants of vaccination coverage in

Malawi: evidence from the demographic and health surveys, vaccination coverage among those who are first born children are higher than those who are born later (Munthali, 2007). As seen in 2000, 79% of the first born versus 58% of children who were 6th + in the birth order, aged 12-23 months were fully vaccinated, while in 1996, 89% of the first born vs 74% of those children who were 6th + in the birth order. Hence, as other studies have shown, in Malawi birth order seems to be an important determinant as it is in northwestern Nigeria (Munthali, 2007). This could probably be explained by the fact that first born are usually regarded by parents / care givers as very precious, hence more likely to be well taken care of than the subsequent children in the family.

Strength of the Study

The major strength of this study is the fact the DHS data used for the analysis is a representative of the entire population of the North West geographical region, as the enumeration areas cut across all States, LGAs, and wards with sampling that was randomized that gives all populations equal opportunity of been represented in the study. The outcome can be generalized on the entire population without fear of misrepresentation of any population groups.

Limitations of the Study

The study was a cross-sectional in design, using secondary data, hence, not without its limitations; one of the limitations from this study was the lack of some key variables (amount of money or other valuables spent to reach the health facility providing RI) to be used as a proxy to evaluate a component of a research question since the information was not available in the DHS data base as data was not primarily collected

for this study (Smith et al., 2011). Another limitation was the fact that, though in the literature review, I have highlighted the role of health facility delivery and parents/care givers knowledge of immunization schedules as important factors influencing completion of immunization schedules from other studies in Africa; however, the original data used for this study did not look into these variables. Understanding if they play a role in the completion in the north western Nigeria would have made the identified factors more comprehensive. Furthermore, the use of secondary data is also associated with the inability of the researchers to control for confounders (sex, cultural affiliations, place of residence etc.) that have been identified by previous studies; as such variables may not have been collected during the primary data collection stage (Smith et al., 2011).

Recommendations

It is important for the various governments at all levels to strengthen policies relating to Universal Basic Education (MDG 2) for female children's education in order to increase the enrollment and attainment of at least secondary education by all girls before they are married. This recommendation is based on the findings from the study on the role women's education in the completion of the immunization schedule. The education of girls will go a long way in improving their socioeconomic status in the society, their ability to take decision (autonomy), reduce poverty through securing paid jobs, and address some of the harmful cultural practices that affect the completion of immunization schedules of their children, and ultimately brings about reduction in child (MDG 4) mortality. The need for government to ensure health sector reforms based on community needs, through addressing factors that are known to influence mothers / care

givers decision to vaccinate their children such as women education, cost of health care (immunization) services, wealth index and religious affiliations. There is need to target parents / care givers that were identified to be less likely to complete their children's immunization schedules (priming mothers, grand multiparas, very young mothers and mother older than 35yaers of age) with health education package appropriate to their cultural background to help increase their vaccination uptake.

Providing safe and effective vaccines reduces the high burden of communicable diseases in African countries and helps to meet the health-related millennium development goals (WHO, 2015). Vaccine-preventable diseases contribute significantly to morbidity and mortality; an estimated 4 million people die each year from diseases for which vaccines are available. Pneumonia and diarrhea disease, account for approximately 34% of the global 10.4 million deaths among children aged less than 5 years (WHO, 2015). With effective immunization, many of these deaths could be prevented.

Programs like the Intensification of Routine Immunization Services piloted by the NPHCDA in Nigeria in collaboration with World Health Organization (WHO) and United Nations Children's Funds (UNICEF) in some very high risk states / LGAs (Based on PEI Program) in northern Nigeria will go a long way in improving immunization uptake. The program is an intensive way of taking immunization services to the doorstep of the communities with their involvement as well as hiring private vaccines distributors if sustained will go a long way in improving immunization coverage among under-fives in the region.

There is a need for similar study using primary data to enable collection of data that is primarily intended for the purpose of establishing causality using prospective studies as against using secondary data that will only establish an association, this way we can be sure that a variable has a direct impact on the completion of immunization schedules. This study can also take a look at other variables that this study identified (maternal education, wealth index and others) that will affect the completion of immunization schedules in children under-fives, which will also go a long way towards giving policymakers additional empirical evidence for making an informed decision on policy issues as it affects immunizations coverage, childhood, and under-five mortality.

Implications

There were several small sample size hospital-based studies conducted in Nigeria on coverage of routine antigens; however, there is a paucity of data from community-based studies with appropriate sampling technique and appropriate sample size in the North West region. This underscores the importance of community-based studies in the region with large sample sizes. However, there were also data gaps that need to be filled and hence, this study to determine if there is an association between the parents'/caregivers' socio-cultural factors, place of residence (rural/urban), distance from the immunization routine service point, the cost of transport, session plan and cost of immunization services, and the completion or noncompletion of routine immunization schedules, relationships about which little was known. This study will enable us to better understand factors that determine how parents make health decisions for and about their

children's immunization, given the risk of potential diseases with high levels of morbidity and mortality for those who are not immunized.

Incidentally, this study was able to establish positive associations between immunization schedules completion and the study variables of the research questions, except sex of the child which was found not have any association or influence on the completion of immunization schedules of children. The findings from this study are expected to guide policymakers in modifying population-specific interventions in a way that will improve access and utilization of health services and RI through bringing immunization services close to the communities. This can be achieved through use of the findings from this study as one of the background documents during routine comprehensive EPI review.

It will also guide government, policymakers and immunization programmers to strengthen social services such as women's education, autonomy, income generation, agricultural sectors and other socio-cultural practices that have impact on the health seeking behavior of the parents/caregivers and ultimately improve utilization of immunization services for the better adherence to immunization schedules completion for their children. The involvement of local community members/structures to drive culturally specific interventions should be given a priority, which will go a long way in improving program ownership. The improvement in the completion of immunization schedules will have a positive impact in reducing infant, as well as childhood, morbidity, and mortality.

The findings from this study are expected to directly support healthcare providers, the political leaders and influential people within the various communities in the region to participate in immunization campaigns to increase ownership of the program and to provide raw material for policy makers to address misconceptions safety of vaccines among parents/care givers. Lastly, these findings hope to build up the health care related academia knowledge base and stimulate social change in the community by improving the health mothers and their children's through enhancement of immunization coverage and reducing childhood morbidity and mortality.

The findings of from this study can be used as an input to for social change by developing materials for mass public enlightenment interventions that will target the caregivers, traditional / religious and other opinion leaders who have the potential to improve the access to and utilization of health services and ultimately bring positive health outcomes and improvement in the completion of RI as well as reduction in infant / childhood morbidity and mortality.

Conclusion

The main of objective of this study is to understand if there are significant statistical association between the variables of the research questions and completion of immunization schedules among the children of northwestern region of Nigeria, with a view to help government, policy makers, programmers and community members to make informed decisions in addressing the problem of poor immunization coverage in the region.

The findings from the study have shown a statistically significant association with four of the study variables (education, wealth index, religious affiliations, and cost of health care) in the research questions and completion of immunization schedules. Hence, the need for immunization stakeholders to address some of these socio-cultural, economic and health system factors that have a significant association with completion of immunization schedules of children in the region. So also, the need to address challenges of parents'/caregivers' such as education of parents / care givers, wealth index of the family, religious affiliations and cost of health care services (vaccination) that were identified to have a statistically significant effect in the completion or noncompletion of RI schedules. This can be address through targeted programs that will have direct bearing on women's education, women's economic empowerment programs, health insurance programs that will subsidize cost of health care services and targeted health education to communities.

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