



# Knowledge, Attitude and Practice on Routine Immunization in the Northeast of Nigeria

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**How to cite this paper:** Kuchichi, A.B., Bolori, M.T., Bukar, F.L., Mukhtar, F., Abulfathi, A.A., Kucici, Y.B., Argungu, M.Y., Mechanic, M.A., Yusuf, U.L., Okafor, G. and Gazali, W.A. (2025) Knowledge, Attitude and Practice on Routine Immunization in the Northeast of Nigeria. *Open Access Library Journal*, 12: e13718. <https://doi.org/10.4236/oalib.1113718>

**Received:** June 2, 2025

**Accepted:** July 25, 2025

**Published:** July 28, 2025

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## Abstract

**Introduction:** The required immunization coverage of at least 90.0% has not been achieved in most parts of Nigeria. The routine immunization [RI] knowledge, attitude, and practice of mothers towards achieving the recommended coverage for all the vaccines have remained poor in Nigeria, especially in the northern part leading to high morbidity and mortality of children below the age of five years. There were suggestions that a lack of knowledge of the benefits of childhood routine immunization resulted in poor judgments, wrong decisions and actions. This study aimed to describe the knowledge, attitudes, and practices of mothers on RI in northeastern Nigeria. **Method:** The study design was a community-based cross-sectional descriptive study utilizing a combination of quantitative and qualitative methods for data collection [mixed-method]. **Results:** About 92.5% of the respondents heard about routine immunization mainly through health workers [88.3%] and media [65.7%]. The in-depth interview clarified that all of them knew what RI was referring to. Many [63.3%] of the respondents knew that RI begins immediately after childbirth. Slightly above half of the respondents knew that RI prevents polio [61.3%], tuberculosis [54.3%] and meningitis [53.3%], and other vaccine-preventable diseases. The majority of the respondents thought RI was effective and were satisfied [87.8%] with it. However, only about 56.5% thought RI leads to side effects and fewer [11.8%] thought that the RI was aimed at causing sickness to children. About 62.8% of the respondents had their children fully immunized with evidence. Others had their children either partially immunized [9.5%] or not immunized [13.5%]. The rest [14.2%] did not know the immunization status of their children. **Conclusion:**

The gaps in the knowledge, attitude and practice among the respondents remain worrisome and was thought to have contributed to low RI coverage which needs to be addressed. Recommendations: Government and the relevant stakeholders should enhance positive modification of knowledge, attitude, and practice regarding RI through health education especially through the health workers and the media.

## Subject Areas

Public Health

## Keywords

Knowledge, Attitude, Routine Immunization, Northeast, Nigeria

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## 1. Introduction

Knowledge, attitude, and practice on routine immunization [RI] are essential determinants of the level of protection of children from childhood killer diseases. Mother's level of knowledge of RI is a critical determinant of their practices [1]. Knowledge influences attitude and practice. Routine immunization protects over three million lives of young children a year the world over [2]. The knowledge and attitude of mothers are essential to the successful immunization of a child [3]. Over three million young children lose their lives to childhood killer diseases across the world [3]. In Nigeria, childhood killer diseases account for more than 22% of under-five mortality resulting in over 200,000 deaths per year [4]. Despite huge resources being expended by the government, it has not resulted in achieving the desired immunization coverage in Nigeria [4]. The RI coverage for 2021 in Maiduguri Local Government Area [LGA], the capital city of Borno State was 40.7% [5]. The RI coverage of Maiduguri LGA did not meet the requirement of the Global Vaccine Action Plan 2011-2020 endorsed by the World Health Assembly in 2012 which called on all countries to reach at least 90% national coverage for all vaccines in the country's RI schedule by 2020 [6]. Countries such as Greece, and Georgia have achieved at least 90.0% RI coverage reflecting their good levels of knowledge, attitude, and practice concerning RI [2] [7]. Studies conducted in developing countries such as Ethiopia (North-East Ethiopia) showed good knowledge, a favorable attitude, and good practice on RI among mothers [8]. A study conducted in Benin City, Nigeria also revealed good knowledge levels of the mothers [9]. However, neither in Nigeria nor in Ethiopia did RI coverage reach 90%. A previous study in the study locale showed 35.3% RI coverage according to Njidda *et al.* [10]. This reflects the poor knowledge, attitude, and practice of mothers towards RI. More recent data showed an RI coverage rate of 40.7% in Maiduguri LGA [5]. Mothers are supposed to be knowledgeable and have good attitudes and practices regarding RI to achieve 90% coverage as recommended by the

United Nations. The United Nations General Assembly Special Session [UNGASS] set a goal to ensure full immunization of children under one year at 90% coverage at all levels by 2010 [1]. However, some factors such as vaccine availability, indirect costs like transport fees, and the place of birth of the child among others have been identified as barriers to routine immunization [11]. Also, the Global Vaccine Action Plan 2011-2020 endorsed by the World Health Assembly in 2012, aimed at achieving at least 90% RI coverage in all countries by the year 2020 [6]. The Alma Ata declaration adopted immunization as one of the key components towards the achievement of health for all [12]. Immunization coverage of 90% has not been achieved in most parts of Nigeria. As of 2021, the RI coverage for Nigeria stood at 36% according to the National Bureau of Statistics [13]. The RI coverage in Maiduguri LGA and Borno State was about 40.7 % and 78.8% respectively [5]. The RI knowledge, attitude, and practice of mothers towards achieving the recommended coverage of 90% for all the vaccines have remained poor in Nigeria, especially in the northern part leading to high morbidity and mortality of children below the age of five years [14]. Lack of attention to the poor RI coverage in the communities translates to worsening child morbidity and mortality with subsequent loss of more resources. Increased outbreaks of diseases that can be prevented by immunization were caused by a lack of knowledge and false information. However, a study by Njidda in Maiduguri on “assessment of parents’ knowledge towards the benefits of child Immunization” indicated that lack of knowledge regarding RI might result in poor judgments and even harmful decisions [10]. This study aimed to describe the knowledge, attitude, and practice of mothers on RI in Maiduguri LGA. The findings benefit researchers, academicians, field workers, and policymakers by providing them with data-guided recommendations to improve RI coverage. The study aids the improvement of the implementation of the World Health Organization AFRO region [WHO/AFRO] plan for curbing the menace of childhood killer diseases in the African sub-region. This research contributes to the achievement of Sustainable Development Goal [SDG] 3, especially by enhancing effective and safe vaccine access to all eligible infants and children leading to a reduction of the morbidity and mortality due to childhood killer diseases [15].

Literature review: Immunization is the process of preventing a person from an infectious agent by administration of vaccines into the body [9]. Immunization is one of the most cost-effective strategies for preventing infectious diseases [6] [16]. A clear understanding of the knowledge and attitude of mothers about immunization for children under the age of twenty-three months and below is key in the design and implementation of immunization services and programs to achieve the required RI coverage [17]. Poor knowledge and attitudes of mothers about RI hinder childhood immunization [14]. The utilization of RI services depends on many factors such as mothers’ knowledge of the immunization services and the vaccines, attitude/behaviour, accessibility to the RI services, attitude and behaviour of service providers, etc. Poor routine immunization coverage is related to the mother’s

lack of knowledge about the immunization, fear of the child getting sick after the immunization, and belief that immunization is unsafe and can cause serious side effects among other factors [18]. The knowledge, attitude, and practice of mothers toward immunization are important issues when talking about RI coverage [19]. Immunization policies are made to enhance the process of creating herd immunity for the population the government aims to protect [20]. It is so important that governments make RI compulsory in some countries. The policies related to immunization aim to confer immunity against childhood killer diseases [20]. Apart from protection of individuals, Herd immunity is another benefit that immunization policies are intended to give the community as a whole. Because nearly every member of the population is immunized against the disease in issue, herd immunity refers to the protection of the whole population within a specific geographic area. Even the few who are not immunized are protected because of the presence of herd immunity within the population. Herd immunity provides protection to those who were not immunized due to any reason, such as immune disorders or non-compliance, etc. So, for herd immunity to be developed majority of those who are vaccine-eligible within a given population must be immunized. Knowledge, attitude and practice of mothers are very important in acquiring herd immunity in any given population. The immunization policy is the one that the government adopted to enhance the behaviour and practice towards immunization within the population [21]. The aim of immunization policies is to eliminate illnesses by creating herd immunity within the target population. The National Immunization Program [NIP] is a federal government initiative that functions in accordance with broader health-related policy. The National Program on Immunization [NPI], also known as the Expanded Program on Immunization [EPI], which was first implemented in 1978, aims to prevent childhood killer diseases among children under the age of 23 months through an RI program. The objective of EPI in Nigeria is to eradicate the six childhood killer diseases: polio, measles, diphtheria, whooping cough, tuberculosis, and yellow fever in order to enhance the health of Nigerian children. The Federal Government during a National Vaccine Summit in April 2012 launched the project “Saving a million lives” using funds from the petroleum subsidy removal, which has decreased poliovirus transmission [21].

**Routine immunization schedule:** The immunization schedule for Nigerian children was designed to guide the periodic and timely administration of the vaccine to the infants to strengthen their immunity against specific vaccine-preventable childhood diseases. The vaccines are Bacillus Calmette-Gurin [BCG], Oral Polio Virus vaccine [OPV], Hepatitis B vaccine [HBV], Pentavalent vaccine [containing Diphtheria-Pertussis-Tetanus Hepatitis B Virus and Haemophilus influenzae type b antigens]. Others are the Pneumococcal Conjugate vaccine [PCV], Oral Polio vaccine [OPV], Inactivated Polio vaccine [IPV], measles vaccine [MV] and Yellow fever Vaccines [YF] [22]. The route of administration for the pentavalent vaccine, Hep B, PCV and IPV is intramuscular while OPV is given orally. The MV and YF vaccines are given subcutaneously.

**Barriers to Childhood RI:** These are factors that stop mothers from accessing RI services for their children. These are categorized into three major categories which include parental/caretaker, health system and providers' barriers. Parents'/caretakers' barriers are often stated as modifiable factors such as lack of knowledge, misconceptions, trust, childbirth at home, long waiting time, providers' hostility, parents' forgetfulness, inconvenient time and language barrier. All these discourage mothers from accessing and utilizing RI services for their children. Ignorance of mothers regarding RI is particularly seen as a very important barrier to childhood immunization [23]. It was observed that a child born to a mother who is unaware of RI might not finish receiving the necessary RI doses. Misperceptions about RI were recorded as barriers to using RI services. It was reported that some parents believed that the immunity by RI is less effective compared to that imparted by natural infection [23]. Mothers with such beliefs prefer their children to suffer from the natural disease rather than use RI to prevent the occurrence of the disease. Some mothers believe more in traditional methods of prevention than in using immunization for disease prevention. Lack of confidence in RI was a reported barrier. Some community members nurture the belief that RI vaccines are harmful, expired and can cause physical disability or death of children. Long waiting time in health facilities is perceived by many mothers as a deterrent factor against seeking RI services. Other deterrent factors against immunization seen as difficult to modify are those factors that are extrinsic to the parents or the providers. These include occupation, financial limitations, place of residence of mother, religion, ethnicity, family size, male partners' support, migration and seasonal farm work leading to travels or relocations [23].

A key factor influencing children's RI was reported to be the mother's nature of work. Housewives were reported to most likely have better RI coverage status compared to mothers who are employed in the public or private sector or those who are merchants. The mother's place of residence was reported as a determinant of the full RI of a child. The likelihood of RI in a child within the first week after birth is higher among children of mothers residing in rural areas than in urban and pre-urban settings [23]. Socio-cultural factors and religion were noted to have negatively impacted RI utilization. Certain ethnic groups within the same country were identified to be associated with low RI coverage. Large family size was found to be associated more with low RI utilization, perhaps due to the increased burden of caring for too many children.

**Community Participation in RI:** Community participation is important in attaining higher RI coverage to reduce the number of incidences of childhood killer diseases [24]. Therefore, the community needs to have confidence in RI services. An informed community is more likely to participate actively in the RI program. Managers at all levels should keep communities informed about RI services and invite the participation of local stakeholders such as politicians, religious leaders, and parents in planning and implementing the RI programs. The RI service providers and the representatives of the communities should be together in planning,

implementing, monitoring and evaluating the performance of RI programs to achieve better coverage while addressing challenges. The managers and community members remain closely together to achieve the required RI results through effective communication. Community leaders and members should be supported in understanding what diseases are being tackled and all the important aspects of the RI program.

Communicating with Clients/Parents and Communities: Good communication with relevant persons and groups leads to improved RI coverage [24]. Communications only take place if messages passed are understood. The reason for health communication is to influence the behaviour of the clients/parents for the better. Qualities of good communication include friendliness between health workers and clients, simplicity of statements, timeliness and relevance of messages, truthfulness and paying attention with good eye contact, postures and body gestures. All the concerns of the mothers should be taken into consideration during communications. Essential messages concerning RI should be passed to parents. The six key messages in RI must be well communicated at the right time to the mothers or caregivers. The six key RI messages contribute positively to good RI coverage. The key messages include:

[i] the type vaccine given, [ii] number of doses needed, [iii] date, time and venue of next visit for immunization, [iv] side effects that may occur, [v] to bring the child for immunization even if the child is sick and [vi] good care of the RI card.

Socio-economic and other Factors Affecting RI: Many factors are considered to influence RI coverage. The socioeconomic and health status of the mother is an important factor in determining the health and RI status of children [25], for instance, mothers below 30 years were more likely to get their children fully immunized. The education of mothers was found to be very relevant to the health and RI statuses of children immunized compared to uneducated mothers [9]. It is therefore clear that the RI status of children can be increased through the improvement in the education of women on health care services. The marital status of the mother influences the RI status of the children. A positive association has been demonstrated in terms of religion, marital status, household size, and age with the mothers' knowledge of RI. The education and wealth status of mothers have a strong correlation with health-seeking behaviour as well as child survival. Wealthier mothers are more likely and correctly to attend RI sessions right from the first visit compared to poorer mothers. It was noted that children from urban areas have consistency in terms of higher immunization rates compared to those in rural areas. The Health Behaviour of women along with other factors such as place of delivery, and access to health facilities was found to be associated with the immunization status of children [25]. It was indicated that antenatal visits and birth in health facilities offer children a better chance of being fully immunized because of more likely access to information on immunization. For example, children who were born in health facilities are more likely to be immunized with BCG at birth unlike children born at home. Mothers who regularly attend antenatal clinics dur-

ing pregnancy are found to have better access to health care services such as immunization and institutional delivery.

Empirical literature review on knowledge, attitude and practice on RI among mothers.

A study on knowledge regarding RI with 1885 mothers recruited as participants in Greece showed that majority [98%] had their children fully immunized against vaccine-preventable diseases. The respondents' commonest source of immunization information was their paediatricians [89%]. There was a high level of knowledge of RI among the mothers in Greece. The high knowledge of childhood RI against vaccine-preventable diseases was associated with the education of mothers enhancing good communication between health workers and mothers. This emphasizes the importance of good communication to mothers of unimmunized or under-immunized children and public authorities as well as policy makers to promote RI through educational programs and campaigns [7].

Another study on mothers' knowledge and attitudes towards RI in Georgia revealed that out of 188 mothers interviewed, majority [97.0%] of them showed a positive attitude towards immunization and believed that immunization plays an important role in disease prevention. About 32.0% were not well informed about the RI leaving about 36.0% of their children partially immunized. Other reasons contributing to the partial immunization state of some of the eligible children were lack of knowledge about the RI schedule [25.5%], inadequate information about the necessity of subsequent doses of immunization [18.6%], fear of side effects [16.0%] and fear of child illness [9.6%]. Mothers' education, practice and attitude regarding immunization were found to be associated with one another. Health institutions [49.5%] and internet sources [21.3%] were the most popular sources of RI information. Majority of the mothers had a positive attitude towards child immunization, but their levels of awareness were very low and they did not have comprehensive information about RI schedule. It was necessary to raise public awareness of the importance of immunization by implementing educational programs and by traditional and social media [18].

In a study on knowledge towards RI among mothers and reasons for incomplete immunization found out in India, it was found that out of 377 mothers interviewed about 30.5% of their children were partially immunized due to the lack of vaccines in the immunization centres [26]. Other reasons for incomplete immunization were lack of knowledge among the mothers regarding age-related vaccines, child was sick on the due date of immunization, and lack of knowledge among the mothers regarding the need for immunization. The study also revealed that a statistically significant relationship exists between each of the following: gender and immunization status, mother's education and knowledge score and area of residence and knowledge score towards immunization.

A study on assessment of knowledge, attitude and practice of Parents about Immunization in Hail city of Saudi Arabia [27] revealed that most parents had a high level of knowledge, attitude and practice about the preventive measures and

the importance of immunization. The knowledge, attitude and practice regarding immunization were not significantly associated with the female gender, educational degree and number of children. The study concluded that majority of the respondents had a good Knowledge, attitude and practice towards immunization. Furthermore, the study recommended educational programs to increase the parents' knowledge and practice, especially among illiterate mothers living in rural areas. A study on Parents' knowledge, attitude and practice of immunization in Lebanon showed that better communication between clients and health workers was a highly important factor for higher knowledge, better attitude and practice. Better knowledge was related to a better attitude, whereas better knowledge and attitude were significantly associated with better practice [1].

A study on assessment of Knowledge on immunization in Kenya, showed that almost all the mothers interviewed knew about the existence of immunization but only 43.0% had appreciable knowledge about immunization while the remaining 57.0% had vague knowledge about details of immunization as mothers [28]. It was found that mothers with many children tend to have better knowledge about immunization than those with only one child [28]. Almost all [99.0%] of the respondents considered immunization as beneficial, safe and harmless. About 87.0% of the respondents were happy with the government's provision of immunization services. About 97.0% of the respondents felt that the immunization schedule should be strictly followed. About 59.0% of the respondents mentioned barriers to immunization services such as access to health facilities [21.0%], lack of information [13.0%], shortage of health workers [19.0%] and others such as lack of transport money, side effects, and distance to health facility and school attendance. About 53.0% doubt the quality and safety of vaccines, while 62.0% doubt the competence of the health workers. Most [66.0%] felt that immunization helps children grow healthy. The majority [96.0%] had a positive attitude and good practice. Almost [99.0%] felt that vaccines were safe. In terms of practice, about 25.0% of the participants had their infants fully immunized while the rest had babies that were less than 9 months or defaulters from immunization. The card retention rate among them was up to 96.0% [28]. The recommendation was for the government to educate mothers and train more health workers to conduct immunization services including outreaches. Another study on the knowledge, attitude and practices of parents about immunization of infants and its associated factors in Walta Woreda North East Ethiopia revealed that 65.1%, of the mothers, had good knowledge, 57.3%, had a favourable attitude, and 55.3% had good practice towards infant immunization. The educational status, urban residency, and the immunization status of the child are affiliated with the knowledge of the mothers on immunization. The mothers' educational status favors a good attitude and practice toward infant immunization. It was recommended that improving the knowledge, attitude, and practice of mothers about RI against vaccine-preventable diseases by providing health education and health promotion interventions would help in closing some of the gaps [8]. A study in Ile Efe, Nigeria, on knowledge,

attitude and barriers to routine immunization among women in rural primary health centres revealed that about 80.0% of the respondents were aware that immunization services are available at primary healthcare centres. About 53.0% of the respondents had no confidence in the quality and safety of vaccines being used while 62.0% reported that health workers were not sufficiently trained. Most agreed that immunization makes children grow healthy [66.0%]. The study also revealed that knowledge of immunization was a better predictor of barriers to it. Mothers could be motivated to have their children immunized by enlightenment right from the antenatal clinics. Good healthcare facilities and improved personnel services will increase the utilization of immunization services [29]. An assessment of knowledge and practice of RI among Mothers and caregivers attending Primary Health Care centres in Benin City, Edo State, Nigeria shows that all the mothers were aware of immunization. About 77.8% of the respondents revealed that the media was their source of information. A higher percentage [44.8%] of respondents had good knowledge while 38.6% and 12.6%, had fair and poor knowledge of immunization respectively. Most [89.1%] of the respondents were knowledgeable about BCG and OPV followed by HBV [77.8%], DPT [70.6%] and Pentavalent vaccines [66.1%]. Pental to measles dropout rate according to the study was 19.5%. The study recommended that the federal and state governments should put emphasis on educating and empowering the girl child and also raising awareness on family planning to enable improvement in the immunization coverage [9].

Assessment of knowledge, attitude and practice of immunization processes and its coverage in rural communities of Bida in Niger state by [4] revealed that the low educational level of mothers in the community was responsible for the poor knowledge, attitude and practice recorded leading to low immunization coverage of 28.0%. The recommendation was prioritization of girl child education and community mobilization towards immunization services. According to report from Bauchi State of Nigeria, mothers' education impacts positively on uptake of RI and about 67.0% knew childhood killer diseases [30]. A study in Emohua Local Government Area of Rivers State revealed that the mothers' knowledge of immunization was poor but their attitude was strongly positive towards RI. It also showed that age, education, and religious background were major factors that influence a mother's attitude toward immunization. The study recommended that awareness campaigns should be prioritized using media channels to encourage all the eligible children [2]. However, Knowledge of RI was poor and attitude was good as observed in a study in the six geopolitical zones of Nigeria among the rural mothers [14]. In Ebonyi state, out of the 141 mothers interviewed only 40 [28.8%] had good knowledge of RI, and 101 [71.6%] mothers had poor practice because of the distance of the RI centres from their homes. Age, parity of respondents, number of living children, educational status, and place of residence were significantly associated with the knowledge of RI among the study participants. The majority of the mothers had poor knowledge of RI. Maternal educa-

tional status was positive and the only significant predictor of good knowledge of RI. It was suggested that RI information be delivered to all mothers at their doorstep, that optimal RI sessions be intensified to include daily RI as much as possible at fixed posts, and that RI be integrated with other health services [31]. Study in Plateau State, Nigeria, that out of 232 mothers investigated, only 3.0% had excellent knowledge of vaccine-preventable diseases, 90.0% had an overall good knowledge while 5.0% each had fair or poor knowledge [3]. The education of the mothers, marital statuses, religion, and geopolitical zones influenced their knowledge. The study also revealed that in a record of 513 children that visited the clinic for the first time in April 2012 only 23.4% completed the required doses for RI, meaning poor practice by mothers with less than 60.0% presenting their children for RI at the right time and less than 3.0% had a negative attitude towards immunization. A study in Borno State, Nigeria revealed that only 35.0% of 442 mothers interviewed fully immunized their children against vaccine-preventable diseases [10]. In some countries such as Georgia, Greece and Saudi Arabia mothers were of good practice, knowledge and attitude among the participants. African countries seem to be having poorer indices in terms of knowledge, attitude and practice regarding RI. The worst indices in most cases were found in Nigeria especially the North Eastern region with varying levels of knowledge, attitude and practices leading to low RI coverage rates. Therefore, serious steps to improve RI coverage should be instituted so that coverage of at least 90.0% should be achieved in every district in Nigeria.

## 2. Methodology

The northeast zone of Nigeria has six states which are Borno, Bauchi, Adamawa, Gombe, Taraba and Yobe states with a total population of about 22.3 million people. The major ethnic groups are Hausa, Fulani and Kanuri, while the minority groups include Shuwa Arabs, Babur-bura, Mumunye, Chamba, Marghi, Manga, Tera, Jukun, Wurkum, Tiv, Bachama, Mambila, Lungudu, and Waja. The main religion practiced in the region is Islam. The people in the northeast region have so much in common in terms of socio-economic and cultural background.

**Research design:** The study design was a community-based cross-sectional descriptive study utilizing combination of quantitative and qualitative methods for data collection [mixed-method, quantitative and qualitative], which enhanced the collection of detailed information and allowed a deeper understanding of the findings.

**Study population:** The population for the study was mothers with children aged 0 to 23 months who were eligible for RI which was assumed to be approximately the same as the population of women of childbearing age or reproductive age [15 to 49 years]. The target population [women of childbearing age] used at the National and Global levels is 26% of the total population [32]. The 26% of 699,071 equalled 181,759 formed the target population of women of childbearing age.

Sources of Data: The study used both primary and secondary data. The primary data collection tool consists of a questionnaire for the quantitative aspect and a question guide for the qualitative aspect for in-depth interviews. The questionnaire was divided into four sections. Section A is concerned with the socio-demographic data of the respondents. Sections B, C, and D asked about the data on the knowledge, attitude and practice concerning RI respectively among mothers in Maiduguri LGA. The questionnaire was modified from a similar study conducted in Kenya [28]. In-depth interviews were also conducted to seek additional information on the knowledge, attitude and practice of mothers on RI in the selected settlements. The secondary data sources include journal articles, books, reports from World Health Organization [WHO], Borno Office, and reports from the Department of Primary Healthcare, Maiduguri.

Sample size: The sample for the study was Four Hundred [400] which was calculated using Taro Yamane's formula for sample size determination for the quantitative method. For this study, the sample size was the number of mothers to be considered for the interview using the questionnaire. The sample size was based on the 95% confidence interval [alpha level of  $p = 0.05$  significance].

The Taro Yamane's formula for the sample size is

$$n = N/1 + Ne^2 \text{ [33].}$$

where:  $n$  = Sample size required,  $N$  = Population under study [Number of women of childbearing age, 15 to 49 years],  $e$  = Sampling error = 0.05, sample size is  $n = 181759/1 + 181759 \times 0.05^2 = 399$  [approximately 400].

Therefore, 400 was the sample size for the quantitative study.

For the qualitative method, the principle of data saturation was used to select additional 24 respondents. Recruitment of respondents stopped when no new information was coming in [34]. The general recommendation for in-depth interviews is to have a sample size of 20-30 [35]. Three respondents were purposively allocated to each of the eight settlements from the two wards to ensure the capture of varied information. After the interviews were conducted, it was certain that no new information was forthcoming.

Sampling technique: The multi-stage sampling method was used for sampling to arrive at the level of selection of respondents.

Stage one: Borno was chosen for the study as a representative of the region because of convenience. Stage two: Maiduguri was selected purposely because of its size and the population with a high number of tribal groups and the two main religions proportionately well represented.

Stage three: Two out of the 15 wards of Maiduguri LGA were purposively selected as wards with the highest [Gwange 2] and least [Shehuri South] number of fully immunized children respectively.

Stage four: Random sampling method was used to identify mothers with children aged 0 to 23 in the households of the selected settlements to serve as respondents to the questionnaire till the number of respondents required in the sample size was reached. In a situation where the actual mother was inevitably not avail-

able for the interview, the caretaker of that child was interviewed in the place of the mother.

Qualitative method: an in-depth interview was conducted. The respondents were 24 in number, selected by convenience method to ensure no new answers to the questions emerged during the in-depth interview. Twelve respondents were selected from each of the two wards, 3 from each of the settlements selected. The questions were asked with the help of a question guide prepared specifically for this purpose.

Method of Data Collection: The quantitative data collection was through an Open Data Kit [ODK] based questionnaire administered by surveyors. Before administering the questionnaire to each respondent, the reason for the research and benefits were explained clearly to the respondents in the local languages [Kanuri or Hausa], which are understood by all the respondents. The research assistants explained to the respondents the benefits and disadvantages of participation in the research. Each surveyor recorded the geo-coordinate of each household using the ODK mobile Android phone application. See Appendix 5 for the spatial distribution of the respondents in the study locale. The date of the questionnaire administered and the surveyor's name were recorded. Data collection was by face-to-face interviews using a questionnaire on the ODK Android phone software platform. The surveyors record all the responses on the ODK platform on the phone and send them to the server. A data manager downloaded the records on the ODK server for quality control and analysis. Any record that fell below the expected quality was deleted and the attention of the surveyor was called for a redo. The data which were sent to the server earlier on was retrieved and analysed. The operational variables were the three dependent variables [DV] which include the status of knowledge, attitude and practice concerning questions regarding RI which were the independent variables [IV].

Secondary data includes socio-demographic information concerning the study locale and other key information like the target population from the LGA records. Data were collected by four research assistants or surveyors who had at least a Diploma certificate in health-related courses as an educational qualification as well as previous experience using the ODK platform for data collection. The surveyors were specially trained for the work. All the surveyors were of the female gender to enable free interaction with the mothers without bridging the cultural norms.

For the qualitative method, an in-depth interview with structured open-ended questions was conducted by one of the researchers who is an expert in routine immunization). This enabled a deeper understanding of the knowledge, attitude and practice of the respondents regarding RI. The researcher interviewed the respondents who were mothers of childbearing age with a child aged 0 - 23 months face-to-face using the question guides. The respondents who were purposively selected comprised 24 mothers, 12 from each of the two wards. Audio recordings and notes were taken from their responses. The data collection process took 4 weeks to complete [between February and March 2023].

**Method of Data Analysis:** For the quantitative method data from the questionnaire were analysed using descriptive statistics [average, frequencies and percentages] through the use of computer software, Statistical Package for Social Sciences [SPSS] version 25. Content analysis was used for the qualitative method. The responses of the respondent were transcribed into written text and analysed. Content analysis is a set of procedures for collecting and organizing information in a standardized format that allows analysts to make inferences about the characteristics and meaning of written and other recorded materials [36].

In the in-depth interview the mothers' attitude towards RI was graded as excellent, good, and poor. The scoring was from 1 to 10 in accordance with the investigator's satisfaction with the answers provided by the respondents. The scores were graded as follows: 8 out of 10 graded as excellent, 5 out of 10 graded as good, and less than 5 graded as poor. The grading of the levels of knowledge and practice of RI was done according to the investigator's personal assessment as an expert in routine immunization during the interview.

**Ethical Procedures:** Ethical approval was obtained from the ethical committee of the Borno State Ministry of Health for the study. Ethical research principles such as non-maleficence, beneficence and confidentiality were strictly observed.

### 3. Results

Average age in years 28.4 years [Standard Deviation = 6.2].

The largest proportion [30.5%] of the respondents was from the age bracket 25 to < 30 years, as in **Table 1**. Almost all were married, Muslims, poor, artisans and had Quranic background in terms of education.

**Table 1.** Mother's socio-demographic characteristics [n = 400].

Variables	Frequency	Percent
<b>Age</b>		
15 - <20 yrs	22	5.5
20 - <25 yrs	110	27.5
25 - <30 yrs	122	30.5
30 - <35 yrs	93	23.3
35 - <40 yrs	28	7
40 - <45 yrs	25	6.3
<b>Religion</b>		
Islam	398	99.5
Christianity	2	0.5
Others	0	0

**Continued**

<b>Number of children</b>		
1 - 2	106	26.5
3 - 4	139	34.8
5 - 6	76	19
More than 6	79	19.8
<b>Marital Status</b>		
Single	17	4.3
Married	370	92.5
Widow	11	2.8
Divorced	2	0.5
Others	0	0
<b>Educational qualification of the mother</b>		
Quranic	225	56.3
Primary	41	10.3
Secondary	92	23
Tertiary	25	6.3
University	8	2
None	9	2.3
<b>Income in Naira</b>		
≤5000	274	68.5
>5000 - 10,000	90	22.5
>10,000 - 15,000	24	6
>15,000 - 20,000	8	2
>20,000	4	1
<b>Occupation</b>		
Cap sewing	226	56.5
Frying, Petty trading, house help	107	26.8
Teaching	23	5.8
Others	44	11

Source: Fieldwork Survey, 2023.

**Table 2** showed that almost all of the respondents had about RI. Majority heard about RI from health workers. However, there were a lot of gaps in their knowledge about RI.

**Table 2.** Mothers' knowledge of RI [n = 400].

Variables	Frequency	Percent [%]
<b>Have you heard about immunization? [n = 400]</b>		
Yes	370	92.5
No	30	7.5
<b>If yes, what is your source of information?</b>		
Health workers [n = 400]	265	88.3
Media [n = 400]	197	65.7
Traditional leader [n = 400]	75	25
Neighbours [n = 400]	32	10.7
Word of mouth [n = 400]	39	13
Others [n = 400]	14	4.7
<b>At what age will a child start receiving RI? [n = 400]</b>		
Immediately at birth	253	63.3
Two weeks after birth	77	19.3
After 40 days [postpartum]	33	8.3
When the child is sick	5	1.3
Others	6	1.5
I don't know	26	6.5
<b>Does RI prevent diseases? [n = 400]</b>		
Yes	359	89.8
No	27	6.8
I don't know	14	3.5
<b>If yes, what diseases are prevented by RI?</b>		
Polio [n = 359]	184	61.3
TB [n = 359]	163	54.3
Pneumonia [n = 359]	129	43
Meningitis [n = 359]	160	53.3
Measles [n = 359]	291	97
Yellow fever [n = 359]	85	28.3
Others [n = 359]	30	10
I don't know [n = 359]	46	15.3

## Continued

Is it true that healthy children do not need immunization? [n = 400]		
Yes	71	17.8
No	303	75.8
I don't know	26	6.5
Does an expanded program on Immunization offer free immunization to children? [n = 400]		
Yes	356	89
No	36	9
I don't know	8	2

Source: Fieldwork Survey, 2023.

**Table 3** further shows more of the gaps in the knowledge of respondents in terms of eligibility and diseases prevented by RI.

**Table 3.** Mothers' knowledge towards RI [n = 24] in-depth interview.

Description	Frequency	Percent [%]	
Knowledge of the meaning of RI	Knows	24	100
	Don't know	0	0
	Partially knows	0	0
Knowledge of eligibility for RI	Know	8	33.3
	Don't know	16	66.6
	Partially knows	0	0
Knowledge of diseases prevented by RI	Knows	5	20.8
	Don't know	2	0.1
	Partially knows	17	70.8

Source: Fieldwork Survey, 2023.

**Table 4** shows that attitude of respondents about RI has many issues that need to be addressed.

**Table 4.** Mothers' attitude towards RI [n = 400].

Variables	Frequency	Percent
Is RI harmful to children?		
Yes	106	26.5
No	279	69.8
I don't know	15	3.8

## Continued

<b>Is RI effective?</b>		
Yes	363	90.8
No	27	6.8
I don't know	10	2.5
<b>Is RI affordable?</b>		
Yes	307	76.8
No	86	21.5
I don't know	7	1.8
<b>Do you think RI has a side effect [s]?</b>		
Yes	234	58.5
No	153	38.3
I don't know	13	3.3
<b>Are you satisfied with the immunization services offered by the Ministry of Health?</b>		
Yes	351	87.8
No	43	10.8
I don't know	6	1.5
<b>Is the aim of immunization to make children sick?</b>		
Yes	47	11.8
No	336	84
I don't know	17	4.3
<b>Is it important to follow the immunization schedule?</b>		
Yes	355	88.8
No	30	7.5
I don't know	15	3.8

Source: Fieldwork Survey, 2023.

**Table 5** shows that the respondents' acceptance was inadequate. The thought of the respondents regarding knowledge of the community members on RI and their attitude was poor.

**Table 6** shows information concerning practice of respondents regarding RI. The number of eligible children immunized was 62.8%.

**Table 7** showed that the majority [58.3%] of the respondents thought that the practice of RI among the mothers within the community was below requirement.

**Table 5.** Mothers' attitude towards RI [n = 24] in-depth interview.

Description		Frequency	Percent [%]
Adequacy of acceptance of RI within the communities	Adequate	19	79.2
	Inadequate	5	20.8
The thought of respondents about quality of knowledge about RI among the community members.	score of 8 out of 10	8	33.3
	Score of 5 out of 10	13	54.2
	Score of Less than 5	1	4.2
The thought of respondents about quality of the attitude regarding RI within the community	Score of 8 out of 10	13	54.2
	Score of 5 out of 10	9	37.5
	Score of Less than 5	2	8.3

Source: Fieldwork Survey, 2023; Note on scores: 8 out of 10: excellent, 5 out of 10: fair, less than 5: poor.

**Table 6.** Mother's practice towards RI [n = 400].

Variables	Frequency	Percent
<b>Is your child fully immunized?</b>		
Yes	251	62.8
No	104	26
I don't know	45	11.3
<b>If no, why?</b>		
Husband does not allow	43	10.8
Side effects	6	1.5
Clinic is far	2	0.5
Providers are not friendly	2	0.5
Not aware	4	1
I don't believe in immunization	3	0.8
Others	15	3.8
I don't know	29	7.3
<b>If no, what is your child's immunization status?</b>		
Partially immunized	38	9.5
Not immunized	54	13.5
I don't know	12	3
<b>If partially or not immunized, what is the reason?</b>		
Child was sick	9	2.3
Reacted to previous immunization	5	1.3

**Continued**

The attitude of health workers	1	0.3
Cannot afford to pay for transport	1	0.3
Others	8	2
I don't know	14	3.5
<b>Which Side Effects [SE] did your child suffer in the past</b>		
Fever [n = 400]	285	95
Pain [n = 400]	112	37.3
Rash [n = 400]	28	9.3
Swelling [n = 400]	101	33.7
Excessive cry [n = 400]	209	69.7
Others [n = 400]	18	6
I don't know [n = 400]	44	14.7
<b>If there was SE, did you inform the health care provider about the SE?</b>		
Yes	256	64
No	144	36
<b>Have you ever used analgesics for swelling or pain after RI?</b>		
Yes	288	72
No	112	28

Source: Fieldwork survey, 2023.

**Table 7.** Respondents rating of RI practice among mothers by In-depth Interview [n = 24].

Description	Frequency	Percent [%]
The practice of RI as required regarding RI	10	41.7
The practice of RI below the requirement	14	58.3

Source: Field work survey, 2023.

Respondents posited that the mothers need to be educated and advised to present their children for RI. (See **Table 8**)

**Table 8.** Pieces of advice on how to improve RI by mothers' in-depth interview [n = 24].

Description	Frequency	Percent [%]
Encourage mothers to present their babies for RI	12	50.0
Health Education for Mothers on RI	13	54.2
Improve service delivery	2	8.3
None	1	4.2

Source: Field work survey, 2023.

## 4. Discussions

The majority of the respondents were young, married, illiterates in terms of western education, with small family size, low-income earners as well as artisans. **Table 1** shows that 53.8% of the respondents belonged to the age bracket 20 to 25 and 30 to <35 years similar to the finding in a similar study in Sudan in which the proportion of mothers within the age range 25 to <35 years was 59.1% [37]. The average age of the respondents was calculated as 28.4 years [Standard Deviation = 6.2]. Religion-wise, the majority [99.5%] of respondents were Muslims as Islam is the dominant religion within the study area. The prevalence of single motherhood was [4.3%] as shown in **Table 1**. Almost all of the mothers in the present study were married while the proportion of the single mothers was low [4.3%] in the study locale as expected in the north-eastern part of Nigeria compared to the national average [9.5%] and South-South part of the country where the highest [20.3%] prevalence of single mothers was recorded [38]. Very few [23.0%] reached secondary level in terms of the Western education. Most of the mothers [68.5%] were low-income earners as most were involved in caps sewing as their main source of income which fetches them  $\leq 5000$  Naira per month. The majority of the mothers in the present study had Quranic education as their highest education level as almost all were Muslims. Quranic education is essential for all Muslims. Approximately one-third of the families, or 34.8%, have 3 to 4 children, which is lower than the Nigerian national average family size of 4.9 to 5.9 per household. Furthermore, about 19.8% of the households in this study have families with six or more children.

The majority [92.5%] of the respondents heard about RI but only 63.3% knew the right time to start the RI as depicted in **Table 2**. The most frequent source of information for the respondents was health workers [88.3%] similar to findings of other studies conducted in other parts of Nigeria in which health workers were mentioned as the most frequent source of information on RI. For instance, health workers were the most frequent source of information regarding RI in Edo [94.8%] [9] and Bauchi states [46.8%] [30]. Similarly, the most frequent [89.0%] source of information mentioned by respondents in a Greek study on RI was health workers [7]. The majority [63.3%] of the respondents knew when to start RI for their children. Only 6.5% of the respondents admitted to not knowing the time to start RI for their children while others guessed wrongly or kept quiet. The majority [89.8%] knew that RI vaccines were meant to prevent diseases compared to 91.4% in Edo studies that mentioned prevention as the main reason for RI [9]. A similar study in Kenya found that 98.0% of the respondents knew that RI was meant to prevent diseases [28]. Many of the respondents variously mentioned diseases prevented by different vaccines correctly as in Polio [61.3%] TB [54.3%], Pneumonia [43.0%], Meningitis [53.3%], measles [97.0%], and Yellow Fever [28.3%]. The study in Edo state showed a little bit different result on the various RI antigens that prevent diseases such as BCG [89.1%], Polio [89.1%], HBV [74.7%], PENTA [66.1%], measles [53.3%], PCV [49.5%], and yellow fever [49.2%]. Some [17.8%]

of the respondents did not know that children below the age of one need RI [9]. The qualitative data showed that most [66.6%] of respondents were not aware of which groups of children were eligible for RI as shown in **Table 3**. A lack of knowledge on the eligibility of children for RI makes mothers less likely to present their children for immunization. Only about 20.0% of the respondents knew about which diseases were prevented by RI as revealed by the in-depth interview. **Table 2** and **Table 3** showed that the respondents had good knowledge about RI. However, some had exhibited some degree of ignorance concerning diseases prevented by RI, the time to start immunization or the eligibility of children for RI. The findings in the present study shared a great similarity with the findings of studies in Edo state, Bauchi state and Kenya in which the level of awareness about RI was 100.0% [9], 95.1% [30] and 71.0% [28] respectively. In order to successfully vaccinate eligible children with all the necessary antigens, mothers' and caregivers' knowledge of RI is a crucial factor. If high coverage levels are to be maintained, attention should be paid to this [16].

Some [26.5%] of the respondents thought RI was harmful compared to those who thought otherwise [69.8%] as in **Table 4**. The majority, of the respondents felt that RI was effective [90.8%], affordable [76.8%], and not aimed at making children sick [88.0%]. In agreement with the present study, a similar study in Kenya found that almost all [99.0%] of the respondents thought RI was beneficial, harmless and safe. In the present study, about 38.3% felt RI has no side effects. About 87.8% were satisfied with the immunization services provided by the government in concurrence with the findings in Congo and Ethiopia where 80.0 – 84.0% of teenage mothers interviewed were satisfied with the immunization services provided [28]. An unpublished study conducted in 2016 by a postgraduate student of ABU Zaria recorded 69.0% of respondents with positive attitudes towards immunization while the rest maintained that their children's problem was malaria and not immunization. A similar study in a developing African country reported the attitude of the respondents as poor regarding RI [28]. A study in Ebonyi state of Nigeria showed a positive attitude towards immunization was seen in 98.6% of mothers. About 87.8% of the respondents emphasized the importance of adhering to the immunization schedule in the present study compared to the findings in Kenya that showed about 97.0% of the respondents thought that the immunization schedule should be strictly followed [28]. The result of the in-depth interviews of the respondents on the attitude of mothers toward RI showed adequate acceptance of RI within the communities as depicted in **Table 5**. Only 20.8% reported inadequacy of acceptance, and the remaining 79.2 said it was adequate. Regarding the knowledge about RI, about 33.3% of respondents thought mothers within the community had excellent levels of knowledge while 54.2% and 4.2% were rated as having fair and poor levels of knowledge on RI respectively. The respondents thought that the majority [54.2%] of the mothers in the community had excellent attitudes towards RI, while 37.5% and 8.3% had fair and poor attitudes towards RI respectively.

Only 62.5% of the respondents had their children fully immunized as in **Table 6** which was much higher than the Borno State routine immunization coverage reported in 2019 which was 40.0% [39]. It is better than the findings of a similar study conducted in Bida Local government area of Niger State in which the immunization coverage was 27.8% [4]. The RI coverage found in the present study was also higher than the national average of 25.5% [40]. The RI coverage of 62.5% in the present study was lower when compared with the finding of RI coverage of 77.0% in southern India [41]. It is worth noting that the vaccination coverage for children aged 12-23 months was significantly low, falling below 20% for young women. This certainly affects the goal for vaccination coverage, particularly for children of young women from the northern Nigerian region, which has been historically known for its low vaccination rates in the country [42].

In the present study, many [64.0%] of the children immunized had experienced side effects according to the respondents which included fever [95.0%] and excessive crying [69.7%] which was relatively higher than the proportion of children [16.6%] who suffered side effects recorded in Georgia [18]. The fear of side effects contributed to 16.0% of noncompliance with immunization in Tbilisi, the capital city of Georgia. Effective spontaneous reporting of side effects due to immunization is supposed to be the first step to discourage noncompliance. **Table 6** further revealed that the main reason for eligible children not being immunized was the attitude of health workers [0.3%], cannot afford transport fare [0.3%] or the child was sick [2.3%], reaction to previous immunization [1.3%]. In the present study transport cost served as a barrier to immunization among 0.3% of respondents. A study in Somalia has also identified cost of transport as a negative factor against immunization [11]. Many respondents could not give a reason [3.5%]. The in-depth interview revealed that majority [58.3%] of the respondents thought that the practice of RI among the mothers within the community was below requirement as found consistent with the findings in the quantitative data. This leaves a lot of room for improvement as depicted in **Table 7**.

The respondents felt that RI can be improved by empowering the community members through encouragement [50.0%] and education [54.2%] as shown in **Table 8**. About 8.3% of respondents thought that improving service delivery will encourage mothers to participate in RI, and 4.2% of the respondents did not give any form of advice. These pieces of advice were partially what seems to be the solution to failure to complete immunization as shown in **Table 7**. A similar study in Bauchi recommended Government to employ more health workers, and other personnel to improve how they interact with mothers who seek the RI services, and that health facilities be established close to the beneficiaries. Government should intensify efforts to educate mothers on the importance of RI and how to go about it [30]. The biggest barrier to immunization has been identified to be that of access, especially for the most vulnerable underserved with the basic healthcare services, and in areas where vaccines are made available but inconvenient for people to get due to various reasons. Other challenges include vaccine stock-outs, lack of

personal protective equipment, travel restrictions, distances to health centres, limited opening hours, and inconvenient booking systems.

## 5. Conclusion

In summary, the study investigated the knowledge, attitude and practice of mothers on RI. The significance of the study was highlighted towards ways to improve RI in Maiduguri, Borno state and North Eastern part of Nigeria. It can be concluded that the findings of the study revealed that the majority of the respondents knew about RI in terms of when to start, diseases prevented and that it is given free of charge. Furthermore, the majority knew that all the children need to receive RI vaccines. The attitude regarding RI was shown to be good. The majority of the respondents had immunized their children. Despite the fact that most had good knowledge, attitude and practice, the issues that were identified in relation to knowledge, attitude and practice remain worrisome leaving a significant gap to be addressed. Recommendations include that the government engaging more health workers to address the issues of inadequate staffing in RI clinics to enhance health education and other essential health services. The health workers in the immunization clinics should have periodic reviews of their activities and refresher training to ensure efficiency and quality of service at all times. Health facilities should be close to the communities in line with the principles of primary health care and universal health coverage. The stakeholders are to ensure adequacy of knowledge on immunization among the mothers within the communities using the RI clinics and the various media of communication such as radio and TV.

## Conflicts of Interest

The authors declare no conflicts of interest.

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