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Assessing Immunization Status and Factors Influencing Vaccination Coverage Among Children in Rural Suburbs of Sokoto State, Nigeria

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Abstract

Purpose – This study aimed to assess the immunization status of children in the rural suburbs of Sokoto state. The study aimed to examine the knowledge and perception of the respondents towards immunization, their vaccination coverage, and factors that may influence their immunization status.
Design/methods/approach – This study, which took place in Sokoto state, Nigeria, used a questionnaire as the data collection instrument for a descriptive observational survey. The participants in the study consisted of opinion/community leaders, community men and women, and healthcare providers from the study area. The study population encompassed all people in the region under investigation. The sample size was 300 respondents selected through cluster sampling, and data were analyzed using descriptive statistics and the X^2 test.
Findings – The study's respondents were primarily male (66.7%), with a significant female population (33.3%), all aged 26-35. The majority were married (66.7%) and had tertiary education (66.7%), while some had secondary (16.7%) or primary education (16.7%). Immunization knowledge was primarily obtained through friends (66.7%) and healthcare workers (33.3%), with the expected time to begin immunization after nine months of age. All respondents had vaccinated their children and possessed vaccination cards. Factors affecting immunization included socioeconomic status (33.3%), beliefs (26.7%), geographic barriers (16.6%), and awareness (16.7%). The DPT1/DPT3 immunization coverage rate was 85%.
Research implications/limitations – This study offers valuable insights for developing effective immunization programs in rural areas. The findings highlight the importance of educating friends and family members and promoting high levels of awareness and motivation towards immunization to encourage the adoption of similar strategies. However, it is essential to note that the study's focus on immunization in children may limit its relevance to other age groups.
Practical implications – Immunization is crucial for saving lives and protecting individuals, families, and communities from various diseases, offering profound benefits beyond health. This study has practical implications for policymakers, researchers, healthcare providers, students, and non-governmental organizations who can benefit from its findings to improve immunization strategies.
Originality/value – This study provides valuable insights into the immunization status of children in rural areas of Sokoto state, highlighting the importance of education, awareness, and motivation towards immunization to promote higher vaccination coverage rates and improve public health.

Keywords Immunization of children, Vaccination coverage, Early childhood education

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1. Introduction

Immunization is fundamental to eliciting the body's immunity against infectious agents through vaccine administration. This cost-effective public health intervention has successfully prevented, controlled, eliminated, or eradicated many infectious diseases worldwide, including smallpox, polio, diphtheria, tetanus, cough, and measles (Akwataghibe et al., 2019; Ethiopian Public Health Training Initiative, 2002; Lyons et al., 2015; Oche et al., 2011). Immunization has been credited with preventing over 2 million deaths by 2003, including 1.5 million deaths among children under the age of 2 (Oche et al., 2011). This success has led to the declaration of the Millennium Development Goals, calling for a two-thirds reduction in child mortality by 2015 (Ramdhania & Djoehaeni, 2022; WHO, 2022).

Recent evidence suggests that immunization is a successful and cost-effective method of protecting individuals from infectious diseases. According to WHO, immunization prevents at least 3 million deaths of children every year (European Centre for Disease Prevention and Control, 2022; Mhatre & Schryer-Roy, 2009; UNICEF, 2018). Vaccination reduced measles mortality by 84% between 2000 and 2016, while pertussis mortality reduced from 390,000 in 1999 to 160,700 deaths in 2014 (Mhatre & Schryer-Roy, 2009). The Expanded Program on Immunization (EPI) mandates every child in Africa to receive specific vaccines at specific ages (Mhatre & Schryer-Roy, 2009). To improve immunization coverage, Nigeria adopted the Reaching Every Word (REW) strategy in 2005 (Akwataghibe et al., 2019). However, previous studies identified cultural barriers in Sokoto that may impact immunization success (Mhatre & Schryer-Roy, 2009). It is crucial to routinely monitor immunization status and address issues to ensure adequate immunization in Africa, Nigeria, and Sokoto.

Achieving optimal childhood immunization coverage to control, eliminate, and eradicate vaccine-preventable diseases is an important goal of immunization. However, the Global Vaccine Action Plan (GVAP) 2011-2020 highlighted that inadequate vaccine supply, access barriers, and low demand are common obstacles to immunization at various levels. Immunization coverage gaps persist between high and low-income nations worldwide, with Africa having the lowest coverage of the DTP3 vaccine for infants under one year (Abad et al., 2017; Nieburg & Mclaren, 2011; Rodrigues & Plotkin, 2020; Stanford Medicine Children's Health, 2021). Although Nigeria aims to achieve GVAP goals of over 90% coverage of all vaccines across all country districts, it still reports circulating derived poliovirus and high under-five mortality rates. Nearly one in four deaths could be avoided if children received recommended immunization. Unfortunately, DTP3 coverage in Nigeria declined from 38% in 2013 to 33% in 2016, indicating a need for urgent action (Abad et al., 2017; Ghosh et al., 2021).

Immunization is widely acknowledged as a highly cost-effective health intervention that significantly reduces under-five mortality rates (Keats et al., 2018; Lassi et al., 2010). However, despite efforts to increase global immunization coverage, there were 19.4 million unvaccinated children globally in 2015, with Nigeria having the highest number of unvaccinated children. Nigeria, the most densely populated country in Africa with an annual population growth of 2.83%, also has the second-highest under-five mortality rate in the world. Shockingly, reports from 2013 showed that only 5% of children aged 12-23 months in Nigeria had completed routine immunization, with the northwest zonal region of the country reporting the lowest coverage at 10%. Researchers have attributed the poor immunization coverage in Nigeria to a range of factors, including mistrust by socio-political factors, weak health systems, poor health behavior of clients, and conflicts in programs (Akwataghibe et al., 2019). In particular, the north-western state of Sokoto has consistently reported low DTP3 coverage, with just 3% coverage reported in 2016, despite concerted efforts by stakeholders. Issues such as rumors, lack of trust, and poor health systems have been identified as reasons for the poor immunization coverage in the state (Abad et al., 2017).

Social sociodemographic factors influence immunization, which is classified into five levels: intrapersonal, interpersonal, institutional, community, and public policies (Hu et al., 2021). These levels interact with individuals and children, affecting their vaccination tendency. As for Sokoto state, genetics, sex, age, health status, eating behavior, family home, parents' wealth, school, peers, working status, and social care can impact health and immunization. Additionally, culture and religion play a role in shaping people's behavior. However, challenges in the education sector have been reported in Sokoto state, which can influence immunization rates (Hiliya et al., 2022; Madubu, 2021; Sarkingobir et al., 2022; Simpson, 2015; Umar et al., 2018).

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In order to evaluate issues related to immunization in Sokoto state, Nigeria, various studies were conducted. One study focused on the immunization status of children in rural areas of several local governments within the state. The study revealed that only 7 percent of the children were fully immunized then, with male children receiving more immunizations than female children and inadequate coverage of all necessary vaccines. It indicates poor nutrition and immunization services in rural areas of Sokoto state (Okolo et al., 2003). Another study conducted at Usmanu Danfodiyo University Teaching Hospital Sokoto examined parents' knowledge, attitudes, and practices toward immunizing their children for protection against preventable diseases. Most respondents had positive attitudes and practices, but problems were identified, such as husbands' hesitancy and lack of education (Awosan et al., 2018).

Several studies conducted in Sokoto have revealed various factors contributing to low immunization coverage among children in the state. The first study emphasized the effectiveness of utilizing traditional barbers to refer mothers to immunization facilities and the need for continuous awareness creation among the selected barbers (Dougherty et al., 2020). The second study found that the low immunization coverage was due to several factors, including the lack of stability of mothers/caregivers to take children for immunization, poor awareness about immunization, and the shortage of materials at health centers (Tijjani, 2020). Lastly, a recent study showed that many parents refused vaccination for their under-five children due to insufficient knowledge about immunization suitability and spreading rumors about vaccine effects (Isezuo & Adamu, 2022). These studies highlight the importance of educating caregivers and increasing awareness to increase vaccination coverage in Sokoto.

Several studies have been conducted in Nigeria to explore various aspects of public health. One such study in Sokoto state found that most adults were willing to take the COVID-19 vaccine (Oche et al., 2022). Another study conducted in several states of Northern Nigeria, including Zamfara, revealed low vaccination rates due to a shortage of vaccination materials (Ibraheem et al., 2022). A study on food security and nutrition in a rural area found that a quarter of under-five children were acutely malnourished (A. Kaoje et al., 2019). Lastly, a study on primary health care in Sokoto state identified resources and services that could improve maternal and childcare coverage (A. U. Kaoje et al., 2018).

Numerous studies have focused on Sokoto city and hospitals, showing poor immunization uptake, compliance, trust, and resources. The healthcare system in Sokoto state is inadequate, and malnutrition is a prevalent issue. As a result, children in the state are at risk of poor immunity due to malnutrition, poor immunization, and poor health care. It is crucial to reevaluate the situation in rural areas, as they are more vulnerable to such issues. Thus, a better understanding of the situation is needed to improve development. This study aimed to evaluate the immunization status of children in a rural suburb of Sokoto state.

2. Methods

2. 1. Research setting

Located on the West Coast of Africa, Nigeria spans 5º North Equator and between 3º and 4º East of the Greenwich Meridian. The study was conducted in Sokoto, a state in Nigeria with a federal system of government consisting of thirty-six (36) states, the Federal Capital Territory (FCT) being Abuja. The Sokoto state borders the Niger Republic to the North and Kebbi state to the southwest and is home to the Sultan of Sokoto, a Nigerian Muslim leader. The state encompasses a land area of about 32,000 Sqkm, comprising twenty-three (23) local government areas, including Sokoto North, Sokoto South, Wamakko, and Dange-Shuni. According to the 2006 Census, the state has a total population of 4,427,760. Kware houses the federal Neuro-Psychiatric Hospital, while the UDUTHS is the only teaching hospital affiliated with the Usmanu Danfodiyo University. There are also two women's and children's hospitals, several private hospitals, one specialist hospital, and one orthopedic hospital in the state (Nasiru, 2015).

2. 2. Research design

The research design for this study is a descriptive observational survey concerned with the collection and interpretation of data regarding the status of immunization in Sokoto suburb at a given point and

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given time, primarily based on qualitative data, which entails thoughts, ideas, beliefs, and suggestions of subjects of this work.

2. 3. The population of the study

In academic studies, the population typically refers to all members or elements of a group that can be generalized for the research findings. These individuals are the direct beneficiaries of the investigation, and the scope of the research is often extensive, making direct examination challenging. For instance, in the Sokoto suburb, the study population includes opinion/community leaders, community members, healthcare providers, and all individuals in the study area. Most of the population is Hausa/Fulani, Muslim, and comprises farmers, business people, and literate individuals, with healthcare facilities nearby. In order to address the research problem, the study will manipulate variables from this population (Sarkingobir et al., 2019).

2. 4. Sampling and sample size

The facts are that the population of the study is substantial. The researcher is obliged to select some subjects to represent the whole population of the study. The persons/ health facilities selected from the larger population to serve as representatives are the sample drawn through sampling. The method used to choose a sample for this study was cluster sampling by dividing the population into clusters of community leaders, health workers, household heads, and mothers (Nasiru, 2015). The sample size was obtained using a formula reported by (Oche et al., 2011). Hence, the sample size was 300 gotten, from 161 + 139 (to compensate for non-response and attrition).

$$n = \frac{\{u\sqrt{[\pi_1(1-\pi_1) + \pi_2(1-\pi_2)]} + v\sqrt{[2\pi(1-\pi)]}\}^2}{(\pi_2 - \pi_1)^2}$$

Where $\pi = \pi_1 + \pi_{2/2}$.
U = One sided percentage point of normal distribution corresponding to 100% (power). Here power = 90%, u = 1.28.
v = Percentage point of the normal distribution corresponding to the two sided significance level = 50%, v = 1.96.
π_1 = Proportion of value (DPT3 coverage) to be determined = 30% in a previous reports (Akande, 1996; NDHS, 2009).
π_2 = Proportion of value to be determined post-intervention = 15%, n= 161.

Figure 1: Formula for sample size, Source: (Oche et al., 2011)

2. 5. Data collection instrument and validation

An interview-administered questionnaire was utilized as the instrument for data collection. The questionnaire contained questions to uncover the respondents' thoughts, beliefs, and ideas regarding immunization status in the study area. This approach was deemed effective as it allowed for a larger sample size. Specifically, the questionnaire sought to gather information on the socioeconomic characteristics of the respondents, evaluate their knowledge of childhood immunization services, identify factors that influence immunization services, and explore ways to improve the uptake of immunization services. To ensure the quality of the questionnaire, experts scrutinized it, and a pretest method was also conducted.

2. 6. Techniques of data analysis

Tables with numbered entries were used in this study to display the results of the collected data analysis and present the frequency analysis outcome. Specifically, the data were analyzed using simple frequencies and percentages. Specifically, the tables displayed the results of the frequency count analysis. Then afterward, a discussion of the same tables follows. The researcher argues the results in the discussion by supplying the reasons for positivity, negativity, indifference, and the likes wherever necessary.

3. Result

This study aimed to evaluate the immunization status of children in a rural suburb of Sokoto state. The results of this study are shown in tables 1-4. The respondents' demographic characteristics were significant, with an X^2 value of 620.000 at $p<0.05$. Table 1 illustrates that the majority of the respondents were males (66.7%), with a significant proportion being females (33.3%), and all falling within the age

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range of 26-35 (100.0%). Furthermore, most of the subjects were married (66.7%), while the rest were single (33.3%), and their occupations included civil servants (33.3%), farmers (33.3%), and business people (33.3%). Additionally, 66.7% of the subjects had tertiary education, 16.7% had secondary education, and 16.7% had primary education. These findings differ from those of Oche et al. (2011), whose control respondents lacked western education and were predominantly full-time homemakers. This divergence may be attributed to the more significant efforts made by governments and traditional rulers, which could account for the noticeable improvements seen in this study.

Table 1. Sociodemographic characteristics of respondents

Parameter	Frequency	Percentage	X^2
Sex			620.000
Male	200	66.7	
Female	100	33.3	
Age			
26-35 years	300	100	
18-15 years	0	0.0	
Marital status			
Married	200	66.7	
Single	100	33.3	
Occupation			
Civil servant	100	33.3	
Trader	100	33.3	
Farmers	100	33.3	
Level of education			
Tertiary	200	66.7	
Secondary	50	16.7	
Primary	50	16.7	

Table 2. Showing knowledge of immunization of the respondents

Parameter	Frequency	Percentage	X^2
Are you aware of immunization?			3333.333
Yes	300	100.0	
No	0	0.0	
Source of immunization information			
Friends	200	66.7	
Health worker	100	33.3	
Vaccines enumerated by respondents			1620.000
Polio	30	10.0	
Pentavalent	30	10.0	
Hep	30	10.0	
TT	30	10.0	
Rota	30	10.0	
Dpt	30	10.0	
Measles vaccine	30	10.0	
BCG	30	10.0	
Meningitis	30	10.0	
Yellow fever	30	10.0	
Expected age of immunizations			
Nine months	300	100.0	
Use of immunization			
To prevent diseases	300	100.0	

The knowledge of immunization among the study subjects in the Sokoto suburb is presented in Table 2. The results indicate that all of the respondents (100.0%) were aware of immunization, with most of them (66.7%) learning about it from friends and some (33.3%) from healthcare workers. Additionally, the respondents could correctly name some immunization vaccines and recognize the appropriate time to start immunization after nine months. The respondents also viewed immunization as a preventive method to ward off diseases. These findings are consistent with those of (Oche et al., 2011),

which reported that mothers in Kware, Sokoto state, had sufficient knowledge of childhood immunization. Interestingly, the study by (Akwataghibe et al., 2019) in Ogun state found that even healthcare providers had inadequate knowledge of immunization schedules, in contrast to the results of the present study. The current study highlights the excellent knowledge of immunization among the respondents and aligns with the recommended time for immunization, as reported by Goodman (WHO, 2022) and the American Academy of Pediatrics (2022).

The study found a significant X^2 value of 620.000 at $p<0.05$, indicating that the results are statistically significant. According to Table 3, all study subjects reported that they had vaccinated their children (100.0%) and possessed vaccination cards (100.0%). The factors affecting immunization were identified as socioeconomic (33.3%), belief (26.7%), geographic barriers (16.6%), and awareness (16.7%). The coverage of DPT1/DPT3 was reported to be 85% in the area, indicating a good immunization practice among the respondents. However, a nearby study conducted by Oche et al. (2011) reported low immunization levels, possibly due to differences in knowledge levels, as the former demonstrated good knowledge while the latter reported poor knowledge. Other studies by (Akwataghibe et al., 2019) in Ogun state and (Abad et al., 2017) in Sokoto identified similar factors as barriers to immunization, including community, facility, and administration factors (Mhatre & Schryer-Roy, 2009). In a review study, also mentioned belief and geography as factors affecting immunization. The leading indicator of immunization, DPT1/DPT3, showed good coverage and status, contrasting with the findings of a previous study (Oche et al., 2011).

Table 3. The practice of immunization among respondents

Parameter	Frequency	Percentage	X^2
Have you ever vaccinated your child?			745.333
Yes	300	100.0	
Are you in possession of a vaccination card?			
Yes	300	100.0	
What are the factors influencing immunization?			
Health services factors	100	33.3	
Socioeconomic	20	6.6	
Geographical barriers	50	16.7	
Belief	80	26.7	
Awareness	50	16.7	
% coverage of DPT1/DPT3 85%	300	100.0	

4. Discussion

Immunization has been identified as a cost-effective strategy to reduce under-five mortality, particularly among children (Madubu, 2021; WHO, 2022). In Nigeria, where the Northwest zone has reported high levels of inequality due to various factors such as medical mistrust and weak health systems, it is necessary to evaluate immunization programs periodically to make necessary adjustments (Akwataghibe et al., 2019; Ghosh et al., 2021). This study has identified several sociodemographic and socioeconomic factors that can influence immunization uptake, such as knowledge and education, which have shown positive impacts and can be modified to make significant progress (Akwataghibe et al., 2019; Oche et al., 2011). Madubu's study (2021) in Sokoto specifically found that parents' education level and family wealth positively influence children's immunization status. Therefore, it is recommended to prioritize reaching out to families with low levels of education to enhance the uptake of immunization and prevent death and injuries due to preventable diseases among children (Madubu, 2021).

Bronfenbrenner's Social Ecological Model/Theory has been developed to explain the impact of sociodemographic status on individuals, particularly children. This model highlights five layers that affect a child's health, starting with the child itself. Positive health behaviors and genetics can significantly impact a child's overall health when interacting with other layers. However, children with genetic disorders or diseases that cause nutritional defects may have weak immunity and poor health (Lyons et al., 2015). The next layer that influences a child's health is the microsystem, including the family, health services, and school (Berry et al., 2019). Parents with good knowledge and awareness about health and immunization can help ensure their child's health (Hansen et al., 2021). Parents'

occupation also affects their ability to provide medical care and support their child's health. The availability of health services in the community can also positively impact families with educated parents who are more likely to take advantage of health facility vaccination campaigns (Madubu, 2021; Simpson, 2015).

The results of this study indicate that individuals possess adequate knowledge and practice of immunization, which can be attributed to their level of education, occupation, and overall awareness (Ghosh et al., 2021). The respondents noted that their awareness of immunization was mainly due to the efforts of friends and health services. These factors have proven effective in improving immunization rates, even in rural areas. Moreover, respondents highlighted various facilitators of immunization, such as socioeconomic, belief, geographic barriers, and awareness. High socioeconomic status can lead to increased immunization rates, while awareness also significantly improves immunization rates (Mhatre & Schryer-Roy, 2009). Previous studies identified geographical barriers that impede immunization (Akwataghibe et al., 2019; Mhatre & Schryer-Roy, 2009). Overall, the positive outcomes of this study have led to an 85% DPT1/DPT3 immunization status.

Immunization is an essential public health measure that benefits children, individuals, communities, and society. Despite its importance, immunization uptake has not been fully implemented, resulting in outbreaks of vaccine-preventable infections in various regions, even in developed nations worldwide. According to MacDonald et al.(2018) and Rodrigues and Plotkin (2020), these outbreaks occur due to the different immunization gaps influenced by the environment and culture of the area. To address this issue, stakeholders need to assess the immunization status in rural suburbs of Sokoto state, Nigeria, to identify specific features related to the area and provide valuable data for action. This data can also serve as a basis for research by scholars and students and support the advocacy for more health education among the populace.

The findings of this study reveal that a rural suburb in Sokoto has a population with good sociodemographic characteristics associated with better knowledge and practice of childhood immunization, resulting in a high coverage rate of 85%. This success can be attributed to the efforts made by the government and other stakeholders to improve immunization uptake in Sokoto, which is a significant improvement compared to past studies that showed poor immunization status, knowledge, attitude, and practice. According to Awosan et al. (2018), previous studies indicated that only 7% of children in rural areas received full immunization, and the coverage of all vaccines was poor, with more males being immunized than females. Okolo et al. (2003) also reported low nutrition status in the same population. However, a more recent study by Awosan et al. (2018) found that most respondents had a positive attitude and practice toward immunization, with the main challenges being husbands' hesitancy and lack of education. Nevertheless, vaccination hesitancy among parents in Sokoto remains a problem, with 37.0% avoiding vaccination due to insufficient knowledge and rumors of vaccine effects (Abdalla et al., 2022; Isezuo & Adamu, 2022; A. U. Kaoje et al., 2018).

This study is significant as it sheds light on immunization in rural areas, which was largely ignored in past research focusing only on urban areas. The study reveals that immunization rates are reasonable in rural areas of Sokoto, promoting children's health and development and helping alleviate malnutrition. The study also highlights the importance of peer pressure and traditional approaches in promoting immunization and the role of healthcare staff in providing information to parents. These findings provide valuable insights into improving immunization rates in related areas (Abad et al., 2017; Abdulkarim et al., 2011; Dougherty et al., 2020; Isezuo & Adamu, 2022; A. Kaoje et al., 2019; A. U. Kaoje et al., 2018).

5. Conclusion

This study provides evidence of a high immunization status in a rural area of Sokoto state, Nigeria, with good sociodemographic factors that contribute to good immunization knowledge, practice, and status. Peer pressure and healthcare staff are influential stimulating factors for promoting immunization. However, the limitations of this study include a small sample size and a focus on only one rural area in Sokoto state. Therefore, future studies should explore more rural areas in the state to generalize the findings. In addition, efforts should be made to increase immunization coverage and awareness through compelling health talks, religious and traditional leaders, and government initiatives to improve primary healthcare services to rural populations to achieve sustainable development goals.

Declarations

Author contribution statement

Malami Dikko the presented idea. Yusuf Sarkingobir was data taker. Mukhtar Abubakar Abdullahi and Ibrahim Salihu developed the theory of immunization, factors influencing vaccination and early childhood education. Ummu Tukur was the analysis method. All authors discussed the results and contributed to the final manuscript.

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Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declaration of interests statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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