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MOTHERS' ATTITUDES TOWARD CHILDHOOD IMMUNIZATION AGAINST VACCINE-PREVENTABLE DISEASES AMONG MOTHERS IN BAUCHI STATE, NIGERIA

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Abstract: *Immunization is a proven public health intervention for preventing childhood vaccine-preventable diseases through the administration of vaccines. Despite the availability of immunization services, variations in mothers' attitudes toward childhood immunization remain a major challenge to achieving optimal coverage. This study examined mothers' attitudes toward immunization against childhood vaccine-preventable diseases in Bauchi State, Nigeria. The study adopted a descriptive cross-sectional survey design. Four research questions were formulated and four null hypotheses were postulated and tested at the 0.05 level of significance. Quantitative data were collected from 420 mothers using a structured questionnaire titled Attitude toward Immunization against Childhood Vaccine-Preventable Diseases Questionnaire. Data were analyzed using frequency counts, percentages, and mean scores to answer the research questions, while independent samples t-test*

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was used to test the hypotheses. The findings revealed that mothers in Bauchi State generally exhibited negative attitudes toward immunization against childhood vaccine-preventable diseases. The results further showed that there was no significant difference in the mean responses of mothers' attitudes based on age and location. Mothers' attitudes toward immunization were found to be significantly influenced by level of education, while religion showed a statistically significant difference in mothers' attitudes toward childhood immunization (t = 2.648, p = 0.008).Based on the findings, it was recommended that the Bauchi State Primary Health Care Development Agency, in collaboration with the National Primary Health Care Development Agency and relevant donor organizations, should strengthen supplemental immunization activities such as Immunization Plus Days (IPDs), Integrated Medical Outreach Programme (IMOP), Optimized Integrated Routine Immunization Sessions (OIRIS), Routine Immunization Intensification Programme (RIIP), and Periodic Intensification of Routine Immunization (PIRI). Community engagement should be enhanced to promote ownership of immunization programs. Additionally, collaboration with religious leaders, particularly in rural areas, should be intensified to improve vaccine acceptance. Targeted Information, Education, and Communication (IEC) strategies should be developed for Muslim women, rural mothers, and mothers with low educational attainment to support informed decision-making regarding childhood immunization.

Keywords: *Mothers' Attitudes, Childhood Immunization, Vaccine-Preventable, Bauchi State, Nigeria*

Introduction

Childhood immunization remains one of the most effective and cost-efficient public health interventions for preventing infectious diseases, reducing childhood morbidity and mortality, and improving population health. Vaccination protects children against numerous vaccine-preventable diseases (VPDs), including measles, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B, pneumococcal disease, rotavirus diarrhoea, and tuberculosis, thereby contributing substantially to improved child survival and life expectancy (World Health Organization [WHO], 2024; United Nations Children's Fund [UNICEF], 2024). Globally, immunization is estimated to avert approximately 3.5–5 million deaths annually from vaccine-preventable diseases, making it one of the most impactful achievements in modern public health (WHO, 2024).

Despite remarkable progress in vaccine development and immunization programmes, millions of children worldwide continue to miss essential vaccines.

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According to the WHO and UNICEF Estimates of National Immunization Coverage (WUENIC), approximately 14.5 million children were classified as "zero-dose" in 2023, having not received even the first dose of the diphtheria tetanus pertussis (DTP) vaccine. Additionally, millions more failed to complete the recommended immunization schedule, thereby increasing their susceptibility to preventable infectious diseases and outbreaks (WHO & UNICEF, 2024). These gaps in immunization coverage threaten global efforts toward achieving the Sustainable Development Goals (SDGs), particularly Goal 3, which seeks to ensure healthy lives and promote well-being for all at all ages (United Nations, 2023).

Sub-Saharan Africa continues to experience a disproportionately high burden of vaccine-preventable diseases due to inequitable access to healthcare services, weak health systems, socioeconomic disparities, vaccine hesitancy, misinformation, and inadequate routine immunization coverage (WHO Regional Office for Africa, 2024). Recent outbreaks of measles, yellow fever, circulating vaccine-derived poliovirus, and diphtheria across several African countries further underscore the persistent challenges in achieving optimal immunization coverage despite the availability of effective vaccines (Africa Centres for Disease Control and Prevention [Africa CDC], 2024).

Nigeria bears one of the largest burdens of under-immunized and zero-dose children globally. Although the country has implemented several national immunization initiatives through the National Primary Health Care Development Agency (NPHCDA), substantial disparities in vaccine coverage persist across geographical regions, socioeconomic groups, and educational levels. Data from the Nigeria Demographic and Health Survey (NDHS) 2023–2024 indicate that full basic vaccination coverage among children aged 12–23 months remains below the level required to achieve herd immunity in many parts of the country, particularly in northern Nigeria where routine immunization uptake remains considerably lower than the national average (National Population Commission [NPC] & ICF, 2024). These disparities continue to contribute to recurrent outbreaks of vaccine-preventable diseases, including measles, diphtheria, and yellow fever (NCDC, 2024).

Numerous studies have demonstrated that childhood immunization uptake is influenced not only by the availability of vaccines but also by parental knowledge, attitudes, beliefs, perceptions, and confidence in vaccination programmes (Larson et al., 2022; UNICEF, 2023). Mothers, who are often the primary caregivers and decision-makers regarding child health in many low- and middle-income countries, play a pivotal role in determining whether children receive recommended vaccines according to the national immunization schedule. Positive maternal attitudes have consistently been associated with improved vaccine acceptance and completion of childhood immunization schedules, whereas misconceptions, fear of adverse events

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following immunization, religious beliefs, cultural norms, misinformation, and limited trust in health systems contribute to delayed or incomplete vaccination (WHO, 2024; Larson et al., 2022).

In Bauchi State, located in northeastern Nigeria, childhood immunization coverage remains suboptimal compared with national targets. The state has experienced repeated outbreaks of vaccine-preventable diseases including measles, diphtheria, and yellow fever, reflecting persistent immunity gaps among vulnerable populations (NCDC, 2024; WHO Regional Office for Africa, 2024). While several interventions have focused on improving vaccine supply, outreach services, and health education, relatively limited empirical evidence exists regarding mothers' attitudes toward childhood immunization and the socio-demographic factors influencing these attitudes within the state. Understanding these behavioural determinants is essential for designing context-specific interventions capable of improving vaccine acceptance and increasing routine immunization coverage.

Given the continued burden of vaccine-preventable diseases and the critical influence of maternal attitudes on childhood vaccination decisions, this study aims to assess mothers' attitudes toward childhood immunization against vaccine-preventable diseases in Bauchi State, Nigeria. The findings are expected to provide evidence that will support policymakers, public health practitioners, and immunization programme managers in developing targeted behavioural and educational interventions to improve routine immunization uptake, reduce vaccine hesitancy, and strengthen child health outcomes in the state.

History and Development of Immunization

The history of immunization represents one of the greatest achievements in medicine and public health, spanning centuries of scientific discovery and innovation in disease prevention. The earliest documented attempts to prevent infectious diseases were through variolation, a practice involving deliberate exposure of healthy individuals to material obtained from smallpox lesions. Historical evidence suggests that variolation was practiced in China, India, the Middle East, and parts of Africa several centuries before the development of modern vaccines. Although the procedure carried significant risks, including severe infection and disease transmission, it demonstrated that deliberate exposure to infectious material could induce protection against future infections, thereby laying the scientific foundation for modern vaccination (World Health Organization [WHO], 2024; Montero et al., 2024).

A major milestone in the development of immunization occurred in 1796, when the English physician Edward Jenner demonstrated that inoculation with cowpox protected against smallpox. Jenner vaccinated an eight-year-old boy, James Phipps,

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using material from cowpox lesions and subsequently demonstrated immunity to smallpox. This landmark experiment introduced the concept of vaccination, a term derived from the Latin word *vacca* (cow), and marked the beginning of modern immunology and preventive medicine (WHO, 2024; Plotkin et al., 2024).

The nineteenth century witnessed remarkable advances in microbiology and immunology that accelerated vaccine development. Louis Pasteur established the germ theory of disease and pioneered microbial attenuation techniques, leading to the successful development of vaccines against chicken cholera, anthrax, and rabies. Around the same period, Robert Koch identified several important bacterial pathogens, while Emil von Behring and Shibasaburo Kitasato demonstrated the protective role of antitoxins against diphtheria and tetanus. These discoveries significantly advanced scientific understanding of host immunity and established the immunological principles that underpin modern vaccinology (Montero et al., 2024; Pollard & Bijker, 2021).

During the twentieth century, vaccine development expanded rapidly with the introduction of vaccines against tuberculosis, diphtheria, tetanus, pertussis, poliomyelitis, measles, mumps, rubella, hepatitis B, and Haemophilus influenzae type b. One of the most significant milestones was the establishment of the World Health Organization's Expanded Programme on Immunization (EPI) in 1974, which aimed to ensure universal access to essential childhood vaccines. The programme initially targeted six vaccine-preventable diseases but has since expanded to include additional life-saving vaccines, contributing substantially to reductions in childhood morbidity and mortality worldwide (WHO, 2024; Lindstrand et al., 2021).

The effectiveness of vaccination programmes was demonstrated by the successful global eradication of smallpox in 1980, making it the first human infectious disease to be eradicated through coordinated international vaccination efforts. Since then, remarkable progress has been achieved in reducing the global burden of poliomyelitis, neonatal tetanus, measles, and several other vaccine-preventable diseases. Continued advances in biotechnology have facilitated the development of recombinant vaccines, conjugate vaccines, viral-vector vaccines, and, more recently, messenger RNA (mRNA) vaccines, which played a pivotal role in controlling the Coronavirus Disease 2019 (COVID-19) pandemic (Montero et al., 2024; WHO, 2025).

Recent global immunization efforts have been guided by the Immunization Agenda 2030 (IA2030), a comprehensive strategy developed by the World Health Organization and its partners to ensure equitable access to vaccines throughout the life course. Despite significant scientific progress, numerous challenges including vaccine hesitancy, misinformation, armed conflicts, fragile health systems, and disruptions associated with the COVID-19 pandemic continue to hinder routine immunization programmes, particularly in low and middle-income countries. Nevertheless,

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vaccination remains one of the most cost-effective public health interventions, preventing an estimated 3.5–5 million deaths annually and contributing substantially to improvements in global life expectancy and child survival (WHO, 2024; WHO & UNICEF, 2024; Gavi, 2024).

The continued evolution of vaccinology, supported by advances in molecular epidemiology, genomic surveillance, vaccine safety monitoring, and implementation science, has strengthened disease prevention and outbreak control worldwide. Understanding the historical development of immunization provides important context for appreciating the success of contemporary vaccination programmes while emphasizing the need to sustain high vaccine coverage and public confidence in immunization to prevent the resurgence of vaccine-preventable diseases (Montero et al., 2024; Pollard & Bijker, 2021; WHO, 2024).

Statement of the Problem

Childhood immunization is universally recognized as one of the most effective and cost-efficient public health interventions for preventing morbidity, disability, and mortality associated with vaccine-preventable diseases (VPDs). Over the past five decades, routine immunization programmes have contributed substantially to reductions in childhood deaths and have played a pivotal role in controlling diseases such as measles, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B, and rotavirus infections. High vaccination coverage not only protects vaccinated individuals but also contributes to herd immunity, thereby reducing disease transmission within communities and strengthening health systems (World Health Organization [WHO], 2025; UNICEF, 2024; Gavi, 2024).

Despite these achievements, inadequate immunization coverage remains a major global public health challenge. According to the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), approximately 14.5 million children worldwide did not receive even the first dose of the diphtheria–tetanus–pertussis (DTP1) vaccine in 2023, classifying them as "zero-dose" children. Millions of additional children failed to complete the recommended immunization schedule, leaving them vulnerable to vaccine-preventable diseases and contributing to recurrent outbreaks of measles, diphtheria, poliomyelitis, and yellow fever in several countries (WHO & UNICEF, 2024; WHO, 2025). These gaps in vaccine coverage threaten progress toward achieving the Immunization Agenda 2030 (IA2030) and the Sustainable Development Goals, particularly Goal 3, which aims to ensure healthy lives and promote well-being for all (United Nations, 2023).

The burden of under-immunization is particularly severe in sub-Saharan Africa, where fragile health systems, socioeconomic inequalities, armed conflicts,

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inadequate healthcare infrastructure, vaccine misinformation, and geographical barriers continue to limit equitable access to routine immunization services. Consequently, the African Region continues to account for a disproportionate share of global vaccine-preventable disease outbreaks, including measles, circulating vaccine-derived poliovirus, diphtheria, and yellow fever (WHO Regional Office for Africa, 2024; Africa Centres for Disease Control and Prevention [Africa CDC], 2024). These recurring outbreaks underscore the need for sustained efforts to improve vaccine acceptance and utilization across the continent.

Nigeria remains one of the countries with the largest population of zero-dose and under-immunized children globally. Although the Federal Government, through the National Primary Health Care Development Agency (NPHCDA) and development partners, has implemented several strategies to strengthen routine immunization services, national vaccination coverage remains below the level required to achieve optimal population immunity. The Nigeria Demographic and Health Survey (NDHS) 2023–2024 reported considerable disparities in childhood immunization coverage across regions, with children residing in northern Nigeria consistently recording lower vaccination rates than those in southern regions. These disparities continue to contribute to recurring outbreaks of measles, diphtheria, yellow fever, and circulating vaccine-derived poliovirus, posing a significant threat to child survival and public health (National Population Commission [NPC] & ICF, 2024; Nigeria Centre for

Disease Control and Prevention [NCDC], 2024; WHO, 2025).

Evidence suggests that inadequate immunization coverage is not solely attributable to vaccine availability but is also influenced by behavioural, social, cultural, and health-system factors. Among these, maternal attitudes toward childhood immunization have consistently been identified as one of the strongest determinants of vaccine acceptance and completion of routine immunization schedules. Mothers who possess positive attitudes and confidence in vaccine safety and effectiveness are more likely to ensure that their children receive vaccines according to the recommended schedule. Conversely, misconceptions, fear of adverse events following immunization, misinformation disseminated through social media, religious and cultural beliefs, low educational attainment, poor access to reliable health information, and limited trust in healthcare providers have been associated with vaccine hesitancy and incomplete childhood immunization (Larson et al., 2022; UNICEF, 2023; WHO, 2024).

Bauchi State, located in northeastern Nigeria, continues to experience suboptimal routine immunization coverage and periodic outbreaks of vaccine-preventable diseases. Recent surveillance reports have documented outbreaks of measles, diphtheria, yellow fever, and circulating vaccine-derived poliovirus in several northern Nigerian states, including Bauchi, reflecting persistent immunity gaps among vulnerable populations (NCDC, 2024; WHO Regional Office for Africa,

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2024). Although several governmental and partner-supported interventions have focused on strengthening vaccine delivery systems, improving cold-chain logistics, and expanding community outreach programmes, vaccine uptake remains below national and global targets in many communities within the state (NPHCDA, 2024; Gavi, 2024).

While previous studies conducted in Nigeria have investigated childhood immunization coverage, knowledge, and vaccine uptake, relatively few have comprehensively examined mothers' attitudes toward childhood immunization specifically within Bauchi State using recent evidence. Furthermore, changes in vaccine communication following the COVID-19 pandemic, increasing exposure to misinformation through digital media, and evolving community perceptions necessitate renewed investigation into maternal attitudes toward routine childhood vaccination. Without a clear understanding of these attitudes and the socio-demographic factors influencing them, interventions designed to improve vaccine acceptance and increase routine immunization coverage may not achieve their intended public health impact (Larson et al., 2022; WHO, 2024).

Therefore, this study seeks to assess mothers' attitudes toward childhood immunization against vaccine-preventable diseases in Bauchi State, Nigeria. The findings will provide evidence to inform policymakers, immunization programme managers, and public health practitioners in designing context-specific behavioural interventions aimed at improving vaccine acceptance, increasing routine immunization coverage, reducing vaccine hesitancy, and ultimately decreasing the burden of vaccine-preventable diseases among children in Bauchi State and similar settings.

Objectives of the Study

The general objective of this study is to assess mothers' attitudes toward childhood immunization against vaccine-preventable diseases in Bauchi State, Nigeria. The specific objectives of the study are to:

1. examine mothers' attitudes toward immunization against childhood vaccine-preventable diseases in Bauchi State, Nigeria; and
2. identify socio-demographic factors influencing mothers' attitudes, of childhood immunization against vaccine-preventable diseases.

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Research Questions

The following research questions will guide the study:

1. What are mothers' attitudes toward immunization against childhood vaccine-preventable diseases in Bauchi State, Nigeria?
2. What socio-demographic factors influence mothers' knowledge, attitudes, and practices of childhood immunization against vaccine-preventable diseases?

Research Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance:

H_{01}: There is no statistically significant difference in mothers' attitudes toward childhood immunization based on maternal age.

H_{02}: There is no statistically significant difference in mothers' attitudes toward childhood immunization based on educational level.

H_{03}: There is no statistically significant difference in mothers' attitudes toward childhood immunization based on place of residence.

H_{04}: There is no statistically significant difference in mothers' attitudes toward childhood immunization based on religion.

Empirical Literature Review

Mothers' Attitudes toward Childhood Immunization

Mothers' attitudes toward childhood immunization constitute an important behavioural determinant of vaccine acceptance, timely vaccination, and completion of recommended childhood immunization schedules. Maternal attitude refers to a mother's beliefs, feelings, perceptions, level of confidence, and overall disposition toward the safety, effectiveness, necessity, and benefits of vaccines. Although the availability of vaccines and access to immunization services are essential for improving coverage, the willingness of mothers to accept vaccination and adhere to recommended schedules is also strongly influenced by how they perceive vaccines and the institutions responsible for delivering them. Recent public health research has therefore increasingly emphasized that childhood immunization is shaped by an interaction between individual beliefs, family and community influences, access to health information, trust in health workers, and broader health-system conditions

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(World Health Organization [WHO], 2023, 2024; United Nations Children's Fund [UNICEF], 2023; Cagnotta et al., 2025).

Recent studies conducted in different settings have generally shown that many mothers hold favourable attitudes toward childhood immunization and recognize vaccination as an important strategy for protecting children against vaccine-preventable diseases. Positive maternal attitudes are commonly expressed through agreement that vaccines are beneficial, confidence that immunization protects children from serious illnesses, willingness to complete the recommended vaccination schedule, and readiness to recommend vaccination to other parents. For example, Ndaki et al. (2024) reported that a majority of mothers demonstrated positive attitudes toward childhood immunization, with many respondents recognizing the importance of completing the vaccination schedule and acknowledging the role of vaccination in maintaining child health. Similarly, Sinuraya et al. (2022) found that positive parental attitudes were associated with favourable immunization practices during the COVID-19 pandemic, although the pandemic created additional concerns regarding access to health facilities and exposure to infection. These findings suggest that positive attitudes can support continued utilization of routine immunization services even during periods of public health disruption (Ndaki et al., 2024; Sinuraya et al., 2022).

Evidence from Nigeria also indicates that maternal attitudes toward routine childhood immunization are often generally positive but may not always result in complete and timely vaccination. Adedire et al. (2021) reported that maternal knowledge, attitudes, and perceptions were important factors influencing participation in routine childhood immunization programmes in southwestern Nigeria. The findings suggested that mothers who understood the benefits of vaccination and expressed confidence in immunization services were more likely to support routine childhood vaccination. Similarly, Ariyibi et al. (2023) found that maternal knowledge and selected socio-demographic characteristics were associated with childhood vaccination status in North-Central Nigeria. Although knowledge and attitude are distinct constructs, adequate knowledge may contribute to favourable attitudes by improving mothers' understanding of vaccine benefits, recommended schedules, and the consequences of missed vaccination (Adedire et al., 2021; Ariyibi et al., 2023).

However, positive attitudes do not necessarily translate into complete immunization uptake. Recent evidence indicates that mothers may support childhood vaccination in principle but still experience practical, social, or health-system barriers that delay or prevent completion of the recommended schedule. Such barriers include long distances to immunization centres, transportation costs, inconvenient clinic hours, long waiting times, vaccine stock-outs, competing household responsibilities, and limited access to accurate information. Consequently, favourable attitudes should

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not be interpreted as evidence that all children are fully immunized. The relationship between maternal attitudes and immunization behaviour is mediated by access to services and the ability of mothers to act on their intentions (WHO, 2023; UNICEF, 2023; Adesina et al., 2023).

A growing body of evidence has also identified vaccine confidence as a central component of maternal attitudes. Vaccine confidence encompasses trust in the safety and effectiveness of vaccines, confidence in the competence and integrity of healthcare providers, and trust in the institutions responsible for vaccine development, regulation, and delivery. Mothers who trust healthcare workers and believe that vaccines are safe and effective are generally more likely to accept recommended childhood vaccines and complete immunization schedules. Conversely, reduced trust may contribute to vaccine hesitancy, delayed vaccination, selective acceptance of vaccines, or refusal of immunization. Recent reviews have linked parental vaccine hesitancy to misinformation, concerns about adverse effects, low confidence in healthcare systems, and limited access to credible vaccine information (Brumbaugh et al., 2025; Cagnotta et al., 2025; WHO, 2024).

Concerns regarding vaccine safety remain an important source of negative maternal attitudes. Some mothers may fear that vaccines cause serious adverse effects, weaken children, affect fertility, overload the immune system, or contain harmful substances. Such concerns may be reinforced by misinformation shared through social media, informal community networks, and unverified online sources. The rapid expansion of digital communication has increased access to health information but has also created opportunities for inaccurate vaccine-related messages to spread widely. Recent evidence indicates that misinformation may increase uncertainty and reduce confidence, particularly when mothers lack access to trusted healthcare professionals who can address their concerns respectfully and provide clear, evidence-based explanations (Cagnotta et al., 2025; Brumbaugh et al., 2025; UNICEF, 2023).

The influence of healthcare workers on maternal attitudes has been consistently emphasized in recent public health literature. Healthcare providers are frequently regarded as trusted sources of information and may influence mothers' decisions through health education, counselling, interpersonal communication, and reassurance about vaccine safety. Positive interactions with healthcare workers may strengthen maternal confidence, while poor communication, disrespectful treatment, inadequate counselling, or failure to explain the purpose and possible minor effects of vaccines may contribute to uncertainty and negative attitudes. Maternal satisfaction with vaccination services may therefore influence both confidence in immunization and willingness to return for subsequent doses. Recent evidence has shown that service quality, respectful care, and effective provider communication are important

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components of positive maternal experiences with childhood vaccination programmes (Assimamaw et al., 2024; WHO, 2023; UNICEF, 2023).

Social and cultural influences also shape maternal attitudes toward childhood immunization. Mothers do not make vaccination decisions in isolation; their decisions may be influenced by spouses, grandparents, religious leaders, traditional leaders, friends, and other community members. In some settings, community support and positive social norms encourage vaccination, whereas rumours and negative beliefs may discourage vaccine acceptance. Religious beliefs may influence attitudes when vaccination is interpreted through religious teachings or when community members receive conflicting information from religious authorities. However, religion should not be regarded as an inherently negative influence because faith-based institutions and religious leaders can also promote vaccine acceptance by providing accurate information and supporting public health interventions. The effect of religion is therefore likely to depend on local beliefs, the level of trust in religious leaders, and the messages communicated within communities (Adeyanju & Betsch, 2024; UNICEF, 2023; WHO, 2024).

Recent qualitative evidence from Nigeria has further demonstrated that maternal vaccination decisions are shaped by a combination of individual beliefs, family relationships, community expectations, and experiences with health services. Adeyanju and Betsch (2024) emphasized that vaccination decision-making among Nigerian mothers is not solely based on knowledge of vaccine benefits. Mothers may also consider advice from family members, perceptions of vaccine safety, previous experiences with healthcare services, and the practical challenges involved in attending immunization clinics. This finding supports the view that maternal attitudes are socially and contextually constructed rather than being determined only by individual knowledge. It also suggests that interventions designed to improve maternal attitudes should engage families and communities in addition to providing information directly to mothers (Adeyanju & Betsch, 2024).

Studies from rural and underserved populations have demonstrated that maternal attitudes may be influenced by socioeconomic conditions and access to healthcare services. Adesina et al. (2023) found that maternal age, geographical region, educational attainment, household wealth, and antenatal care attendance were important determinants of childhood immunization completion among rural mothers in Nigeria. These findings indicate that attitudes toward immunization may interact with structural conditions. Mothers who value vaccination may still be unable to complete the recommended schedule because of poverty, distance, transportation difficulties, limited autonomy, or inadequate access to health facilities. Therefore, interventions focused only on changing attitudes may have limited effectiveness if

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barriers to service utilization are not addressed simultaneously (Adesina et al., 2023; WHO, 2023).

The COVID-19 pandemic also influenced maternal attitudes and routine childhood immunization in several settings. Concerns about infection, restrictions on movement, disruptions to health services, and changes in public confidence affected access to routine vaccination. Sinuraya et al. (2022) observed that parental knowledge and attitudes remained important determinants of childhood immunization practices during the pandemic. The experience of the pandemic also increased public discussion about vaccine safety and may have contributed to changes in how parents evaluate health information and assess risks. Although increased public awareness of vaccines may have improved understanding in some communities, exposure to misinformation and conflicting messages may have increased uncertainty among others. These developments highlight the need for continuous and context-specific communication strategies that address emerging concerns while maintaining confidence in routine childhood immunization (Sinuraya et al., 2022; WHO, 2023; UNICEF, 2023).

Across recent studies, maternal attitudes have therefore been shown to range from strongly positive acceptance to varying degrees of uncertainty and vaccine hesitancy. Positive attitudes are commonly associated with confidence in vaccine safety and effectiveness, trust in healthcare workers, adequate knowledge, positive previous experiences, supportive family and community norms, and convenient access to immunization services. In contrast, negative attitudes are frequently associated with fear of adverse effects, misinformation, distrust, poor communication, religious or cultural misconceptions, and barriers to accessing vaccination services (Brumbaugh et al., 2025; Cagnotta et al., 2025; WHO, 2024). The diversity of findings across countries and communities indicates that maternal attitudes are context-dependent and may vary according to social, cultural, economic, and health-system conditions.

Despite the growing body of evidence, important gaps remain in the literature. Many studies have focused primarily on maternal knowledge or childhood vaccination status rather than examining attitudes as an independent behavioural construct. In addition, some studies have combined knowledge, attitude, and practice into a single measure, making it difficult to determine the specific contribution of maternal attitudes to childhood immunization behaviour. The available evidence also varies substantially in the measurement tools, definitions of positive and negative attitudes, study populations, and vaccination outcomes assessed. These methodological differences limit direct comparison between studies and highlight the need for context-specific research using clearly defined and validated measures of maternal attitudes (Lima et al., 2024; Cagnotta et al., 2025).

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Socio-Demographic Determinants of Mothers' Attitudes toward Childhood Immunization

Maternal socio-demographic characteristics are important contextual determinants of childhood immunization because they influence mothers' access to health information, perceptions of vaccine benefits and risks, interaction with health services, and capacity to make and implement vaccination decisions. Recent evidence indicates that maternal education, age, household socioeconomic status, place of residence, religion, marital status, occupation, and family structure can influence immunization behaviour, although their effects vary across populations and settings (Galadima et al., 2021; Bangura et al., 2020; Adesina et al., 2023; WHO, 2024). Importantly, these characteristics should not be interpreted as direct causes of maternal attitudes; rather, they may operate through pathways involving health literacy, autonomy, exposure to information, social networks, household resources, and access to health services.

Maternal Education

Maternal education is among the most consistently reported socio-demographic factors associated with childhood immunization. Education can improve mothers' health literacy, ability to understand vaccination schedules, capacity to evaluate health information, and confidence in communicating with healthcare providers. Evidence from Nigeria demonstrates substantial inequities according to maternal educational attainment. In a recent systematic review and equity analysis, children whose mothers had secondary or higher education had significantly greater odds of receiving basic childhood vaccinations than children of mothers without formal education (AOR = 1.79, 95% CI: 1.39–2.31) (Brown et al., 2024). Similarly, evidence from Ethiopia indicates a graded relationship between maternal education and vaccination completion, with secondary or higher education associated with substantially greater likelihood of completing childhood vaccination compared with no formal education (Ayele et al., 2024).

The relationship between education and maternal attitudes may partly reflect differences in health literacy and decision-making autonomy. Educated mothers may be more likely to seek information from healthcare professionals, understand the consequences of vaccine-preventable diseases, and critically assess misinformation. However, education alone does not guarantee positive attitudes or complete

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vaccination because highly educated mothers may also encounter misinformation or express concerns about vaccine safety. Thus, educational attainment should be understood as an enabling factor rather than a sufficient condition for favourable attitudes toward immunization (Galadima et al., 2021; WHO, 2022).

Maternal Age

Maternal age may also influence attitudes and childhood immunization practices through differences in parenting experience, exposure to health information, and interaction with health services. Evidence from Nigeria indicates that children of older mothers may have higher vaccination coverage than children of adolescent mothers. Brown et al. (2024), for example, reported that children born to mothers aged 35–49 years had more than twice the odds of receiving basic vaccinations compared with children of mothers aged 15–19 years (AOR = 2.25, 95% CI: 1.46–3.49). Similarly, multilevel evidence from East Africa found that children of mothers aged 25–34 and ≥35 years had higher odds of complete basic vaccination than those of younger mothers (Lakew et al., 2021).

However, the relationship between maternal age and vaccination is not necessarily linear. Younger mothers may have fewer experiences with health services or less autonomy in household decision-making, whereas older mothers may possess greater experience navigating maternal and child health services. Conversely, older mothers with several children may face competing household responsibilities that could interfere with timely vaccination. Therefore, maternal age may interact with parity, education, socioeconomic status, and access to healthcare rather than independently determining maternal attitudes.

Household Socioeconomic Status and Income

Household socioeconomic status is another important determinant of immunization inequity. Although vaccines provided through routine public health programmes may be free at the point of delivery, indirect costs such as transportation, lost income, childcare responsibilities, and distance to facilities can affect utilization. Evidence from Nigeria shows a pronounced wealth gradient in childhood vaccination: children from the richest households had more than three times the odds of receiving basic vaccinations compared with children from the poorest households (AOR = 3.21, 95% CI: 2.06–5.00) (Brown et al., 2024). Similar wealth-related inequalities have been reported in Benin and across several African populations, where higher household wealth is associated with better vaccination coverage (Kandala et al., 2023; Tessema et al., 2023).

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Socioeconomic disadvantage can therefore influence maternal attitudes indirectly by shaping mothers' experiences with the health system. A mother who strongly supports immunization may nevertheless perceive vaccination services as inaccessible if transportation is expensive or the nearest facility is distant. Consequently, interventions aimed at improving maternal attitudes should be complemented by strategies that reduce financial and geographical barriers to vaccination.

Place of Residence

Place of residence is another important determinant, particularly in countries where health infrastructure and socioeconomic conditions differ substantially between urban and rural communities. Rural mothers may experience greater geographical barriers, fewer health facilities, transportation difficulties, lower availability of vaccines and vaccinators, and reduced access to reliable health information. A systematic review of African evidence identified residence, distance to health facilities, accessibility of vaccination sites, and transportation as important determinants of childhood immunization (Galadima et al., 2021).

Evidence from Nigeria similarly demonstrates important geographic inequalities. Recent analysis of national data found that children living in the North East and North West had substantially lower full-immunization coverage than children in several southern regions, while maternal education, household wealth, and region remained significant predictors after adjustment (2025). Such findings are particularly relevant to Bauchi State, where geographical and socioeconomic disparities may influence mothers' experiences with routine immunization services.

Marital Status, Occupation and Family Structure

Marital status and maternal occupation may influence immunization indirectly through household decision-making, economic resources, time availability, and social support. Married mothers may benefit from greater household support in some settings, although this does not necessarily translate into favourable vaccination attitudes where partners or extended family members hold conflicting beliefs. Maternal occupation can similarly have contrasting effects: employment may increase financial resources and exposure to health information but may also create time constraints that make attendance at immunization clinics difficult. Recent African evidence indicates that maternal occupation, marital status, family income, number of

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siblings, and household characteristics can contribute to differences in vaccination uptake (Galadima et al., 2021; Tessema et al., 2023).

Religion and Cultural Context

Religion and cultural context can influence mothers' perceptions of vaccination through community norms, trust, interpretation of health messages, and the influence of religious and traditional leaders. Evidence from the Nigerian social-determinants literature identifies religion and ethnicity among the characteristics associated with childhood immunization inequalities (Brown et al., 2024). Nevertheless, the relationship should not be interpreted as implying that a particular religion inherently produces negative vaccination attitudes. Rather, religious affiliation may operate through local leadership, social networks, cultural beliefs, and the type of vaccine-related information available to families. Engagement with trusted religious and community leaders may therefore be an important strategy for strengthening vaccine confidence in communities where such leaders have substantial influence.

Recent evidence indicates that socio-demographic determinants of childhood immunization are interconnected rather than operating independently. Maternal education and household wealth are consistently associated with improved vaccination outcomes, while maternal age, residence, religion, occupation, marital status, and family structure may modify mothers' access to information, resources, autonomy, and health services (Galadima et al., 2021; Brown et al., 2024; Tessema et al., 2023). Importantly, socio-demographic characteristics should not be treated as immutable explanations for poor immunization. They identify populations that may experience different structural opportunities and barriers, thereby helping public health programmes target interventions more equitably.

Vaccine Hesitancy

Vaccine hesitancy is an important behavioural and public health challenge that can undermine the effectiveness of immunization programmes even where vaccines are available and vaccination services are accessible. It broadly refers to delay in acceptance or refusal of recommended vaccines despite availability of vaccination services, and exists on a continuum between complete acceptance and outright refusal (World Health Organization [WHO], 2022; Galadima et al., 2021). Importantly, vaccine hesitancy should be distinguished from vaccine access barriers. Some children remain unvaccinated because of distance, cost, service interruptions, insecurity, or vaccine availability rather than because their parents deliberately reject vaccination. The WHO therefore recommends examining the behavioural and social drivers underlying

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under-vaccination rather than assuming that every unvaccinated child reflects hesitancy (WHO, 2022, 2024).

Recent evidence indicates that vaccine hesitancy is multidimensional and influenced by perceptions of vaccine safety and effectiveness, confidence in healthcare providers and institutions, perceived risk of vaccine-preventable diseases, previous vaccination experiences, social norms, misinformation, and access to credible health information (Galadima et al., 2021; WHO, 2022; UNICEF, 2023). Mothers may therefore hesitate when they perceive vaccination risks to outweigh its benefits, when they have concerns about adverse events, or when they receive conflicting information from healthcare workers, family members, community leaders, social media, or other informal sources. Conversely, trust in health professionals, confidence in vaccine effectiveness, positive previous experiences, and awareness of the consequences of vaccine-preventable diseases can support vaccine acceptance (WHO, 2022; UNICEF, 2023).

The COVID-19 pandemic further complicated the global vaccine-confidence landscape. UNICEF reported that perceptions of the importance of childhood vaccines declined in 52 of 55 countries assessed, although vaccine confidence remained relatively high in many settings. The decline was associated with factors including misinformation, reduced trust in expertise, uncertainty surrounding the pandemic, and political polarization (UNICEF, 2023). These findings are important because attitudes toward COVID-19 vaccination may influence the broader information environment surrounding routine childhood immunization, even though hesitancy toward a COVID-19 vaccine should not automatically be interpreted as hesitancy toward established childhood vaccines.

In Africa, vaccine hesitancy occurs alongside substantial structural barriers to immunization. A systematic review by Galadima et al. (2021) identified factors such as inadequate knowledge, concerns about vaccine safety, mistrust, misinformation, cultural beliefs, distance to health facilities, poor service accessibility, and socioeconomic disadvantage as contributors to childhood immunization gaps. This demonstrates that vaccine hesitancy in African settings should be understood within the broader context of health-system capacity and social inequality rather than solely as an individual mother's refusal to vaccinate (Galadima et al., 2021). Similar evidence indicates that socioeconomic conditions, maternal education, place of residence, and access to healthcare can interact with confidence and motivation to influence vaccination decisions (Bangura et al., 2020; WHO, 2022).

In Nigeria, vaccine hesitancy remains particularly important because the country continues to experience substantial numbers of zero-dose and under-immunized children. Maternal concerns, misinformation, low trust, religious and cultural influences, inadequate communication, and previous negative experiences

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with health services can influence acceptance of routine immunization. However, these demand-side factors coexist with supply-side challenges such as geographical inaccessibility, service disruptions, insecurity, and socioeconomic barriers. Consequently, interventions addressing hesitancy in Nigeria need to combine community engagement and confidence-building with improvements in the accessibility and quality of immunization services (Galadima et al., 2021; WHO, 2022; UNICEF, 2023).

Healthcare workers have a particularly important role in addressing vaccine hesitancy. Mothers commonly depend on health professionals for information concerning vaccine benefits, schedules, contraindications, and possible adverse events. Respectful communication, active listening, clear explanations, and consistent information can strengthen trust and reduce uncertainty, whereas dismissive communication or failure to respond to parental concerns may increase distrust (WHO, 2022, 2024). The WHO Behavioural and Social Drivers framework consequently recommends measuring confidence, social influences, motivation, and practical barriers so that interventions can be tailored to the specific reasons for under-vaccination rather than applying generic educational campaigns (WHO, 2022).

A critical consideration is that vaccine hesitancy is not synonymous with negative maternal attitude. A mother may have a generally positive attitude toward immunization but postpone a child's vaccination because of fear of a particular adverse event, conflicting advice from family members, temporary illness of the child, inconvenient clinic schedules, or difficulties reaching the health facility. Conversely, a mother may express confidence in vaccination but fail to complete the schedule because of structural barriers. Therefore, examining hesitancy alongside socio-demographic characteristics, maternal attitudes, and access-related factors provides a more comprehensive understanding of childhood immunization behaviour (WHO, 2022; Galadima et al., 2021).

Effective strategies should strengthen trust between mothers and healthcare providers, improve the quality of interpersonal communication, engage trusted community and religious leaders, address misinformation, and make immunization services convenient and accessible (WHO, 2022; UNICEF, 2023). For Bauchi State, understanding the extent and determinants of maternal vaccine hesitancy is particularly relevant because interventions must respond to the local social, cultural, socioeconomic, and health-system context. Assessing vaccine hesitancy alongside mothers' attitudes and socio-demographic characteristics can therefore provide useful evidence for designing targeted interventions to improve childhood immunization acceptance and reduce preventable vaccination gaps.

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Nigerian and African Evidence

Evidence from African countries demonstrates that childhood immunization is influenced by a combination of maternal characteristics, vaccine confidence, community perceptions, and health-system factors. A systematic review of 51 studies from Africa identified maternal knowledge, attitudes, self-efficacy, sociodemographic characteristics, accessibility, logistics, and health-service factors as important determinants of childhood immunization uptake (Galadima et al., 2021). Similarly, evidence from Kenya, Malawi, and Ethiopia indicates that vaccine hesitancy is multidimensional, arising from interactions between caregiver concerns, community influences, misinformation, and health-system experiences (Adamu et al., 2021).

Recent evidence further demonstrates that parental vaccine hesitancy remains an important challenge across sub-Saharan Africa. A multicountry study involving 12 sub-Saharan African countries found that parental hesitancy toward routine childhood vaccination was influenced by factors relating to vaccine confidence, perceptions, and social and health-system contexts (Fadl et al., 2024). This supports the broader observation that improving immunization coverage requires interventions that address both demand-side factors, including maternal attitudes and confidence, and supply-side barriers affecting access to services.

In Nigeria, the challenge is particularly important because the country continues to have a substantial population of zero-dose and under-immunized children. A 2024 scoping review identified geographical inequality, limited accessibility, health-system constraints, caregiver-related barriers, and community-level influences as recurring determinants of routine immunization uptake in Nigeria (Ogunniyi, 2024; Obohwemu et al., 2024). The findings emphasize that poor immunization coverage cannot be attributed exclusively to parental unwillingness because structural barriers may prevent willing caregivers from completing vaccination schedules.

Recent Nigerian studies provide further evidence of substantial variation between regions. In Jigawa State, Sabo et al. (2025) identified maternal and household characteristics together with health-service factors as important determinants of routine immunization coverage among under-five children. Similarly, research in Ebonyi State demonstrated that timely and age-appropriate vaccination was associated with maternal education, place of residence, facility delivery, birth order, and travel time to immunization facilities (2025). These findings are particularly relevant to northern Nigeria because they demonstrate that geographic accessibility and socioeconomic circumstances can influence vaccination even where mothers recognize its importance.

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Qualitative evidence from Nigeria also shows that vaccination decisions are shaped by more than individual knowledge. Research involving mothers, community leaders, and healthcare workers identified concerns about vaccine safety, information gaps, service accessibility, community influences, and interactions with healthcare providers as important considerations in childhood immunization (2023). More recently, Adeyanju and Betsch (2024) demonstrated that mothers' vaccination decisions are influenced by their perceptions of vaccine benefits and risks, social relationships, information sources, and experiences with health services.

Evidence concerning vaccine hesitancy in Nigeria further supports the importance of maternal attitudes. Ogbuabor and Chime (2021), studying expectant mothers in Enugu, reported considerable levels of childhood vaccine hesitancy and identified younger maternal age as an important predictor. Although the study population comprised pregnant women rather than mothers of vaccinated children, its findings suggest that attitudes and confidence toward childhood vaccination can develop before the child reaches the routine immunization period.

Contradictory Findings

Although a substantial body of evidence demonstrates that favourable maternal attitudes, adequate knowledge, and confidence in vaccines are associated with improved childhood immunization, findings across studies are not entirely consistent. Differences have been observed in the relationship between maternal characteristics, vaccine hesitancy, perceived vaccine safety, and actual immunization uptake. A systematic review of African evidence found that maternal knowledge and attitude were important determinants of immunization, but also demonstrated that logistical, administrative, socioeconomic, and health-service factors independently influenced vaccination uptake (Galadima et al., 2021). Similarly, evidence from sub-Saharan Africa indicates that barriers to vaccination may arise from both caregiver-related factors and health-system constraints, making it difficult to attribute incomplete vaccination solely to parental attitudes (Bangura et al., 2020).

One important contradiction concerns the relationship between positive attitudes and actual vaccination behaviour. Some mothers may recognize the benefits of immunization and express confidence in vaccines but nevertheless fail to complete their children's vaccination schedules because of distance to health facilities, transportation difficulties, inconvenient clinic schedules, vaccine availability, or competing household responsibilities. Conversely, some caregivers with reservations about vaccination may still accept vaccines when they receive reassurance from

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trusted health workers or when vaccination services are readily accessible (Bangura et al., 2020; Galadima et al., 2021; Obohwemu et al., 2022).

There are also contradictory findings concerning vaccine hesitancy itself. Hesitancy is not a simple pro-vaccine versus anti-vaccine phenomenon; rather, it exists along a continuum ranging from complete acceptance to delayed or selective vaccination and outright refusal (Obohwemu et al., 2022). Consequently, studies using different definitions, measurement instruments, or thresholds may report substantially different estimates of hesitancy even within similar populations. A systematic review of parental vaccine-attitude measures found considerable heterogeneity in the instruments and questions used to assess parental attitudes, highlighting the difficulty of directly comparing findings across studies (Dyda et al., 2020). More recent evidence continues to emphasize the importance of validated and standardized approaches to measuring parental vaccine hesitancy (Cao et al., 2026).

Contradictions have also been reported regarding the influence of socio-demographic characteristics. Maternal education, age, household socioeconomic status, and residence are frequently associated with childhood vaccination, but the direction and magnitude of these relationships vary between settings. In some populations, higher maternal education and household wealth are associated with better immunization uptake, whereas in other contexts these factors have weaker associations after adjustment for access to health services and other determinants (Galadima et al., 2021; Obohwemu et al., 2022). This suggests that socio-demographic characteristics may operate indirectly through health literacy, autonomy, information exposure, social networks, and accessibility rather than functioning as independent determinants in every population.

Evidence from Nigeria further illustrates these inconsistencies. Qualitative research among Nigerian mothers indicates that vaccination decisions are shaped by perceived benefits and risks, information sources, interpersonal relationships, and experiences with healthcare providers (Adeyanju & Betsch, 2024). However, recent research in high zero-dose-burden communities in Kano and Lagos demonstrates that immunization barriers also include service accessibility and other structural factors, reinforcing the argument that low vaccination coverage should not automatically be interpreted as evidence of negative maternal attitudes (Bolarinwa et al., 2025).

The contradictory findings in the literature may partly reflect differences in study populations, geographical settings, definitions of hesitancy, measurement instruments, health-system characteristics, and the distinction between willingness to vaccinate and actual ability to access services. The systematic review of parental vaccine-hesitancy instruments particularly highlights methodological variation in measuring this construct, while recent African evidence demonstrates that

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behavioural and structural determinants frequently operate simultaneously (Cao et al., 2026; Dzinamarira et al., 2026).

The reviewed literature demonstrates that childhood immunization remains one of the most effective public health interventions for preventing vaccine-preventable diseases and reducing childhood morbidity and mortality. Nevertheless, substantial inequalities in immunization coverage persist globally and are particularly pronounced in low- and middle-income countries. In 2024, approximately 14.3 million children globally were estimated to be zero-dose children, while Africa continued to account for a disproportionate share of children who had never received a routine vaccine (World Health Organization [WHO], 2025; WHO Regional Office for Africa, 2024).

Evidence reviewed in this study indicates that mothers' attitudes, vaccine confidence, knowledge, perceived risks and benefits, trust in healthcare providers, and exposure to vaccine information influence childhood immunization behaviour (Bangura et al., 2020; Galadima et al., 2021; Obohwemu et al., 2022). Positive attitudes and confidence generally encourage acceptance and completion of recommended vaccination schedules, whereas concerns about adverse effects, misinformation, distrust, and negative experiences with health services may contribute to hesitancy or delayed vaccination. However, the literature also demonstrates that poor vaccination coverage cannot always be attributed to maternal hesitancy because structural factors—including distance to facilities, transportation difficulties, socioeconomic disadvantage, service availability, and health-system limitations—may prevent willing mothers from vaccinating their children (Bangura et al., 2020; Galadima et al., 2021; WHO, 2024).

Socio-demographic characteristics, including maternal age, educational attainment, occupation, marital status, household socioeconomic position, residence, religion, and parity, have also been associated with differences in immunization outcomes. However, their effects are inconsistent across populations and may operate indirectly through health literacy, autonomy, social networks, access to information, and accessibility of health services (Galadima et al., 2021; Tessema et al., 2023; Brown et al., 2024). Similarly, studies examining vaccine hesitancy demonstrate considerable variation in its prevalence and determinants, partly because researchers use different definitions, measurement instruments, populations, and contextual frameworks (Dyda et al., 2020; Obohwemu et al., 2022).

Despite the growing body of evidence on childhood immunization in Africa and Nigeria, several important gaps remain. First, much of the existing Nigerian

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literature has focused primarily on immunization coverage, vaccination uptake, or determinants of incomplete vaccination, rather than directly examining mothers' attitudes toward childhood immunization as a distinct behavioural construct. Second, available studies have produced inconsistent findings regarding the relationships between maternal socio-demographic characteristics and immunization behaviour, suggesting that these relationships may be context-specific (Galadima et al., 2021; Obohwemu et al., 2022).

Third, there remains limited evidence from Northeastern Nigeria, particularly Bauchi State, concerning how mothers perceive childhood immunization and whether their attitudes differ according to selected socio-demographic characteristics. This geographic gap is important because Nigeria continues to experience substantial immunization inequities, while national evidence can conceal considerable subnational differences in access, uptake, and social determinants of vaccination (UNICEF Nigeria, 2024; WHO, 2024).

Fourth, the literature indicates that attitude, vaccine hesitancy, intention, access, and actual vaccination uptake are related but distinct constructs. Consequently, a mother may have a favourable attitude toward immunization but fail to vaccinate because of structural barriers, while another may have concerns about vaccination but ultimately accept it following counselling from a trusted health worker. This distinction creates a need for studies that specifically assess maternal attitudes while simultaneously considering relevant socio-demographic characteristics.

Therefore, the present study seeks to address these gaps by examining mothers' attitudes toward childhood immunization and their relationship with selected socio-demographic characteristics in the study area. By generating context-specific evidence, the study may provide useful information for public health practitioners, immunization programme managers, healthcare providers, and policymakers in designing targeted health education, communication, community-engagement, and service-delivery strategies aimed at improving childhood immunization acceptance and reducing preventable vaccination gaps.

Methods

A descriptive cross-sectional survey design was employed to assess mothers' attitudes toward childhood immunization against vaccine-preventable diseases in Bauchi State, Nigeria. The cross-sectional approach was considered appropriate because data on mothers' attitudes and selected socio-demographic characteristics were collected at a single point in time, allowing the study to describe the prevailing pattern of attitudes and examine differences across selected socio-demographic

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groups. The design was also appropriate for generating population-level evidence that could inform immunization communication and health-promotion strategies.

The study was conducted in Bauchi State, northeastern Nigeria. The state comprises 20 Local Government Areas (LGAs) and 323 wards, encompassing both urban and rural communities. The study area was selected because childhood immunization remains an important public health priority in the state and because differences in social, demographic, geographical, and health-service characteristics may influence mothers' perceptions and attitudes toward routine childhood immunization. The inclusion of communities across the state provided an opportunity to capture variation between urban and rural populations and between mothers with different socio-demographic characteristics. This broad geographical coverage also improves the contextual relevance of the findings to maternal and child-health programming within Bauchi State.

The study population comprised women of childbearing age residing in the 20 LGAs of Bauchi State. The target population was drawn from communities distributed across the state's 323 wards. The study focused on mothers because they are important participants in decisions concerning childhood healthcare and routine immunization. A total of 420 respondents participated in the study. The sample was distributed across the selected locations using the multistage sampling procedure. All 420 questionnaires administered were returned adequately completed and were considered suitable for analysis, giving a 100% questionnaire retrieval and usable-response rate. A multistage sampling procedure was employed to select respondents from the study population. The sampling process covered the administrative structure of Bauchi State, comprising 20 LGAs and 323 wards. Appropriate sampling techniques were applied sequentially at different stages to obtain respondents from the selected communities.

Data were collected using a structured questionnaire designed to obtain information on respondents' socio-demographic characteristics and attitudes toward childhood immunization against vaccine-preventable diseases.

The attitude component consisted of 12 items assessing mothers' perceptions and dispositions toward childhood immunization. The attitude items were measured using a Likert-type response format. The resulting responses were used to calculate individual and overall attitude scores. The questionnaire was subjected to face and content validation through expert review. Experts from the Departments of Public and Community Health and Measurement and Evaluation at Novena University reviewed the instrument to assess the adequacy, relevance, clarity, and appropriateness of the items in relation to the study objectives. The reliability of the questionnaire was assessed using the test–retest method. The procedure involved administering the instrument on two occasions and comparing the responses to assess the stability and consistency of the measures over time.

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Four hundred and twenty (420) copies of the structured questionnaire were administered to eligible respondents selected through the multistage sampling procedure. The completed questionnaires were retrieved, checked for completeness, organized, and prepared for statistical analysis. All 420 administered questionnaires were reported as adequately completed and usable, resulting in a 100% response rate. Mothers' attitudes toward childhood immunization were assessed using 12 Likert-scale items. Responses to the items were coded numerically and aggregated to generate attitude scores for each respondent. Higher or lower scores were interpreted according to the direction of the individual questionnaire items, with negatively worded items requiring appropriate reverse interpretation where applicable.

Completed questionnaires were checked for completeness before data entry and analysis. Data were coded and analyzed using the Statistical Package for the Social Sciences (IBM SPSS), version 25. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize respondents' socio-demographic characteristics and responses to attitude items. The results were presented using tables and appropriate narrative descriptions. For inferential analysis, independent-samples t-tests were used to examine differences in mean attitude scores between two-category socio-demographic groups, including age categories, educational status, place of residence, and religion. Ethical principles governing research involving human participants were observed throughout the study. Participation was voluntary, respondents were appropriately informed about the purpose of the study, and information obtained from participants was treated confidentially.

Results

The results of data analyses were presented according to the research questions and hypotheses set for the study. Four hundred twenty (420) copies of the questionnaire were produced for data collection. All this number of questionnaires were administered to the respondents who met the inclusion criteria. All administered copies were properly completed and fit for statistical analysis. The questionnaire return rate was therefore 100%. Data were collected, organized and subjected to data analysis using descriptive and inferential statistics. Data on demographic characteristics and for the objectives were analyzed using frequencies and their percentages, while data for the hypotheses were tested using t-test and chi-square. The results for all analyses were presented in respective tables below with their interpretations.

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Maternal Age and Attitude toward Childhood Immunization

Table 4.1 Independent-Samples t-Test of Mothers' Attitude toward Childhood Immunization by Age

Age group	N	Mean	SD	SE	df	t	p	Decision
15–30 years	276	28.6739	7.37234	0.44376				
31–45 years	144	29.3611	6.93185	0.57765	**418**	**−0.925**	**.355**	**Not significant**

Significant at $p < .05$.

The mean attitude score was slightly higher among mothers aged 31–45 years (29.36 ± 6.93) than among those aged 15–30 years (28.67 ± 7.37). However, the difference was not statistically significant, $t(418) = -0.925$, $p = .355$. Since $p > .05$, the null hypothesis was not rejected. Thus, maternal age was not significantly associated with differences in attitude toward childhood immunization in this study.

4.3 Educational Level and Attitude toward Childhood Immunization

Table 4.2 Independent-Samples t-Test of Mothers' Attitude toward Childhood Immunization by Educational Level

Educational level	N	Mean	SD	SE	df	t	p	Decision
Formal education	265	28.8189	7.37453	0.45301				
No formal education	155	29.0645	6.97833	0.56051	**418**	**0.336**	**.737**	**Not significant**

Significant at $p < .05$.

Mothers with formal education had a mean attitude score of 28.82 ± 7.37, compared with 29.06 ± 6.98 among mothers without formal education. The difference was very small and was not statistically significant, $t(418) = 0.336$, $p = .737$. Consequently, the null hypothesis was not rejected, indicating that educational status

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was not significantly associated with maternal attitude toward childhood immunization.

Place of Residence and Attitude toward Childhood Immunization

Table 4.3 Independent-Samples t-Test of Mothers' Attitude toward Childhood Immunization by Place of Residence

Residence	N	Mean	SD	SE	df	t	p	Decision
Urban	214	28.5047	7.98399	0.54577				
Rural	206	29.3301	6.32978	0.44102	**418**	**−1.171**	**.242**	**Not significant**

Significant at $p < .05$.

Rural respondents recorded a slightly higher mean attitude score (29.33 ± 6.33) than urban respondents (28.50 ± 7.98). However, the difference was not statistically significant, $t(418) = -1.171$, $p = .242$. The null hypothesis was therefore not rejected, indicating that place of residence was not significantly associated with maternal attitude toward childhood immunization.

Religion and Attitude toward Childhood Immunization

Table 4.4 Independent-Samples t-Test of Mothers' Attitude toward Childhood Immunization by Religion

Religion	N	Mean	SD	SE	df	T	P	Decision
Islam	331	28.4290	7.06701	0.38844				
Christianity	89	30.6966	7.55345	0.80066	**418**	**−2.648**	**.008**	**Significant**

Significant at $p < .05$.

Christian respondents had a higher mean attitude score (30.70 ± 7.55) than Muslim respondents (28.43 ± 7.07). The difference was statistically significant, $t(418) = -2.648$, $p = .008$. Since $p < .05$, the null hypothesis was rejected. Religion was therefore significantly associated with differences in mothers' attitudes toward childhood immunization in this study.

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Discussion

Maternal Age and Attitude toward Childhood Immunization

The study found no statistically significant difference in mothers' attitudes toward childhood immunization by age. Mothers aged 15–30 years had a mean attitude score of 28.67 ± 7.37, compared with 29.36 ± 6.93 among those aged 31–45 years, t(418) = −0.925, p = .355. Therefore, H_{01} was not rejected. This suggests that maternal age alone did not significantly differentiate immunization attitudes in the study population. This finding indicates that mothers across age groups may have comparable exposure to immunization information through health facilities, community mobilization and other communication channels. Although maternal age has been identified as a determinant of childhood immunization in some African studies, its effect varies across populations and may operate through other factors such as education, healthcare utilization and socioeconomic circumstances (Galadima et al., 2021; Williams et al., 2024). Thus, the present finding emphasizes that age should not be considered in isolation when addressing maternal attitudes toward immunization.

Educational Level and Attitude toward Childhood Immunization

There was no statistically significant difference in maternal attitude according to educational level. Mothers with formal education recorded a mean score of 28.82 ± 7.37, compared with 29.06 ± 6.98 among mothers without formal education, t(418) = 0.336, p = .737. Consequently, H_{02} was not rejected. The finding suggests that formal education may not necessarily translate directly into more favourable immunization attitudes. Mothers without formal schooling may obtain vaccine information through healthcare workers, community leaders, interpersonal communication and mass media. Nevertheless, this result differs from evidence showing that maternal education is associated with actual vaccination coverage. Williams et al. (2024), using Nigerian data, found significantly higher basic vaccination coverage among children whose mothers had secondary or higher education. Similarly, Galadima et al. (2021) identified maternal education as an important determinant of childhood immunization across Africa.

The difference may reflect the distinction between attitude and vaccination uptake. Education may improve a mother's ability to navigate health services and complete vaccination schedules without necessarily producing a statistically significant difference in her measured attitude. Therefore, immunization education

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should remain inclusive and should not be targeted solely at mothers with little or no formal education.

Place of Residence and Attitude toward Childhood Immunization

The study also found no statistically significant difference in maternal attitudes based on place of residence. Urban mothers had a mean score of 28.50 ± 7.98, while rural mothers had a mean score of 29.33 ± 6.33, t (418) = −1.171, p = .242. Thus, H_{03} was not rejected. Although rural mothers recorded a slightly higher mean score, the difference was not statistically meaningful. This may indicate that urban and rural mothers are increasingly exposed to similar immunization messages through routine immunization services, community outreach and mass communication.

However, evidence suggests that residence may have greater influence on access and vaccination coverage than on attitudes. Williams et al. (2024) identified place of residence as an important social determinant of childhood immunization in Nigeria, while Galadima et al. (2021) reported geographical accessibility, distance to health facilities and service availability among important determinants of immunization uptake in Africa. The present finding therefore suggests that similar attitudes do not necessarily imply equal access to vaccination services. Rural mothers may still encounter transportation, distance and health-service barriers despite having attitudes comparable to their urban counterparts.

Religion and Attitude toward Childhood Immunization

In contrast to age, education and residence, religion was significantly associated with maternal attitudes toward childhood immunization. Muslim mothers recorded a mean attitude score of 28.43 ± 7.07, compared with 30.70 ± 7.55 among Christian mothers. The difference was statistically significant, t(418) = −2.648, p = .008. Therefore, H_{04} was rejected. This finding is consistent with evidence identifying religion as one of the socioeconomic and sociocultural factors associated with childhood immunization in African settings (Galadima et al., 2021). Williams et al. (2024) also identified religion among the social determinants associated with childhood vaccination inequities in Nigeria.

However, the finding should not be interpreted to mean that religion itself causes negative or positive attitudes. Religious affiliation may reflect differences in social networks, trusted information sources, community norms and exposure to vaccine-related messages. Recent Nigerian research similarly indicates that vaccination decision-making is influenced by social, cultural, informational and interpersonal factors rather than by a single characteristic (Adeyanju & Betsch, 2024).

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The finding has important implications for immunization programming in Bauchi State. Religious leaders and institutions can be engaged as trusted partners in vaccine communication, particularly in addressing misinformation and strengthening confidence in routine childhood immunization. Thus, culturally sensitive and faith-aware communication may complement conventional health education strategies.

The study found that maternal age, educational level and place of residence were not significantly associated with attitudes toward childhood immunization, whereas religion showed a significant association. These findings demonstrate that maternal immunization attitudes are complex and cannot be adequately explained by demographic characteristics alone.

The results are broadly consistent with the wider African literature, which emphasizes the interaction of maternal characteristics with knowledge, beliefs, socioeconomic conditions, accessibility, healthcare experiences and community influences (Galadima et al., 2021). The Nigerian evidence further demonstrates that vaccination inequities are shaped by socioeconomic, geographic, maternal and healthcare-related factors (Williams et al., 2024).

Conclusion

This study assessed mothers' attitudes toward childhood immunization against vaccine-preventable diseases in Bauchi State, Nigeria, with particular attention to maternal age, educational level, place of residence, and religion. The findings showed that mothers generally demonstrated an unfavourable attitude toward childhood immunization, indicating the need for strengthened and context-specific immunization communication and demand-generation strategies.

The study further demonstrated that maternal age, educational level, and place of residence were not significantly associated with differences in mothers' attitudes toward childhood immunization. However, religion was significantly associated with maternal attitude, suggesting that sociocultural and community influences may be important considerations when designing immunization interventions in the study setting.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. **Strengthen routine immunization health education**: Primary healthcare facilities should intensify regular, clear and culturally appropriate education for

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mothers on the benefits, safety and importance of completing childhood immunization schedules.

2. **Engage religious leaders:** Given the significant association between religion and maternal attitudes, immunization programmes should actively involve respected religious leaders from different faith communities in vaccine education, community sensitization and misinformation correction.
3. **Strengthen community-based communication:** Health authorities should expand community outreach, interpersonal communication and mobilization activities to ensure that accurate immunization information reaches mothers through trusted community channels.
4. **Address vaccine misinformation**: Local health authorities should establish mechanisms for identifying and responding promptly to vaccine rumours and misinformation, particularly those circulating through interpersonal networks and social media.
5. **Improve healthcare-worker communication**: Healthcare workers should receive regular training in respectful, culturally sensitive and evidence-based communication so that mothers can confidently ask questions and receive accurate information about childhood vaccines.
6. **Maintain equitable urban and rural interventions**: Although place of residence was not significantly associated with attitude in this study, immunization programmes should continue to strengthen outreach and service delivery in rural communities because geographical and service-access barriers may still affect vaccination uptake.
7. **Promote inclusive maternal education**: Immunization communication should be designed for mothers irrespective of educational attainment, using simple language, visual materials, local languages and other communication approaches that facilitate understanding.
8. **Strengthen monitoring and evaluation:** Immunization programmes in Bauchi State should routinely assess caregivers' attitudes, concerns, information needs and reasons for missed vaccination opportunities to guide evidence-based interventions.
9. **Encourage further research:** Future studies should examine the relationship between maternal attitudes and actual childhood vaccination status, while also investigating the roles of vaccine confidence, misinformation, household decision-making, religious beliefs, socioeconomic status, healthcare-worker interaction and accessibility of immunization services.
10. **Develop context-specific interventions**: Given the significant association observed with religion, future immunization interventions in Bauchi State

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should incorporate culturally and religiously appropriate strategies while avoiding stigmatization or generalization of any religious group.

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