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A systematic review of Barriers Associated with Immunization Activities Among Under-5 children in Nigeria.

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ABSTRACT

Background: Childhood immunization is a critical public health strategy for reducing vaccine-preventable diseases and associated mortality in Nigeria. Despite efforts to improve vaccination coverage, significant barriers persist, hindering the achievement of universal immunization. This study aims to comprehensively review the knowledge, practices, and factors influencing caregivers' roles in childhood immunization in Nigeria.

Method: A systematic review was conducted in accordance with the PRISMA guidelines. Literature searches were performed on PubMed, EMBASE, and African Journals Online using keywords such as "childhood immunization," "childhood vaccination," "obstacles," "challenges," and "barriers." Studies published from January 2014 to June 2024 were included if they explored factors influencing childhood immunization in Nigeria, employed qualitative, quantitative, or mixed-methods designs, and were in English. Non-peer-reviewed articles, reviews, letters, and studies not addressing vaccination knowledge, attitudes, and practices were excluded. Duplicates were removed, and titles and abstracts were screened for relevance. Full texts of eligible studies were critically appraised using the Joanna Briggs Institute (JBI) tool. Data were extracted focusing on study aims, participant demographics, methodologies, and findings related to vaccination behaviors. A narrative synthesis was employed to identify common themes and patterns across studies, ensuring methodological rigor through triangulation and the development of a conceptual framework.

Results: Following screening and eligibility assessment, 21 articles met the inclusion criteria and were included in the review. The included studies encompassed a range of cross-sectional and qualitative research, with a combined total of 29,321 participants. The review identified five major themes as barriers influencing childhood immunization in Nigeria: knowledge and awareness gaps, limited access and availability of healthcare services, prevalent attitudes and beliefs towards vaccination, challenges within the healthcare system, and sociodemographic factors affecting caregivers.

Conclusion: In our review, several critical barriers influencing childhood immunization in Nigeria were identified. Addressing these barriers required a multifaceted approach involving improved health literacy, enhanced healthcare infrastructure, culturally competent care, and targeted interventions to increase access and reduce disparities. Strengthening communication strategies and leveraging mobile technology for reminders could have significantly enhanced vaccination coverage. Policymakers and healthcare providers needed to prioritize these strategies to achieve higher immunization rates and improve child health outcomes in Nigeria. The protocol for this systematic review was registered with PROSPERO under registration number CRD42024558533

Keywords: Childhood immunization, Vaccine-preventable diseases, Healthcare access, Barriers to immunization, Nigeria.

BACKGROUND

Nigeria, located in West Africa, is the most populous country on the continent with an estimated population of over 200 million people [1]. Nigeria, comprising 36 states and the Federal Capital Territory, Abuja, is a culturally rich nation with over 250 ethnic groups, the largest being the Hausa, Yoruba, and Igbo, each contributing uniquely to the country's diverse cultural, economic, and social landscape [2]. This diversity is also reflected in the country's religious landscape, with Christianity and Islam being the predominant religions, alongside a significant number of adherents to various indigenous beliefs [3]. The demographic profile of Nigeria is characterized by a young population, with more than 60% of Nigerians under the age of 25. Notably, there are over 35 million children under the age of 5, representing a significant portion of the population [4]. This youthful demographic presents opportunities and challenges for Nigeria's development, particularly in education, employment, and healthcare [5]. Urbanization is increasing, with significant migration to cities like Benin City, Lagos, Kano, and Port Harcourt. However, many people still live in rural areas where access to essential services is limited [6].

Childhood immunization activities are fundamental in reducing the burden of vaccine-preventable diseases (VPDs) worldwide. Immunization protects children from diseases such as measles, polio, diphtheria, pertussis, and tuberculosis, contributing significantly to public health [7]. Globally, efforts to achieve near-universal vaccine coverage have varied, with high-income countries generally achieving substantial success [8,9]. In contrast, challenges persist in low- and middle-income countries like Nigeria due to healthcare system limitations, socioeconomic disparities, and cultural factors [10]. The implementation of the World Health Organization's (WHO) Expanded Program on Immunization has significantly improved child health in Nigeria, leading to the country being declared polio-free in August 2020 and reducing measles incidence through regular immunization efforts [11]. However, challenges persist, with disparities in vaccine coverage across regions and between urban and rural areas, influenced by socioeconomic status, healthcare access, and cultural beliefs [12].

The consequences of non-compliance with childhood immunization poses significant public health risks with far-reaching implications across economic, household, and health sectors. Children who do not receive vaccines are highly vulnerable to outbreaks of vaccine-preventable diseases (VPDs),

leading to increased morbidity and mortality rates [13]. The economic impact of these outbreaks is substantial, as healthcare costs rise to treat preventable illnesses and manage outbreaks effectively [14]. Households also bear the burden of caring for sick children, which can strain already limited resources and affect productivity when caregivers need to take time off work [15]. In Nigeria, recent outbreaks of diseases like measles have highlighted the severe consequences of suboptimal vaccine uptake [16]. Beyond immediate health impacts, these outbreaks strain healthcare resources and human capital, especially during other health emergencies like the COVID-19 pandemic [17]. Healthcare facilities face increased demand for services, potentially overwhelming capacities and diverting resources from other essential healthcare needs [18]. Human resources are also stretched thin as healthcare professionals must respond to outbreaks, conduct vaccination campaigns, and manage public health crises [19].

In the context of caregivers' and healthcare workers' roles in childhood immunization, we focused on the barriers to childhood immunization in Nigeria. This study uniquely examined how socio-demographic factors, such as socioeconomic status, health literacy, and cultural beliefs, along with health systems barriers, impacted childhood immunization uptake, using public health theory as a framework. Unlike previous research, this study provided a comprehensive analysis of these factors to identify specific obstacles and inform targeted interventions. The rationale for this research was to address knowledge gaps and develop evidence-based strategies to improve immunization rates, safeguard children's health, and reduce the burden of vaccine-preventable diseases in Nigeria.

MATERIALS AND METHODS

The protocol for this systematic review was registered with PROSPERO (International Prospective Register of Systematic Reviews) under registration number CRD42024558533. This systematic review rigorously followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [20].

Literature search and Screening

Literature search was meticulously carried out on reputable databases such as PubMed, EMBASE, and African Journals Online with adjustments made for variations in database syntax. Search were conducted using a combination of keywords such as "childhood immunization," "childhood vaccination," "child immunization," "vaccination of children," and related terms for barriers including "obstacles," "challenges," "impediments," "hindrances," and "barriers." These terms were connected using Boolean operators (AND, OR) to ensure comprehensive coverage of relevant studies. Throughout the process, initial search results were systematically captured, refined, and documented, facilitating a rigorous and thorough review of the factors impeding childhood immunization in Nigeria.

Eligibility criteria encompassed studies of various designs exploring these factors and their effects on vaccination behaviors among caregivers, healthcare workers, and community members involved in childhood immunization programs across Nigeria. In addition to being published within the past 10 years (January 2014 to June 2024), studies were required to be in English and employ qualitative, quantitative, or mixed-methods designs. The review also included studies identified through systematic reference list searches of relevant articles retrieved from the databases, ensuring comprehensive coverage of the literature. Excluded studies included those that did not meet these criteria, such as non-peer-reviewed articles, systematic reviews, letters, and studies not specifically addressing the themes of vaccination knowledge, attitudes, and practices related to childhood immunization in Nigeria

The search literatures were imported into Mendeley Desktop version 1.19.4 (8). Initial screening involved evaluating titles and abstracts to pinpoint potential studies that aligned with our research objectives. Duplicate articles were then excluded to streamline the selection process and ensure the inclusion of unique and relevant studies. Full-text assessments were subsequently conducted to rigorously evaluate each article against the review's eligibility criteria. This meticulous process

enabled a robust data gathering from a variety of sources, enhancing our understanding of the factors impacting vaccination decisions and behaviors specific to Nigeria.

Data extraction

Data extraction focused on obtaining key information from selected studies, including study aims, participant demographics, methodologies employed, and findings related to vaccination knowledge, attitudes, and practices.

Critical appraisal of literatures

We rigorously assessed the quality of selected literature using the Joanna Briggs Institute (JBI) tool [21]. Our evaluation focused on key aspects including sample size, study design, methods of data collection, and analysis techniques. For cross-sectional studies, the JBI tool covered 8 criteria, while qualitative studies involved 10 criteria. The assessment employed a binary system where "yes" or "no" indicated criterion presence or absence, "unclear" indicated insufficient detail, and "not applicable" indicated irrelevance. Despite lacking predefined thresholds, we categorized studies as low, moderate, or high quality based on specific criteria. High-quality cross-sectional studies scored between 7 and 8, moderate quality scored between 4 and 6, and low quality scored below 4. For qualitative research, high-quality studies scored 9 to 10, moderate quality scored 5 to 8, and low quality scored below 5. All included studies underwent thorough review and discussion to ensure consistency and accuracy, with no exclusions based on quality alone.

Data analysis

The synthesis of findings employed a narrative approach to analyse and integrate results across studies, identifying common themes and disparities in vaccination knowledge, attitudes, and practices. Adhering to grounded theory principles [22], we ensured methodological integrity through rigorous refinement and triangulation, ensuring the relevance and accuracy of the themes. This process enabled the development of a conceptual framework that captures the complexities and interrelationships observed. Consequently, this approach provided a deeper understanding of the underlying factors influencing vaccination behaviors among caregivers and highlighted patterns that could inform targeted interventions.

RESULTS

Attributes of the incorporated literature

A thorough literature search was performed across various electronic databases, resulting in the identification of 1,301 articles from PubMed (1,199 articles), EMBASE (79 articles), and AJOL (23 articles). Two additional articles were identified through a reference list search, resulting in a total of 1,303 articles. During the screening stage, 473 duplicate articles were excluded, leaving 830 articles for further evaluation. A detailed eligibility assessment was conducted on these 830 articles, leading to the exclusion of 774 articles that did not meet the predefined inclusion criteria. Subsequently, the full texts of the remaining 56 articles were reviewed. This process resulted in the exclusion of 35 articles for the following reasons: 17 articles had a non-Nigerian focus, 13 articles' full texts were not accessible, 4 articles were review articles, and 1 article was a letter. Ultimately, 21 articles met all the criteria and were included in the review.

A total of 18 of the included literatures are cross-sectional studies, such as [23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37, 39, 40, 41, 43]. Additionally, 3 qualitative studies include [32, 38, 42], focusing on addressing specific health-related issues in Nigeria. The included quantitative studies had study populations ranging from 204 to 11,844 participants, while the qualitative surveys included a total of 108 participants. Overall, the studies involved 29,321 participants in total.

The 21 included studies encompass a wide range of research covering 12 states across all six geopolitical regions of Nigeria, complemented by 6 studies with national representation. Studies [23], in Adamawa, [24] in Lagos, and [26] in Kwara States highlighted gaps in caregiver knowledge, vaccination utilization rates, and the impact of maternal knowledge on vaccination uptake. Nationally representative studies [26, 30] investigated vaccine wastage, stock management issues, and geographical disparities in immunization coverage. Also, studies [27] in Enugu, [29] in Osun, and [33] in Katsina, Zamfara, Niger, Kwara, and Gombe States explored community-level factors influencing immunization coverage, predictors of good practices, and the role of reminder messages in improving vaccination uptake. Studies [36] in Kano State and a national survey [38] provided insights into community perceptions, barriers to immunization, and the impact of crises such as the COVID-19 pandemic on healthcare access. Studies [37] in Ondo, [40] in Jigawa, and a nationwide study [41] examined health education interventions, maternal factors influencing vaccination status, and the impact of maternal healthcare utilization on childhood

immunization. Studies [23, 32] in Bauchi and Cross River States respectively, as well as nationwide research [42] delved into decision-making processes, fear factors, and communication strategies related to vaccination. Additionally, studies [33, 39] in Ebonyi State, and a nationwide study [40] focused on mothers' willingness to receive vaccination reminders and the influence of maternal characteristics on immunization status. The survey [35] in Ebonyi States assessed vaccination timeliness and caregiver demographics. Studies [28] studied men in Enugu State to assess their childhood immunization knowledge and practices, noting associations with educational backgrounds and religious affiliations. Studies [43] analyzed child health outcomes in Osun State while [34] investigated mothers' acceptance of immunization reminders in Ilorin, Kwara State.

Methodological Quality of Included Studies

Nine cross-sectional studies [30, 33, 34, 35, 36, 39, 40, 41, 43] achieved high methodological quality, each scoring a perfect 8 out of 8 on the JBI tool. Additionally, five cross-sectional studies [24, 25, 26, 27, 28] demonstrated high quality, each with scores of 7 out of 8. Moderate quality was observed in four cross-sectional studies [23, 29, 31, 37] and qualitative studies [32, 38, 42] scoring 6 out of 8 and 8 out of 10 respectively on the JBI tool. Notably, no studies fell below the benchmark of moderate quality, ensuring that all included research maintained at least moderate methodological rigor. This comprehensive approach facilitated a robust narrative synthesis and thematic analysis of the knowledge, practices, and influences of caregivers' roles in childhood immunization.

Barriers associated with Childhood Immunization in Nigeria

The utilization of maternal healthcare services in Nigeria faces various challenges, which can be broadly categorized into 5 major themes. Knowledge and awareness, including health literacy and communication gaps, play a crucial role. Access and availability of healthcare services are limited by geographical barriers, infrastructure disparities, and economic constraints. Attitudes and beliefs, such as stigma, discrimination, and traditional practices, also influence healthcare utilization. The healthcare system itself faces challenges, including systemic issues, training deficiencies, and resource allocation problems. Finally, sociodemographic factors, such as

financial barriers, gender expectations, educational attainment, age, and language barriers, impact healthcare utilization.

Knowledge and Awareness

Inadequate health literacy, particularly among marginalized populations, led to misconceptions about preventive measures and treatment options. Misunderstandings about vaccinations or dietary guidelines negatively impacted health outcomes. The lack of accurate health information contributed to misinformation, making it difficult for individuals to make informed health decisions, as reported by [1]. Study [24] identified that only about 54% of mothers had good knowledge of vaccination, leading to a low immunization coverage of 42.5%. In contrast, studies [26, 29, 27] noted that knowledge of immunization among 80%, 76%, and 77% of caregivers, respectively, correlated with high vaccination compliance. Study [34] established a link between mobile phone ownership and caregivers' readiness for immunization. Despite high ownership rates of phones, study [37] found that only 46% of caregivers were knowledgeable about immunization schedules. This highlights significant gaps in awareness that could potentially limit the effectiveness of reminder systems.

Communication gaps between healthcare providers and patients resulted in misunderstandings and misinterpretations of medical advice. Study [24] highlighted that ineffective communication was a significant barrier to conveying accurate health information, resulting in misunderstandings of immunization schedules. Study [31] highlighted that 15% of caregivers attributed their fear of vaccine administration to insufficient knowledge and awareness. Specifically, caregivers expressed anxiety regarding the use of needles during vaccine delivery and concerns about potential adverse effects following immunization.

Study [32] blamed poor knowledge and awareness among caregivers on deficiencies in training and negative attitudes among healthcare personnel, which discouraged individuals from seeking appropriate healthcare services. The study [43] reported that children in communities implementing health education on immunization showed significantly higher likelihoods of receiving vaccines, with a threefold greater chance for the DPT vaccine and a five and a half times higher likelihood for the measles vaccine compared to those in non-implementing areas.

Mothers generally hold positive views about vaccination but express concerns regarding vaccine safety and trust in the healthcare system, as noted by [42]. They are eager to acquire more

information about vaccines but face challenges in prioritizing vaccination amidst competing demands such as forgetfulness, child illness, and being busy [35].

Access and Availability

Geographical barriers significantly hindered access to healthcare, particularly in rural and remote areas where healthcare facilities are sparse. These facilities often face substantial challenges in healthcare delivery due to incomplete vaccine stock data. Additionally, they typically require a minimum of six children before opening a 10-dose vial of measles-containing vaccine (MCV), resulting in 30% of caregivers being turned away for vaccination, with 53% of these children missing their doses, as noted by [25]. Limited transportation options exacerbate these challenges, preventing repeated visits for immunization schedules.

There are notable disparities in healthcare infrastructure between urban and rural regions. Urban areas typically have better-equipped hospitals and clinics, while rural areas often lack essential medical facilities and specialists [27, 30, 32]. This imbalance affects the availability and quality of healthcare services [30]. High out-of-pocket costs for immunization-related services, where applicable, prevent individuals, particularly those from low-income populations, from seeking necessary healthcare services, exacerbating health disparities [38].

Studies [42, 35] noted that mothers struggle to prioritize vaccination due to competing demands, such as forgetfulness, child illness, and being busy, indicating barriers in accessing immunization services. Interestingly, access to immunization services in Nigeria was negatively impacted by lockdowns during the first wave of the COVID-19 pandemic [38]. Movement restrictions hindered both patients and healthcare providers from reaching hospitals, affecting patients' ability to receive necessary vaccinations.

The study [41] observed that, higher rates of full immunization among children in Nigeria were significantly associated with maternal healthcare utilization, including antenatal care (ANC) attendance, skilled birth attendance (SBA), and maternal postnatal care (PNC) attendance. This indicates that improving maternal healthcare access and utilization is crucial for increasing childhood immunization rates.

Attitudes and Beliefs

Stigma surrounding certain health conditions, such as mental health disorders [40] and sexually transmitted infections [36] along with concerns related to COVID-19 [38], has instilled fear of discrimination among caregivers, contributing to their reluctance to attend immunization sessions [28]. Moreover, mistrust of healthcare providers and the healthcare system, particularly prevalent among marginalized communities due to historical injustices and discrimination, has profoundly affected patient-provider relationships and healthcare access [37]. Additionally, in many communities, traditional healers wield significant influence over treatment preferences, leading individuals to delay or forgo conventional medical care, including immunization. This reliance on traditional practices has undermined efforts to prevent diseases through vaccination, exacerbating overall health outcomes [32]. Religious practices and beliefs also exert a significant influence on health behaviors, shaping decisions regarding medical treatments, lifestyle changes, and even acceptance of immunization efforts [32]. These beliefs sometimes conflict with vaccination initiatives, further impacting health outcomes, as highlighted by studies [42, 28].

Healthcare System Factors

Overcrowding and understaffing in healthcare facilities compromised the quality of care and contributed to prolonged wait times for caregivers. These systemic challenges led to caregivers' dissatisfaction and delayed access to immunization services, as reported by [32]. Inadequate training of healthcare professionals, including insufficient training in evidence-based practices or outdated vaccination knowledge, affected the quality of immunization provided, impacting caregivers' outcomes and immunization effectiveness, highlighted by [33].

Bureaucratic procedures and inefficiencies within healthcare institutions further delayed caregivers' access to care, prolonging immunization visits and initiation. These administrative hurdles were particularly problematic in settings with high caregiver volumes or limited resources, as noted by [34]. Fragmentation in healthcare services, characterized by disjointed coordination between primary care providers and support staff, disrupted continuity of care, leading to gaps in the management of immunization sessions, as reported by [41].

Trust in the healthcare system significantly impacts mothers' vaccination decisions, underscoring the importance of healthcare system factors in immunization practices, as noted by [42]. Inadequate funding for healthcare programs, inequitable distribution of resources, and disparities

in healthcare infrastructure limited access to essential medical services. These financial issues were particularly challenging for underserved communities, highlighted by [43].

Caregivers also attributed poor vaccination uptake to limited vaccination communication within healthcare systems, shortages of health workers, training deficiencies, and poor attitudes of health workers, as noted by [36, 32]. These issues are related to weak political will, leading to inadequate infrastructure and manpower in health facilities.

Studies [37, 33, 34] collectively highlight the dynamics of mobile phone ownership and its impact on the willingness of caregivers to receive immunization reminders in Nigeria. However, poor attitudes of health workers have significantly affected the implementation of these reminder systems.

Sociodemographic Factors

Financial barriers based on income levels prevented low-income individuals from accessing timely and quality healthcare services, resulting in disparities in healthcare utilization and worsened health outcomes, as reported by [27]. Employment status significantly impacted healthcare access, with caregivers without stable employment requiring more frequent reminders to attend immunizations [34], leading to disparities in health outcomes [38].

Societal norms and cultural expectations influenced access to healthcare for women, with gender-specific health-seeking behavior among caregivers indicating that men are less likely to prioritize immunization compared to women, as noted by [28]. This gender disparity is more evident as most studies included reported more women as caregivers during immunizations. Husbands were observed to play a crucial role in vaccination decisions, highlighting the gender influence within the family unit [42].

Higher levels of education were associated with better health literacy, improved understanding of healthcare information, and an increased likelihood of seeking timely medical care [40, 33, 29]. Educational attainment significantly impacted healthcare access and outcomes. Study [30] noted that improved maternal education is associated with an increased number of fully immunized children, while study [28] found that compliance of male caregivers with immunization activities was strongly linked to their level of education. Mothers with lower education levels were more willing to receive reminders compared to those with tertiary education [33].

Cultural competence in healthcare delivery was crucial to addressing the unique needs and preferences of diverse populations, promoting equitable access to healthcare services and improving health outcomes by ensuring healthcare providers were aware of and responsive to the cultural contexts of their patients [26].

Age was a significant factor, with mothers and caregivers older than 30 years and 40 years more likely to comply with vaccination recommendations, as noted by [26, 40]. Study [27] also noted that older age was a good predictor of caregivers' willingness to immunize children.

Language barriers affected caregivers' attitudes towards immunization, with preferences varying between English [37] and local languages [33] for communication during reminders. Language barriers hindered the comprehension of health information, particularly among immigrant caregivers, thereby impeding effective communication and resulting in suboptimal immunization outcomes, as noted by [31]. Caregivers often did not fully understand communicated messages or the importance of vaccination.

In Nigeria, significant demographic disparities exist in healthcare infrastructure between urban and rural regions. Urban areas typically benefit from well-equipped hospitals and clinics, whereas rural areas often lack essential medical facilities and specialized healthcare providers [27, 30, 32]. This imbalance severely affects the availability and quality of immunization services [30].

Furthermore, study [27] detected substantial demographic disparities in mobile phone ownership, revealing higher rates in urban areas (95.8%) compared to rural areas (74.5%). This disparity explains potential limitations in accessing reminder services in less connected rural regions, which are crucial for improving immunization coverage and healthcare access nationwide.

These factors collectively underscore the complex interplay of socio-economic, cultural, educational, and systemic factors that influence caregivers' decisions and access to immunization services, highlighting the need for targeted interventions and policy initiatives to improve vaccination coverage and health outcomes.

DISCUSSION

Our systematic review expanded from a narrow examination of barriers linked to under-five immunizations to a broader exploration of the diverse influences from caregivers, health workers, and sociocultural and demographic factors on immunization activities in Nigeria. This analysis is grounded in various public health theories, including the Health Belief Model (HBM), the Ecological Model of Health Promotion (EMHP), and the Social Determinants of Health (SDH). Primarily, inadequate health literacy, as explained by the HBM, undermines individuals' ability to understand and act on health information crucial for making informed decisions about immunization. This gap in knowledge perpetuates misconceptions about vaccines, lowering perceived susceptibility to diseases and diminishing the perceived benefits of immunization. Additionally, geographical barriers, highlighted by the EMHP, exacerbate disparities in healthcare access. These barriers hinder physical access to healthcare facilities that provide immunization services, especially in remote and underserved areas. The logistical challenges that arise from these barriers restrict timely and regular access to vaccines, contributing to lower immunization coverage rates across various regions in Nigeria. Furthermore, pervasive mistrust of the healthcare system, a critical SDH factor, significantly impacts healthcare-seeking behaviors. This mistrust, deeply rooted in historical injustices and discrimination, erodes confidence in healthcare providers and institutions, leading marginalized communities to be reluctant to seek immunization services. Consequently, disparities in vaccination rates persist, exacerbating health inequities among different population groups. Financial constraints also play a crucial role. High out-of-pocket costs for immunization services deter low-income populations from seeking necessary healthcare, exacerbating health disparities, particularly in underserved communities. Additionally, the financial instability of caregivers, often linked to their employment status, necessitates more frequent reminders to attend immunizations, indicating a direct correlation between socioeconomic status and healthcare utilization. This correlation is supported by the SDH framework, which highlights how economic and social conditions influence individuals' health status and access to health services.

We observed that, inadequate health literacy aggravated misconceptions about preventive measures and treatment options especially in underserved populations. This issue was further compounded by low levels of education among caregivers which negatively influenced the comprehension of healthcare information and affects attendance at immunization sessions [40, 33,

29]. Misinformation stemming from low health literacy adversely affects health outcomes and contributes to suboptimal immunization coverage rates, such as the 42.5% figure noted by [24]. In many marginalized communities, this misinformation leads to the belief that vaccinations can cause harm, fueled by social media and local gossip [44]. Consequently, vaccine hesitancy, fueled by fear, leads parents to opt out of vaccinating their children, leaving them vulnerable to preventable diseases. This situation was evident during the measles outbreak in Samoa in 2019, where misinformation about the MMR vaccine resulted in a severe outbreak that claimed over 80 lives, mostly children [45]. Additionally, dietary misconceptions, such as beliefs that certain foods can boost immunity more effectively than vaccines, contribute to low immunization rates. These cultural beliefs and practices around nutrition and health can overshadow scientific recommendations, leading to resistance against proven medical interventions, as observed in parts of India [46]. Previous study [47] have shown that improved maternal education is associated with higher rates of fully immunized children, emphasizing the role of gender in promoting healthcare utilization and adherence to immunization schedules. Nonetheless, the influential role of male caregivers in vaccination decisions is recognized [42], highlighting gender dynamics within the family unit that impact healthcare choices [48].

We observed a positive correlation between age and health literacy, indicating that older individuals generally possess higher levels of health literacy. This factor significantly influences their understanding of and adherence to vaccination schedules. Older caregivers, with greater health literacy and awareness, often demonstrate higher compliance rates compared to their younger counterparts [26, 40, 48]. Conversely, younger healthcare workers, who may prioritize personal and professional demands over patient care, sometimes exhibit poorer attitudes and lower quality of service delivery [49, 50]. Poor and negative attitudes of health workers can deter caregivers from seeking vaccinations [32, 33, 37, 46]. This lack of prioritization can lead to unnecessary and unethical behaviors, such as stigmatizing caregivers seeking vaccinations. Healthcare workers' biases or misconceptions toward caregivers, particularly those from marginalized backgrounds or with limited health literacy, often contribute to this stigmatization [37]. These negative attitudes erode trust between healthcare providers and caregivers, fostering vaccine hesitancy. As a result, barriers to accessing essential healthcare services, including vaccinations, are perpetuated, exacerbating the challenges of achieving comprehensive immunization coverage [42, 35]. Nonetheless, it is important to recognize that caregiver behaviors

beyond healthcare workers' attitudes also play a significant role in vaccination uptake. Factors such as forgetfulness, childcare responsibilities, and busy schedules contribute to missed vaccination opportunities [41]. Flexible healthcare policies that accommodate these challenges, such as extended clinic hours and onsite childcare services, can help mitigate these barriers and improve vaccination rates [51]. Therefore, integrating immunization services into routine maternal and child health visits is crucial for promoting childhood immunization. Improving maternal healthcare services can positively impact overall health outcomes by ensuring timely vaccination for children [41]. Efforts to combat stigmatization and rebuild trust must include systemic changes that prioritize equity, cultural competence, and inclusivity in healthcare delivery.

Health illiteracy is further compounded by the negative roles of traditional healers. In many communities, traditional healers wield significant influence over healthcare decisions, particularly in Sub-Saharan Africa and parts of Asia, where beliefs in spiritual healing and traditional medicine strongly shape attitudes towards vaccines [52, 32]. This influence often leads individuals to postpone or bypass conventional medical treatments, including vaccinations, promoting herbal remedies or rituals instead. While traditional medicine encompasses culturally rooted practices recognized by the WHO, these beliefs sometimes contradict efforts to prevent diseases through immunization [52]. Efforts to integrate traditional healers into public health strategies have shown promise in enhancing vaccine acceptance. For instance, in some regions, traditional healers are trained to identify signs of vaccine-preventable diseases and refer patients for immunization, bridging traditional and modern healthcare practices [53]. However, collaborations must ensure traditional practices align with evidence-based medical interventions to maintain scientific integrity while respecting cultural beliefs. Similarly, religious practices also significantly shape health literacy, health behaviors and influence vaccine acceptance, occasionally conflicting with vaccination initiatives [42, 28]. Some religious teachings may discourage medical interventions, leading to hesitancy or refusal to vaccinate [54]. This situation could be attributed to the limited integration of religious leaders in health education activities, despite their significant influence and trust within communities. Their role as effective advocates for vaccination is crucial in addressing concerns and clarifying misconceptions in culturally sensitive ways.

Communication barriers significantly impact caregivers' understanding of health information and their communication preferences, particularly evident during immunization reminders [37, 33]. Effective healthcare communication hinges on recognizing and accommodating these preferences. When information is presented in caregivers' preferred language, they are more likely to engage with healthcare services and adhere to immunization schedules [55]. Overcoming these language barriers is crucial for improving vaccination uptake and enhancing overall healthcare utilization among linguistically diverse populations [56]. Study [57] emphasizes that cultural competence involves actively engaging with communities beyond awareness, ensuring healthcare practices are respectful and effective. However, ineffective communication between healthcare providers and patients exacerbates these challenges. Existing argument [24, 31] that, misunderstandings regarding vaccination schedules and concerns about vaccine safety can arise from technical jargon or culturally irrelevant messaging. It's evident that the issue isn't solely the lack of information but also how it's delivered and received, which can alienate patients and erode trust. In leveraging technology to improve health literacy, mobile health (mHealth) initiatives have shown promise in sending SMS reminders about vaccination schedules and providing accessible vaccine information [58]. However, we highlighted that ensuring digital literacy among marginalized populations is essential for these interventions to be effective. Shockingly, demographic disparities in mobile phone ownership pose challenges, particularly in rural areas with lower rates of ownership [59]. This digital divide limits access to communication tools needed for timely immunization reminders and health-related information. In contrast, urban areas with higher mobile phone ownership rates benefit from technology-enabled healthcare coordination, facilitating better adherence to immunization schedules [60]. Supplementing mobile phone ownership with improved patient education using visual aids and simplified language suitable for varying levels of community literacy is influential in helping caregivers adopt clearer communication strategies. We noted These strategies are essential in addressing vaccination hesitancy and enhancing healthcare outcomes [31]. Additionally, our review observed that community health workers who are specially trained to be proficient in local languages and cultural sensitivities played a crucial role in bridging communication gaps and fostering trust within their communities [37]. Another systematic review [61] highlighted that participatory communication approaches between caregivers and healthcare workers through dialogue effectively address specific fears and

misconceptions about vaccines, ensuring comprehensive understanding and action across diverse populations.

Significant disparities in healthcare infrastructure persist between urban and rural areas, as observed in our review. We observed that, urban centers benefit more from well-equipped hospitals and clinics, whereas rural regions often face shortages of facilities and healthcare providers [27, 30, 32]. These disparities lead to substantial inequalities in accessing vaccinations, exacerbated by geographical barriers that hinder healthcare access in remote rural areas. Inadequate funding and bureaucratic inefficiencies further aggravate these challenges, resulting in disparities in healthcare infrastructure and hindering timely access to immunization services [43]. We further observed that, administrative hurdles and fragmented healthcare coordination contributed to delays in vaccine delivery and healthcare access [41, 34]. This finding aligns with those of prior studies [62, 63], which identified disjointed healthcare systems and bureaucratic obstacles as significant factors adversely affecting public health outcomes worldwide. Also, inadequate training of healthcare professionals complicates efforts to improve immunization practices, affecting vaccine effectiveness and caregivers' trust in the healthcare system [64, 65]. The scarcity of specialized healthcare professionals in rural areas exacerbates challenges in accessing immunizations. Moreover, inadequate facilities and equipment in rural clinics compromise vaccine storage and administration, potentially reducing vaccine efficacy. Our review [25] highlighted how healthcare facilities in such areas struggle with incomplete vaccine stock data and stringent policies regarding vaccine vial usage. These challenges often result in many caregivers being turned away or children missing doses, compelling determined caregivers to seek health services in distant areas with better facilities. Many rural health facilities are situated far from communities in difficult-to-reach terrains such as riverine or mountainous areas, owing to disparities in healthcare infrastructure [66, 67]. The lack of reliable public transport forces them to travel long distances on foot or use expensive private means to navigate these challenging terrains, discouraging them from returning for follow-up doses. This transportation barrier further hinders timely and repeated visits for vaccination schedules. This is particularly critical for vaccines that require multiple doses over specific timeframes, such as the DTP (diphtheria, tetanus, and pertussis) vaccine [68]. The combined costs of traveling to a distant clinic and fees for vaccination services where immunization services are not fully subsidized can be prohibitive for

low-income families, leading to children missing critical immunizations [69]. Financial interventions such as subsidies or insurance coverage are crucial to enhancing access to essential healthcare services. This is evident in Rwanda's community-based health insurance scheme which significantly increased vaccination coverage by reducing out-of-pocket expenses and making healthcare more accessible to low-income families [70].

The culmination of inadequate healthcare infrastructure, administrative hurdles and fragmented healthcare coordination leads to overcrowding and prolonged wait times in healthcare facilities, particularly affecting rural settings [33, 71, 72]. These challenges not only impact vaccination coverage but also contribute to caregiver dissatisfaction, echoing similar issues identified in Canada, the United States, and other countries [64, 65]. Another review [73] corroborated our findings that, the COVID-19 pandemic further exacerbated these vulnerabilities globally, disrupting routine immunization programs and highlighting systemic weaknesses in healthcare delivery. Our review observed that lockdowns and movement restrictions hindered access to immunization services, underscoring the need for resilient healthcare systems capable of maintaining essential services during crises. Initiatives like mobile clinics and community health worker programs show promise in addressing these challenges by delivering healthcare directly to hard-to-reach areas [74]. Countries with robust primary healthcare systems and active community engagement achieve higher immunization coverage rates and better health outcomes [75]. For example, Cuba's comprehensive healthcare system and community involvement have led to near-universal vaccination coverage [76]. These successes demonstrate the effectiveness of systemic and community-level interventions in enhancing healthcare access and outcomes globally. Therefore, policy adjustments must prioritize efficiency and accessibility in vaccine delivery, ensuring reliable supply chains to prevent stockouts and missed vaccination opportunities. These efforts are crucial for enhancing immunization coverage and reducing health disparities between urban and rural populations globally.

Implication to Public Health

The implications of our findings are profound for public health, particularly for children under five years old. To address disparities in healthcare infrastructure, a holistic approach is required, as these disparities significantly contribute to unequal vaccination coverage. Rural regions often lack

adequate facilities and healthcare professionals, exacerbating health inequities and increasing the vulnerability of children to vaccine-preventable diseases. According to the Health Belief Model, it is crucial to address logistical and financial barriers that hinder caregivers from accessing vaccination services. Strategies such as subsidies or insurance schemes can help alleviate these challenges, aligning with the model's emphasis on reducing perceived obstacles to encourage positive health behaviors. Furthermore, the Social Cognitive Theory emphasizes the influence of observational learning and social factors on behavior, highlighting the need for public health initiatives to leverage these elements to improve vaccination rates. Thus, effective public health campaigns should enlist the support of trusted community leaders and utilize media channels to improve health literacy and counter misinformation from social media and local gossip. This approach targets caregivers regardless of their education level, combating misconceptions about vaccines and curbing vaccine hesitancy and refusal. Additionally, engaging religious leaders and traditional healers in health education efforts leverages their influence and trust within communities to promote vaccination and dispel myths. This strategy is supported by the Diffusion of Innovations Theory and the Theory of Reasoned Action. To further enhance vaccination coverage, effective training programs designed to improve healthcare worker attitudes and communication skills are essential. Such programs foster positive attitudes among healthcare workers, bridge the gap of mistrust in the healthcare system, and encourage caregivers to seek vaccinations for their children, as advocated by the Theory of Planned Behavior.

Limitation of study

This study's strength lies in its extensive geographical coverage across both northern and southern Nigeria, providing a comprehensive understanding of factors influencing childhood immunization nationwide. However, relying solely on secondary data from National Demographic Health Surveys may overlook recent or region-specific changes in vaccination behaviors. Due to the diverse nature of the studies included, conducting a meta-analysis was not feasible. Nevertheless, the study offered valuable insights into vaccination practices in Nigeria, informing evidence-based policies and interventions aimed at improving immunization coverage and health outcomes. This highlights the need for a nationally representative qualitative study in future to thoroughly explore the barriers to childhood immunization in Nigeria. Such a study would offer detailed insights into

the regional and local factors influencing vaccination decisions, enabling the development of more targeted and effective public health strategies.

Conclusion

Our systematic review identified various intertwined factors that influenced healthcare access and immunization rates, particularly in underserved communities. Socioeconomic disparities such as income, education, and employment significantly affected healthcare access, compounded by financial barriers and transportation challenges in rural areas. Additionally, low health literacy contributed to misconceptions about vaccines, often exacerbated by traditional beliefs and religious influences favoring alternative remedies over immunization. Moreover, communication barriers, including language differences and healthcare worker attitudes, hindered effective healthcare delivery and contributed to caregiver hesitancy. Consequently, we recommended that tailored health campaigns emphasize the importance and safety of vaccines, with a focus on diverse communities. Concurrently, empowering caregivers with accurate health information through digital literacy initiatives was crucial. Policy recommendations included reducing immunization costs and improving rural access. Enhancing healthcare worker training in cultural competence and effective communication was essential to build trust and address concerns. Systemic reforms integrating immunization into routine maternal and child health services aimed to enhance accessibility. Community engagement played a crucial role in promoting vaccine acceptance and combating misinformation. Strengthening patient-provider relationships and ensuring equitable access to immunization services were pivotal for improving global vaccination rates.

Declarations**Ethics approval and consent to participate:**

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Consent for publication:

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Availability of data and materials

Data and materials used in this review are available from the corresponding author on reasonable request.

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Authors' contributions:

AOA designed the review, drafted the protocol, and registered it with PROSPERO. AOA developed the search strategy, conducted the database search, and meticulously extracted data codes related to STI risk factors during title and abstract screening. OML retrieved and evaluated full-text articles, analyzed findings to identify key themes, and compiled comprehensive study tables. EPKI supervised theme synthesis, resolved discrepancies, and ensured methodological rigor. AOA drafted the manuscript with input from all authors and coordinated the final review.

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REFERENCES

1. Angell B, Sanuade O, Adetifa IM, Okeke IN, Adamu AL, Aliyu MH, Ameh EA, Kyari F, Gadanya MA, Mabayoje DA, Yinka-Ogunleye A. Population health outcomes in Nigeria compared with other west African countries, 1998–2019: a systematic analysis for the Global Burden of Disease Study. *The Lancet*. 2022 Mar 19;399(10330):1117-29. <https://doi.org/10.1097/OLQ.0000000000001372>
2. Fashagba JY. Nigeria: Understanding the Contour of the Political Terrain. *Nigerian Politics*. 2021:1-23. https://doi.org/10.1007/978-3-030-50509-7_1
3. Kew D, Kwaja CM. Religion and peacebuilding in Nigeria. *The Wiley Blackwell Companion to Religion and Peace*. 2022 Jul 28:143-54. <https://doi.org/10.1002/9781119424420.ch12>
4. Unicef. UNICEF Data: Monitoring the situation of children and women. How many children live in Nigeria? 2023. <https://dspace.ceid.org.tr/xmlui/handle/1/2245>
5. Abubakar I, Dalglish SL, Angell B, Sanuade O, Abimbola S, Adamu AL, Adetifa IM, Colbourn T, Ogunlesi AO, Onwujekwe O, Owoaje ET. The Lancet Nigeria Commission: investing in health and the future of the nation. *The Lancet*. 2022 Mar 19;399(10330):1155-200. [https://doi.org/10.1016/S0140-6736\(21\)02488-0](https://doi.org/10.1016/S0140-6736(21)02488-0)
6. Obi-Ani NA, Isiani MC. Urbanization in Nigeria: The onitsha experience. *Cities*. 2020 Sep 1;104:102744. <https://doi.org/10.1016/j.cities.2020.102744>
7. McIntyre P, Walls T. Global public health impact of vaccines in children. In *Oxford Research Encyclopedia of Global Public Health* 2020 May 29. <https://doi.org/10.1093/acrefore/9780190632366.013.64>
8. Ashby E, Jefferson KM, Yadav P, Anupindi R, National Academies of Sciences, Engineering, and Medicine. Vaccine Distribution and Delivery. In *Globally Resilient*

Supply Chains for Seasonal and Pandemic Influenza Vaccines 2021 Nov 17. National Academies Press (US). <https://www.ncbi.nlm.nih.gov/books/NBK580009/>

9. Robson J, Bao J, Wang A, McAlister H, Uwizihiwe JP, Sayinzoga F, Sibomana H, Koswin K, Wong J, Zlotkin S. Making sense of Rwanda's remarkable vaccine coverage success. *Int J Healthc*. 2020;6(1):56. <https://doi.org/10.5430/ijh.v6n1p56>
10. Ezeneme EV, Nwokike CE, Portion UC, Nwanekezi IC. The influence of socioeconomic inequality on maternal and child health outcomes in Nigeria: A critical analysis. *GSJ*. 2023 Oct;11(10).
11. Schleiff M, Olateju A, Decker E, Neel AH, Oke R, Peters MA, Rao A, Alonge O. A multi-pronged scoping review approach to understanding the evolving implementation of the Smallpox and Polio eradication programs: what can other Global Health initiatives learn?. *BMC public health*. 2020 Dec;20:1-3. <https://doi.org/10.1186/s12889-020-09439-1>
12. Uzoma IE. Location, Accessibility and Socioeconomic Correlates of Child Immunisation Coverage in Nigeria. In *Health and Medical Geography in Africa: Methods, Applications and Development Linkages* 2023 Oct 31 (pp. 431-444). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-41268-4_20
13. Hasan T, Lynch M, King C, Wehbe C, Plymoth M, Islam MS, Iannuzzi T, Dao A, Lai J, Martiniuk A, Desai S. Vaccine-Preventable Disease Outbreaks among Healthcare Workers: A Scoping Review. *Clinical Infectious Diseases*. 2024 Apr 17;ciae209. <https://doi.org/10.1093/cid/ciae209>
14. Bloom DE, Kuhn M, Prettnner K. Modern infectious diseases: macroeconomic impacts and policy responses. *Journal of Economic Literature*. 2022 Mar 1;60(1):85-131. <https://doi.org/10.1257/jel.20201642>

15. Sakwape K, Machailo R, Koen MP. Exploring role strain and experiences of caregivers of children living with disabilities. *Nursing Open*. 2023 May;10(5):2886-94. <https://doi.org/10.1002/nop2.1530>
16. Sinumvayo JP, Munezero PC, Tope AT, Adeyemo RO, Bale MI, Mutsaka-Makuvaza MJ, Daba TM, Nyandwi JB, Nzungize L, Mutumwinka D, Omotayo MO. Vaccination and vaccine-preventable diseases in Africa. *Scientific African*. 2024 Mar 29:e02199. <https://doi.org/10.1016/j.sciaf.2024.e02199>
17. Gaythorpe K, Abbas K, Huber J, Karachaliou A, Thakkar N, Woodruff K, Li X, Echeverria-Londono S, VIMC Working Group on COVID-19 Impact on Vaccine Preventable Disease, Ferrari M, Jackson ML. Health impact of routine immunisation service disruptions and mass vaccination campaign suspensions caused by the COVID-19 pandemic: multimodel comparative analysis of disruption scenarios for measles, meningococcal A, and yellow fever vaccination in 10 low-and lower middle-income countries. *medRxiv*. 2021 Jan 26:2021-01. **doi:** <https://doi.org/10.1101/2021.01.25.21250489>
18. Balogun JA. Nigerian Healthcare System. Springer International Publishing; 2021. <https://link.springer.com/book/10.1007/978-3-030-88863-3>
19. Gostin LO, Hodge JG, Bloom BR, El-Mohandes A, Fielding J, Hotez P, Kurth A, Larson HJ, Orenstein WA, Rabin K, Ratzan SC. The public health crisis of underimmunisation: a global plan of action. *The Lancet Infectious Diseases*. 2020 Jan 1;20(1):e11-6. [https://doi.org/10.1016/S1473-3099\(19\)30558-4](https://doi.org/10.1016/S1473-3099(19)30558-4)
20. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 6(7): e1000097. <https://doi.org/10.1371/journal.pmed.1000097>

21. Munn Z, Barker TH, Moola S, Tufanaru C, Stern C, McArthur A, *et al.* Methodological quality of case series studies: an introduction to the JBI critical appraisal tool. *JBI Database Syst Rev Implement Reports*. 2019;2127–33. <https://doi.org/10.043.116/JBISIR-D-19-00099>
22. Corbin, J.M., Strauss, A. Grounded theory research: Procedures, canons, and evaluative criteria. *Qual Sociol* 13, 3–21 (1990). <https://doi.org/10.1007/BF00988593>
23. Sato R, Fintan B. Women’s understanding of immunization card and its correlation with vaccination behaviors. *Human Vaccines & Immunotherapeutics*. 2020 Oct 2;16(10):2408-14. [https://doi.org/10.1016/S1473-3099\(19\)30558-4](https://doi.org/10.1016/S1473-3099(19)30558-4)
24. Omomila JO, Ogunyemi AO, Kanma-Okafor OJ, Ogunnowo BE. Vaccine-related knowledge and utilization of childhood immunization among mothers in urban Lagos. *Nigerian journal of paediatrics*. 2020 Aug 6;47(3):270-6. <https://doi.org/10.4314/njp.v47i3.13>
25. Wallace AS, Willis F, Nwaze E, Dieng B, Sipilanyambe N, Daniels D, Abanida E, Gasasira A, Mahmud M, Ryman TK. Vaccine wastage in Nigeria: an assessment of wastage rates and related vaccinator knowledge, attitudes and practices. *Vaccine*. 2017 Dec 4;35(48):6751-8. <https://doi.org/10.1016/j.vaccine.2017.09.082>
26. Ayodele O. Mothers/caregivers’ knowledge of routine childhood immunization and vaccination status in children aged, 12-23 months in Ilorin, Nigeria. *African Health Sciences*. 2023 Dec 29;23(4):582-91. <https://doi.org/10.4314/ahs.v23i4.61>
27. Akamike IC, Agu AP, Okedo-Alex IN, Umeokonkwo AA, Ogbonna-Igwenyi CO, Madumere OD, Keke CO. Predictors of knowledge and practice of newborn care among post-natal mothers attending immunisation clinics in Southeast Nigeria. *Ghana Medical Journal*. 2022 Sep 30;56(3):127-35. <https://doi.org/10.4314/gmj.v56i3.14>

28. Anyanwu CO, Agunwah L, Ibekwe AM, Okafor CJ, Adike CN, Chijioke UO, Vincent CC, Obeagu EI, Onwasigwe CN, Agu CC. Knowledge and Practice of Childhood Immunization among Men with Infants in Enugu Metropolis. *Journal of Pharmaceutical Research International*. 2021 Jul 31;33(39B):5-15. <https://doi.org/10.9734/jpri/2021/v33i39B32174>
29. Adedire EB, Ajumobi O, Bolu O, Nguku P, Ajayi I. Maternal knowledge, attitude, and perception about childhood routine immunization program in Atakumosa-west Local Government Area, Osun State, Southwestern Nigeria. *The Pan African Medical Journal*. 2021;40(Suppl 1). <https://10.11604/pamj.supp.2021.40.1.30876>
30. Obanewa OA, Newell ML. The role of place of residency in childhood immunisation coverage in Nigeria: analysis of data from three DHS rounds 2003–2013. *BMC public health*. 2020 Dec;20:1-3. <https://doi.org/10.1186/s12889-020-8170-6>
31. Sato R, Fintan B. Fear, knowledge, and vaccination behaviors among women in Northern Nigeria. *Human Vaccines & Immunotherapeutics*. 2020 Oct 2;16(10):2438-48. <https://doi.org/10.1080/21645515.2020.1723365>
32. Oku A, Oyo-Ita A, Glenton C, Fretheim A, Eteng G, Ames H, Muloliwa A, Kaufman J, Hill S, Cliff J, Cartier Y. Factors affecting the implementation of childhood vaccination communication strategies in Nigeria: a qualitative study. *BMC public health*. 2017 Dec;17:1-2. <https://doi.org/10.1186/s12889-017-4020-6>
33. Ibraheem RM, Bello AO, Ibrahim OR, Garba BI, Aliu R, Abdulkadir MB, Hashim R, Ibrahim LM, Mohammed SS, Sambo AH, Ahmed G. Willingness of mothers to receive reminders for routine vaccination appointments in Northern Nigeria: a multi-centre cross-sectional study. *Journal of Tropical Pediatrics*. 2021 Aug 1;67(4):fmab085. <https://doi.org/10.1093/tropej/fmab085>

34. Ibraheem RM, Akintola MA. Acceptability of reminders for immunization appointments via mobile devices by mothers in Ilorin, Nigeria: a cross-sectional study. *Oman medical journal*. 2017 Nov;32(6):471. <https://doi.org/10.5001%2Fomj.2017.91>
35. Umeokonkwo AA, Ezeonu TC, Agu AP, Umeokonkwo CD. Timeliness of vaccination among children attending immunization clinic at a tertiary hospital in South-East Nigeria. *Nigerian Medical Journal: Journal of the Nigeria Medical Association*. 2021 Jul;62(4):153. <https://doi.org/10.60787%2FNMJ-62-4-29>
36. Iliyasu Z, Hassan-Hanga F, Ajuji SI, Bello MM, Abdulkadir SS, Nass NS, Salihu HM, Aliyu MH. Correlates of Health Care Workers' Knowledge and HIV-Exposed Infant Immunization Counseling Practice in Northern Nigeria. *International Journal of Maternal and Child Health and AIDS*. 2021;10(1):55. <https://doi.org/10.21106%2Fijma.432>
37. Akinrinade OT, Ajayi IO, Fatiregun AA, Isere EE, Yusuf BO. Ownership of mobile phones and willingness to receive childhood immunisation reminder messages among caregivers of infants in Ondo State, south-western Nigeria. *South African Journal of Child Health*. 2018 Sep 1;12(3):111-6. <https://hdl.handle.net/10520/EJC-1182c905df>
38. Akaba GO, Dirisu O, Okunade KS, Adams E, Ohioghame J, Obikeze OO, Izuka E, Sulieman M, Edeh M. Barriers and facilitators of access to maternal, newborn and child health services during the first wave of COVID-19 pandemic in Nigeria: findings from a qualitative study. *BMC health services research*. 2022 May 6;22(1):611. <https://doi.org/10.1186/s12913-022-07996-2>
39. Valekar SS, Afoke EN, Ikechukwu IC, Aleke CO, Omaka-Omari LN, Imah HI, Ohuruogu BN, Nnubia AO, Okeke IM, Obinna OE. Influence of maternal factors on the immunization

status of under-five in Ebonyi state. *Int J Community Med Public Health*. 2023 Oct;10(10):3535-3544. <http://doi.org/10.18203/2394-6040.ijcmph20221449>

40. Abdullahi AT, Farouk ZL, Imam A. Common mental disorders in mothers of children attending out-patient malnutrition clinics in rural North-western Nigeria: a cross-sectional study. *BMC Public Health*. 2021 Dec;21:1-9. <https://doi.org/10.1186/s12889-021-10227-8>
41. Anichukwu OI, Asamoah BO. The impact of maternal health care utilisation on routine immunisation coverage of children in Nigeria: a cross-sectional study. *BMJ open*. 2019 Jun 1;9(6):e026324. <https://doi.org/10.1136/bmjopen-2018-026324>
42. Adeyanju GC, Betsch C. Vaccination decision-making among mothers of children 0–12 months old in Nigeria: A qualitative study. *Human Vaccines & Immunotherapeutics*. 2024 Dec 31;20(1):2355709. <https://doi.org/10.1080/21645515.2024.2355709>
43. Ogundele OA, Ogundele T. Analysis of the effect of health education activities on selected child health determinants in two communities of Ile Ife, Nigeria. *Ethiopian Journal of Health Sciences*. 2018 Mar 22;28(2):217-26. <https://doi.org/10.4314/ejhs.v28i2.13>
44. Cover R, Haw A, Thompson JD. Marginalising the marginalised: Fake news as a tool of populist power. In *Fake news in digital cultures: Technology, populism and digital misinformation* 2022 Mar 8 (pp. 93-107). Emerald Publishing Limited. <https://doi.org/10.1108/978-1-80117-876-120221007>
45. World Health Organization. Eleventh Pacific Immunization Programme Managers Meeting, Virtual meeting, 14-16 July 2020: meeting report. <https://iris.who.int/bitstream/handle/10665/338720/RS-2020-GE-21-FJI-eng.pdf>

46. Malik D, Narayanasamy N, Pratyusha VA, Thakur J, Sinha N. Understanding Nutrition. In: Textbook of Nutritional Biochemistry 2023 Dec 1 (pp. 43-64). Singapore: Springer Nature Singapore. <https://link.springer.com/content/pdf/bfm:978-981-19-4150-4/1>
47. Raghupathi V, Raghupathi W. The influence of education on health: an empirical assessment of OECD countries for the period 1995–2015. *Archives of Public Health*. 2020 Dec;78:1-8. <https://doi.org/10.1186/s13690-020-00402-5>
48. Patel R, Chauhan S. Gender differential in health care utilisation in India. *Clinical Epidemiology and Global Health*. 2020 Jun 1;8(2):526-30. <https://doi.org/10.1016/j.cegh.2019.11.007>
49. Fleming MD, Shim JK, Yen IH, Thompson-Lastad A, Rubin S, Van Natta M, Burke NJ. Patient engagement at the margins: health care providers' assessments of engagement and the structural determinants of health in the safety-net. *Social Science & Medicine*. 2017 Jun 1;183:11-8. <https://doi.org/10.1016/j.socscimed.2017.04.028>
50. Liang L, Cako A, Urquhart R, Straus SE, Wodchis WP, Baker GR, Gagliardi AR. Patient engagement in hospital health service planning and improvement: a scoping review. *BMJ open*. 2018 Jan 1;8(1):e018263. <https://doi.org/10.1136/bmjopen-2017-018263>
51. Machado AA, Edwards SA, Mueller M, Saini V. Effective interventions to increase routine childhood immunization coverage in low socioeconomic status communities in developed countries: A systematic review and critical appraisal of peer-reviewed literature. *Vaccine*. 2021 May 21;39(22):2938-64. <https://doi.org/10.1016/j.vaccine.2021.03.088>
52. World Health Organization WHO Regional websites. Pacific W. World. 2023 Jun 7. https://iris.who.int/bitstream/handle/10665/170778/EB89_1992-REC-1_eng.pdf?sequence=1

53. Foday I, Stephenson JD. Knowledge of Measles and How Caregivers Decide Between Modern and Traditional Treatments. A Case Study of Campbell Town Community, Waterloo-Sierra Leone. A Case Study of Campbell Town Community, Waterloo-Sierra Leone (August 4, 2023). 2023 Aug 4. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID4817376_code6715606.pdf?abstractid=4817376&mirid=1
54. Alsuwaidi AR, Hammad HA, Elbarazi I, Sheek-Hussein M. Vaccine hesitancy within the Muslim community: Islamic faith and public health perspectives. *Human Vaccines & Immunotherapeutics*. 2023 Jan 2;19(1):2190716. <https://doi.org/10.1080/21645515.2023.2190716>
55. Aksnes BN, Walldorf JA, Nkwenkeu SF, Zoma RL, Mirza I, Tarbangdo F, Fall S, Hien S, Ky C, Kambou L, Diallo AO. Vaccination information, motivations, and barriers in the context of meningococcal serogroup A conjugate vaccine introduction: A qualitative assessment among caregivers in Burkina Faso, 2018. *Vaccine*. 2021 Oct 15;39(43):6370-7. <https://doi.org/10.1016/j.vaccine.2021.09.038>
56. Khatri RB, Assefa Y. Access to health services among culturally and linguistically diverse populations in the Australian universal health care system: issues and challenges. *BMC Public Health*. 2022 May 3;22(1):880. <https://doi.org/10.1186/s12889-022-13256-z>
57. Syed U, Kapera O, Chandrasekhar A, Baylor BT, Hassan A, Magalhães M, Meidany F, Schenker I, Messiah SE, Bhatti A. The role of faith-based organizations in improving vaccination confidence & addressing vaccination disparities to help improve vaccine uptake: a systematic review. *Vaccines*. 2023 Feb 15;11(2):449. <https://doi.org/10.3390/vaccines11020449>

58. Mekonnen ZA, Gelaye KA, Were MC, Tilahun B. Acceptability, barriers and facilitators of mobile text message reminder system implementation in improving child vaccination: a qualitative study in Northwest Ethiopia. *Journal of Multidisciplinary Healthcare*. 2021 Mar 9;605-16. <https://doi.org/10.2147/JMDH.S298167>
59. Al-Shorbaji N, Al-Shorbaji N. Improving healthcare access through digital health: the use of information and communication technologies. *Healthcare Access*. 2021 Aug 30;10.
60. Dudeja N, Khan T, Varughese DT, Abraham SG, Ninan MM, Prasad CL, Sarkar R, Kang G. Technologies for strengthening immunization coverage in India: a systematic review. *The Lancet Regional Health-Southeast Asia*. 2024 Apr 1;23. <https://doi.org/10.1016/j.lansea.2023.100251>
61. Williams SV, Akande T, Abbas K. Systematic review of social determinants of childhood immunisation in low-and middle-income countries and equity impact analysis of childhood vaccination coverage in Nigeria. *Plos one*. 2024 Mar 6;19(3):e0297326. <https://doi.org/10.1371/journal.pone.0297326>
62. Stan S, Erne R. Time for a paradigm change? Incorporating transnational processes into the analysis of the emerging European health-care system. *Transfer: European Review of Labour and Research*. 2021 Aug;27(3):289-302. <https://doi.org/10.1177/10242589211026815>
63. Pepinsky TB, Pierskalla JH, Sacks A. Bureaucracy and service delivery. *Annual Review of Political Science*. 2017 May 11;20:249-68. <https://doi.org/10.1146/annurev-polisci-051215-022705>

64. Vindrola-Padros C, Andrews L, Dowrick A, Djellouli N, Fillmore H, Gonzalez EB, et al. Perceptions and experiences of healthcare workers during the COVID-19 pandemic in the UK. *BMJ Open*. 2020 Nov;10(11). <https://doi.org/10.1136/bmjopen-2020-040503>
65. Liu Q, Luo D, Haase JE, Guo Q, Wang XQ, Liu S, et al. The experiences of health-care providers during the COVID-19 crisis in China: a qualitative study. *Lancet Glob Health*. 2020 Jun;8(6). [https://doi.org/10.1016/S2214-109X\(20\)30204-7](https://doi.org/10.1016/S2214-109X(20)30204-7)
66. Asresie MB, Fekadu GA, Dagne GW. Urban-rural disparities in immunization coverage among children aged 12–23 months in Ethiopia: multivariate decomposition analysis. *BMC Health Services Research*. 2023 Sep 7;23(1):969. <https://doi.org/10.1186/s12913-023-09940-4>
67. Kaur R, Callaghan T, Regan AK. Disparities in maternal influenza immunization among women in rural and urban areas of the United States. *Preventive Medicine*. 2021 Jun 1;147:106531. <https://doi.org/10.1016/j.ypmed.2021.106531>
68. Amanna IJ, Slifka MK. Successful vaccines. Vaccination strategies against highly variable pathogens. 2020:1-30. https://doi.org/10.1007/82_2018_102
69. Powelson J, Magadzire BP, Draiva A, Denno D, Ibraimo A, Benate BB, Jahar LC, Marrune Z, Chilundo B, Chinai JE, Emerson M. Determinants of immunisation dropout among children under the age of 2 in Zambézia province, Mozambique: a community-based participatory research study using Photovoice. *BMJ open*. 2022 Mar 1;12(3):e057245. <https://doi.org/10.1136/bmjopen-2021-057245>
70. Schurer JM, Fowler K, Rafferty E, Masimbi O, Muhire J, Rozanski O, Amuguni HJ. Equity for health delivery: Opportunity costs and benefits among Community Health Workers in

Rwanda. Plos one. 2020 Sep 3;15(9):e0236255.
<https://doi.org/10.1371/journal.pone.0236255>

71. Little C, Choudhury S. A review of the scheduling problem within Canadian healthcare centres. *Appl Sci*. 2022 Nov;12(21):11146. <https://doi.org/10.3390/app122111146>
72. Huffman A. From “A Campfire to a Forest Fire”: The Devastating Effect of Wait Times, Wall Times and Emergency Department Boarding on Treatment Metrics. *Ann Emerg Med*. 2023 Jan;81(1). <https://doi.org/10.1016/j.annemergmed.2022.11.011>
73. Ogbolosingha AJ, Singh A. COVID-19 pandemic: Review of impediments to public health measures in Sub-Saharan Africa. *Am J Prev Med Public Health*. 2020;6(3):68-75. <https://doi.org/10.5455/ajpmph.20200512020014>
74. Octavius GS, Antonio F. Antecedents of intention to adopt mobile health (mHealth) application and its impact on intention to recommend: An Evidence from Indonesian customers. *International journal of telemedicine and applications*. 2021;2021(1):6698627. <https://doi.org/10.1155/2021/6698627>
75. Erku D, Khatri R, Endalamaw A, Wolka E, Nigatu F, Zewdie A, Assefa Y. Community engagement initiatives in primary health care to achieve universal health coverage: A realist synthesis of scoping review. *Plos one*. 2023 May 3;18(5):e0285222. <https://doi.org/10.1371/journal.pone.0285222>
76. Lamrani S. The health system in Cuba: Origin, doctrine and results. *Études caribéennes*. 2021 Jul 15(7). <https://doi.org/10.4000/etudescaribeennes.24110>

Table 1: Summary of study Characteristics of selected studies and key findings

Reference	Author	Title research	Aim of research	Population	Method	Findings (Barriers Immunization)	Conclusion
23	Sato and Fintan 2020	Women's understanding of immunization card and its correlation with vaccination behaviors	To evaluate caregivers' knowledge of the vaccination schedule and their ability to read the immunization card in Jada local government area of Adamawa State, Nigeria.	515 caregivers in 11 settlements in the Jada local government area of Adamawa State, Nigeria.	Cross sectional	More than half of the women had correct knowledge of the vaccination schedule for critical vaccines, yet the knowledge of those without this information did not improve after referring to the immunization card; however, caregivers who recently brought their children to the clinic were more likely to know the schedule correctly, and accurate knowledge was highly correlated with actual vaccination behaviors.	Referring to the immunization card did not improve vaccination schedule knowledge, particularly among the less-educated. Policies should target the uneducated population to boost their knowledge and increase vaccination demand.
24	Omomila et al., 2020	Vaccine-related knowledge and utilization of childhood immunization among mothers in urban Lagos	To assess mothers' knowledge and immunization utilization among under-five children in an urban community.	232 mothers of under-five children in an urban community in Lagos State.	Cross sectional	All respondents were aware of immunization. However, only 53.9% of mothers had good knowledge about it, and just 42.5% of under-five children were fully immunized. The most missed vaccines were oral polio and pentavalent. There was a significant association between mothers' knowledge and their children's immunization status	Mothers with good knowledge of immunization were more likely to have fully vaccinated children. Health workers should enlighten mothers on the benefits of each vaccine to improve immunization rates.

25	Wallace et al., 2017	Vaccine wastage in Nigeria: An assessment of wastage rates and related vaccinator knowledge, attitudes and practices	To evaluate vaccine wastage rates, knowledge of wastage policies, and stock management practices, and to identify missed opportunities for routine vaccination in Nigeria.	The target population includes 263 caregivers across 6 geopolitical zones and the Federal Capital Territory (FCT) in Nigeria.	Cross sectional	Nearly half of facilities had incomplete vaccine stock data. Those with sufficient data had monthly wastage rates of 18% to 35% across all vaccines, with no difference between lyophilized and liquid vaccines. While 98% of vaccinators blamed high wastage for recent stockouts, only 55% knew the multi-dose vial policy. They typically required six children before using a 10-dose MCV vial. DTP3 was given in 84% of sessions, MCV in 63%. 30% of caregivers were turned away for vaccination, with 53% of these children missing their dose.	There is significant vaccine wastage and missed vaccination opportunities in Nigeria. Many health facilities lack adequate knowledge of wastage policies and need better stock management practices. Improved training and adherence to the multi-dose vial policy could reduce wastage and improve vaccination coverage.
26	Ayodele, 2023	Mothers/caregivers' knowledge of routine childhood immunization and vaccination status in children aged, 12-23 months in Ilorin, Nigeria	To determine the knowledge of mothers/caregivers regarding routine childhood immunization and the vaccination status of their children aged 12-23 months and identify socio-demographic factors associated with good knowledge.	The study involved 456 pairs of mothers/caregivers and their children aged 12-23 months in Ilorin East Area, Kwara State, Nigeria.	Cross sectional	Awareness of childhood immunization was high, with 98.0% of respondents being aware, primarily informed by healthcare providers (92.1%). A significant majority (85.3%) had good knowledge of immunization, which correlated with a higher rate of full vaccination among children. Factors positively associated with good knowledge included mothers/caregivers being older than 30 years attending antenatal clinics and having at least secondary education.	Mothers and caregivers demonstrated good knowledge of immunization, which positively impacted the vaccination status of their children. Enhancing female education and encouraging antenatal clinic attendance are vital strategies for improving childhood immunization rates.

27	Akamike et al., 2022	Predictors of knowledge and practice of newborn care among post-natal mothers attending immunization clinics in Southeast Nigeria	To assess the knowledge, practice-associated factors, and predictors of essential newborn care among post-natal mothers attending immunization clinics in Southeast Nigeria.	400 post-natal mothers attending immunization clinics in two primary health care centers in Southeast Nigeria.	Cross sectional	The majority of participants had good knowledge (77%) and practiced essential newborn care (61%). Predictors of good practice included older age, being married, urban residence, and having good knowledge of newborn care. Health facility delivery and support from health workers were associated with better newborn care practices.	The study highlights the importance of health facility delivery, ongoing support from health workers, and targeted post-natal education for rural mothers to improve newborn care. These findings advocate for policy priorities to enhance maternal and newborn health outcomes in Southeast Nigeria.
28	Anyanwu et al., 2021	Knowledge and Practice of Childhood Immunization among Men with Infants in Enugu Metropolis	This study aimed to assess the knowledge and practices of childhood immunization among men with infants in Enugu Metropolis.	The study involved 81 men with infants selected from Ogbete Main Market in Enugu, employing a multi-stage sampling approach	Cross sectional	The study found that the participants had a median age of 35 years, with a mean age of 35.8 ± 3.5 years. Significant associations were identified between the men's overall knowledge levels and their educational backgrounds. Additionally, immunization practices among the participants showed significant associations with their religious affiliations.	The study concludes that although the men showed good knowledge about immunization, their actual practices were poor. This underscores the necessity for targeted educational interventions to narrow the gap between knowledge and practice among fathers and male caregivers in Enugu Metropolis, thereby enhancing childhood immunization rates.
29	Adedire et al., 2021	Maternal knowledge, attitude, and perception about childhood routine immunization program in Atakumosa-west	The aim of the study was to assess mothers' knowledge, attitudes, and perceptions toward the Routine Immunization (RI) program	The study enrolled 750 mothers through WHO cluster sampling in Atakumosa West LGA,	Cross sectional	The mean age of mothers was 27.9 years (± 6.1). 76% of mothers demonstrated good knowledge of RI and VPDs, and the majority exhibited positive attitudes toward the RI program. Factors significantly associated with good knowledge included attendance at antenatal care, health facility delivery, higher	The study concludes that a substantial proportion of mothers in Atakumosa West LGA, Osun State, have good knowledge about childhood RI. Efforts should focus on sustaining current health education strategies in antenatal care

		Local Government Area, Osun State, Southwestern Nigeria		Osun State, Nigeria.		education levels, and tetanus toxoid immunization status.	settings while exploring additional approaches to further enhance immunization knowledge among mothers.
30	Obanewa and Newell 2020	The role of place of residency in childhood immunisation coverage in Nigeria: analysis of data from three DHS rounds 2003–2013	To explore the associations between child, household, community, and health system level factors and fully-immunized child coverage (FIC) in Nigeria, focusing on urban formal, urban slum, and rural residence	The study population included 11,844 children aged 12-23 months in Nigeria, stratified by rural, urban formal, and urban slum residences,	Cross sectional	FIC increased from 7.4% in rural areas, 25.6% in urban formal areas, and 24.9% in urban slums in 2003 to 15.8%, 45.5%, and 38.5% respectively in 2013, with variations across socio-demographics. Maternal education had a significant impact on FIC: higher education was associated with increased odds of FIC in rural, urban formal, and slum areas. The Population Attributable Risk (PAR) indicated that improving maternal education could significantly increase FIC: rural (38.15 percentage points), urban formal (22.88), and slum (23.76).	Low FIC in rural areas is largely due to a lack of health facilities and immunization education, while the reasons for intra-urban disparity are less clear and require further qualitative and interventional research. Addressing specific sociodemographic risks, particularly improving maternal education, can significantly enhance FIC in various communities, guiding prioritization of interventions.
31	Sato and Fintanb 2020	Fear, knowledge, and vaccination behaviors among women in Northern Nigeria	To investigate the correlation between fear of vaccination and knowledge, behaviors, and perceptions related to vaccination in Jada local government area of Adamawa	A total of 412 caregivers who have a child of 8 months old and younger.	Cross sectional	Approximately 15% of caregivers expressed fear regarding vaccination. This fear was not significantly correlated with most socio-demographic characteristics of caregivers. However, fear was significantly associated with lower levels of accurate vaccination knowledge, decreased likelihood of vaccinating their children, and diminished perceptions of the importance of vaccination and intention to vaccinate their children.	The study underscores the impact of fear of vaccination on caregivers' vaccination-related knowledge, behaviors, and perceptions in northeastern Nigeria. Addressing these fears through targeted educational interventions is crucial for improving vaccination uptake and mitigating vaccine hesitancy in the region.

			State, northeastern Nigeria				
32	Oku <i>et al.</i> , 2017	Factors affecting the implementation of childhood vaccination communication strategies in Nigeria: a qualitative study	The study aimed to explore factors affecting the delivery of vaccination communication in Nigeria	A total of 30 participants, involved in vaccination communication within the health services, were included in Bauchi and Cross River States, Nigeria.	Qualitative study	The study identified several barriers to vaccination communication delivery at both health system and community levels, including funding constraints, human resource factors (shortages, training deficiencies, poor attitudes), inadequate infrastructure, and weak political will. Community level factors included attitudes of community stakeholders and parents/caregivers. Facilitators included political support, engagement of traditional and religious institutions, and organized communication committees.	Effective communication is essential for successful immunization programs. Understanding and addressing barriers such as funding constraints, human resource issues, and community attitudes are critical for improving vaccination communication delivery. Policy makers and program managers should leverage facilitators like political support and community engagement to enhance vaccination communication strategies
33	Ibraheem <i>et al.</i> , 2021	Willingness of Mothers to Receive Reminders for Routine Vaccination Appointments in Northern Nigeria: A Multi-Centre Cross-Sectional Study	To assess the willingness of mothers to receive reminder messages for routine vaccination appointments in Northern Nigeria.	A total of 1952 mother–infant pairs from five states in Northern Nigeria,	Cross sectional	The study found that 97.7% of households owned at least one phone, and 82.6% of mothers were willing to receive vaccination reminders. Among them, 62.2% preferred phone calls, with 78.1% favoring reminders a day before the appointment. The local language was the preferred communication method. Mothers with lower education levels were more willing to receive reminders compared to	Eight out of ten women in Northern Nigeria are willing to receive vaccination reminders, preferably via phone calls in the local language. Implementing mobile phone reminders is feasible and could improve vaccination uptake, with collaboration with

						those with tertiary education. Mothers who delivered at home were less likely to want reminder messages.	service providers recommended.
34	Ibraheem and Akintola 2017	Acceptability of Reminders for Immunization Appointments via Mobile Devices by Mothers in Ilorin, Nigeria: A Cross-sectional Study	This study aimed to evaluate the acceptability of reminders for immunization appointments among mothers in Ilorin, Nigeria, as a potential strategy to improve vaccination coverage.	The study recruited 526 mothers from two public hospitals in Ilorin, Nigeria.	Cross sectional	In Ilorin, Nigeria, 92.7% of mothers owned phones and provided contact details; 69.0% were willing to receive immunization reminders. Factors influencing willingness included postsecondary education, antenatal care, and having ≤ 4 children. Artisan mothers were less likely to want reminders compared to unemployed mothers.	The study finds that most mothers in Ilorin, Nigeria, are willing to receive immunization appointment reminders via mobile phones, influenced by education, antenatal care, and number of children. Integrating reminders into immunization strategies could effectively boost coverage, leveraging widespread phone ownership among mothers.
35	Umeokonkwo <i>et al.</i> , 2021	Timeliness of Vaccination among Children Attending Immunization Clinic at a Tertiary Hospital in South-East Nigeria	The aim of the study was to assess the proportion of children receiving timely vaccinations and to identify factors influencing the timely receipt of Bacillus Calmette Guerin (BCG) and the third dose of the pentavalent vaccine (Penta 3) among caregivers in Nigeria.	The study included 599 caregiver-infant pairs aged less than 24 months, attending the immunization clinic of a tertiary hospital in Nigeria.	Cross sectional	Caregivers averaged 30.1 years old, with 73.8% having tertiary education and 90.9% residing in urban areas. Nearly all received antenatal care (99.3%), and most infants were hospital-delivered (97.0%). About half of the children were male (52.9%), and 18% of caregivers missed vaccinations due to forgetfulness (18%), child illness (14%), or being busy (5%). Timely BCG and OPV0 vaccinations were 88% and 91.1%, respectively, but only 29.5% received HBV0 within 24 hours. Measles and yellow fever vaccine timeliness rates were 65.7% and 65.0%.	The findings underscore the need for targeted interventions to improve timely vaccination coverage, particularly for HBV0, measles-containing vaccine, and yellow fever vaccine, despite high overall caregiver education and healthcare access levels in urban Nigeria.

36	Iliyasu, <i>et al.</i> , 2021	Correlates of Health Care Workers' Knowledge and HIV-Exposed Infant Immunization Counseling Practice in Northern Nigeria	This study aimed to assess predictors of health care workers' knowledge of HIV-exposed and HIV-infected infant immunization, as well as their counseling practices, in a tertiary center in Northern Nigeria.	The study included 297 health care workers from various units within the tertiary center,	Cross sectional	Only 32.3% of health care workers demonstrated adequate knowledge of HIV-exposed and HIV-infected infant immunization. A significant proportion appropriately identified the timing of infant diagnosis (67%), categorized infants as HIV-exposed (73%), and HIV-infected (56.2%). However, only 19.5% had counselled a HIV-positive mother on infant immunization.	Healthcare workers lacked sufficient knowledge and exhibited sub-optimal counselling practices for HIV-exposed and infected infant immunization. Influencing factors included work unit, age, experience, children, training, sex, profession, and HIV testing history. Targeted education and capacity-building are needed to improve knowledge and practices.
37	Akinrinade et al., 2018	Ownership of mobile phones and willingness to receive childhood immunisation reminder messages among caregivers of infants in Ondo State, south-western Nigeria	Assess mobile phone ownership among caregivers of infants, their knowledge of immunisation service delivery, and willingness to receive immunisation schedule reminders in Ondo State, Nigeria	A total of 615 caregivers of infants, who brought their children to clinics	Cross sectional	Mobile phone ownership was higher in urban areas (95.8%) compared to rural areas (74.5%). Knowledge about immunisation and vaccination schedules was good among 46% of respondents, while 27.5% had poor knowledge. Almost all caregivers (99.7%) expressed willingness to receive immunisation reminders via their phones. Half of the respondents preferred to receive reminders at any time, with English being the most preferred language (54.5%).	High mobile phone ownership and willingness to receive reminders among caregivers suggest potential for enhancing immunisation uptake. Recommendations include providing mobile phone support and training, especially in rural areas, to optimize this technology for improving childhood immunisation rates.
38	Akaba et al., 2023	Barriers and facilitators of access to maternal, newborn and child health services during the first wave of COVID-19 pandemic in Nigeria: findings	To explore the barriers and facilitators of access to MNCH services during the first wave of the COVID-19 pandemic in Nigeria.	Included 54 Stakeholders including service users, service providers, and	Qualitative study	Access to MNCH services was negatively impacted by lockdowns during the first wave of the COVID-19 pandemic in Nigeria. Movement restrictions hindered both patients and healthcare providers from reaching hospitals and affected patients' ability to pay for services. Fear of contracting COVID-19 at health facilities, along with shortages of PPE and medical supplies, long	Access to MNCH services was negatively affected by the lockdown during the first wave of COVID-19 in Nigeria, mainly due to movement restrictions that hindered both patients and healthcare providers from reaching hospitals and affected patients' ability to pay for services.

		from a qualitative study		policy-makers from 18 public health facilities in Nigeria		waiting times, manpower shortages, unprepared health workers, and the prioritization of essential services, further reduced service utilization.	
39	Valekar et al., 2023	Influence of maternal factors on the immunization status of under-five in Ebonyi state	To determine the influence of maternal characteristics on the immunization status of under-five children in Ebonyi State, Nigeria.	The study focused on 2865 under-five children in Ebonyi State.	Cross sectional	The study found that 83.01% of under-five children in Ebonyi State were fully immunized. Significant associations were observed between the immunization status of children and mothers' parity, occupation, and use of antenatal services. Maternal factors such as parity, occupation, and antenatal service utilization significantly influenced children's immunization status.	The study concluded that immunization coverage was high among under-five children in Ebonyi State. Recommendations included providing incentives for full immunization and implementing policies to prevent enrollment of children without immunization cards in schools.
40	Abdullahi et al., 2021	Common mental disorders in mothers of children attending outpatient malnutrition clinics in rural North-western Nigeria: a cross-sectional study	This study aimed to determine the burden and identify risk factors associated with maternal Common Mental Disorders (CMDs) among mothers of children attending outpatient malnutrition clinics.	The study involved 204 mothers of children with severe acute malnutrition in Jigawa, North-western Nigeria.	Cross sectional	The prevalence of maternal CMDs among mothers attending these clinics was high, at 40.7%. Factors significantly associated with increased odds of CMDs included non-receipt of oral polio vaccine (OPV). Conversely, older spousal age (above 40 years) and longer years spent married were associated with decreased odds of CMDs.	The study underscores a high burden of maternal CMDs among mothers of children attending outpatient malnutrition clinics in North-western Nigeria. Integration of maternal mental health services into community management of acute malnutrition programs is crucial to provide comprehensive care and potentially improve long-term outcomes post-discharge.

41	Anichukwu <i>et al.</i> , 2019	The impact of maternal health care utilization on routine immunisation coverage of children in Nigeria: a cross-sectional study	The aim of this study was to examine the impact of maternal healthcare (MHC) utilization on routine immunization coverage of children in Nigeria.	The study included 5,506 women aged 15–49 years with children aged 12–23 months using data from NDHS 2013.	Cross sectional	The study found that antenatal care (ANC) attendance, skilled birth attendance (SBA), and maternal postnatal care (PNC) attendance were significantly associated with higher rates of full immunization among children in Nigeria.	The findings suggest that improving maternal healthcare utilization, particularly ANC, SBA, and PNC services, could effectively enhance routine immunization coverage of children in Nigeria
42	Adeyanju and Betscha <i>et al.</i> , 2024	Vaccination decision-making among mothers of children 0–12 months old in Nigeria: A qualitative study	The aim of this study was to investigate the factors influencing mothers' decision-making regarding vaccination in Nigeria, particularly focusing on understanding the barriers and motivations related to vaccine uptake.	The study included 24 mothers of children aged 0–12 months from four geographical clusters in Nigeria, selected using a simplified quota sampling method.	Qualitative study	The study revealed that mothers generally viewed vaccination positively but had concerns about vaccine safety and trust in the healthcare system. They were keen on obtaining more information about vaccines but struggled to prioritize vaccination due to competing demands. Mothers recognized the broader community benefits of vaccination and often linked health outcomes to religious beliefs. Husbands played a crucial role in vaccination decisions, highlighting the influence of masculinity. Mothers' motivation for vaccination stemmed from their perception of their children's vulnerability to disease outbreaks.	This study offers crucial insights into factors shaping mothers' vaccination decisions in Nigeria. Addressing barriers like vaccine safety concerns, improving information access, and understanding cultural and gender dynamics are essential for effective vaccination strategies in resource-constrained settings.

43	Ogundele and Ogundele 2018	Analysis of the Effect of Health Education Activities on Selected Child Health Determinants in Two Communities of Ile Ife, Nigeria	The aim of this study was to assess the effect of community-level health education activities on selected child health determinants in Ile Ife, Nigeria.	The study included 722 caregivers who are mothers of index children aged 0-59 months.	Cross sectional	The study found significant differences in child health outcomes between implementing and non-implementing LGAs. In the implementing LGA, 89.1% and 79.8% of children aged 9 months and above received Vitamin A supplementation, compared to lower rates in the non-implementing LGA. For children aged 12-23 months, 93.4% received DPT3 and 91.8% received measles vaccine in the implementing LGA, whereas only 66.7% received DPT and 64% received measles vaccine in the non-implementing LGA. Children in the implementing LGA were three times more likely to receive DPT vaccine and five and a half times more likely to receive measles vaccine compared to the non-implementing LGA.	The study concluded that community-level health education activities have a positive impact on child health practices and determinants. Implementing health education as part of community integrated management of childhood illness (CIMCI) resulted in higher rates of Vitamin A supplementation, DPT vaccination, and measles vaccination among children in the study area.
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Table 2: Thematic table

Themes	Subthemes	Codes
Knowledge and Awareness	Inadequate Health Literacy	1. Misconceptions [1] 2. Misinformation [24] 3. Low knowledge [26, 29, 27, 34, 37, 31, 32, 43, 42, 35]
	Communication Gaps	1. Ineffective communication [24, 42] 2. Fear [31] 3. Anxiety [31] 4. Poor training of healthworkers [32]
	Mobile Phone Ownership	1. Knowledge gaps [34] 2. Reminder systems [34] 3. Access to information [37]
Access and Availability	Geographical Barriers	1. Sparse healthcare facilities [25, 27, 30] 2. Transportation issues [25] 3. Lockdown effects [38]
	Healthcare Infrastructure Disparities	1. Urban vs. rural differences [27] 2. Quality of care [30] 3. Essential services [32]
	Economic Barriers	1. High out-of-pocket costs [38] 2. Financial constraints [42, 35]
	Impact of Maternal Healthcare Utilization	1. Poor Antenatal care services [41] 2. Untrained Skill Birth Attendants [41] 3. Poor Post Natal Care attendance [41] 4. Inconsistent Immunization attendance [41]
Attitudes and Beliefs	Stigma and Discrimination	1. Mental health [40] 2. STIs [36] 3. COVID-19 [38] 4. Fear [28] 5. Mistrust [37, 32, 42]
	Influence of Traditional Healers	1. Delay in medical care [32] 2. Reliance on traditional practices [32]

Healthcare System Factors	Religious Beliefs	1. Reliance on religious beliefs [32] 2. Religion influence on Vaccination decisions [42, 28]
	Systemic Challenges	1. Overcrowding [32] 2. Understaffing [32] 3. Long wait times [32]
	Training and Knowledge Deficiencies	1. Insufficient training [33] 2. Outdated knowledge [33]
	Bureaucratic Procedures	1. Delays in care [34] 2. Administrative inefficiencies [34]
	Fragmentation in Services	1. Disjointed coordination [41] 2. Continuity of care [41]
	Funding and Resource Allocation	1. Inadequate funding [43] 2. Resource disparities [43]
	Communication Within Healthcare Systems	1. Limited communication [36] 2. Health worker shortages [32] 3. Attitudes [32, 37, 33, 34]
Sociodemographic Factors	Financial Barriers	1. Income levels [27] 2. Employment status [34, 38]
	Gender and Cultural Expectations	1. Gender-specific behavior [28] 2. Role of husbands [42]
	Educational Attainment	1. Health literacy [30] 2. Maternal education [28, 33]
	Age	1. Compliance with vaccination [26] 2. Older caregivers [40, 27]
	Language Barriers	1. Communication preferences [37] 2. Comprehension [33, 31]
	Urban vs. Rural Disparities	1. Infrastructure [30] 2. Mobile phone ownership [27] 3. Healthcare access [32]

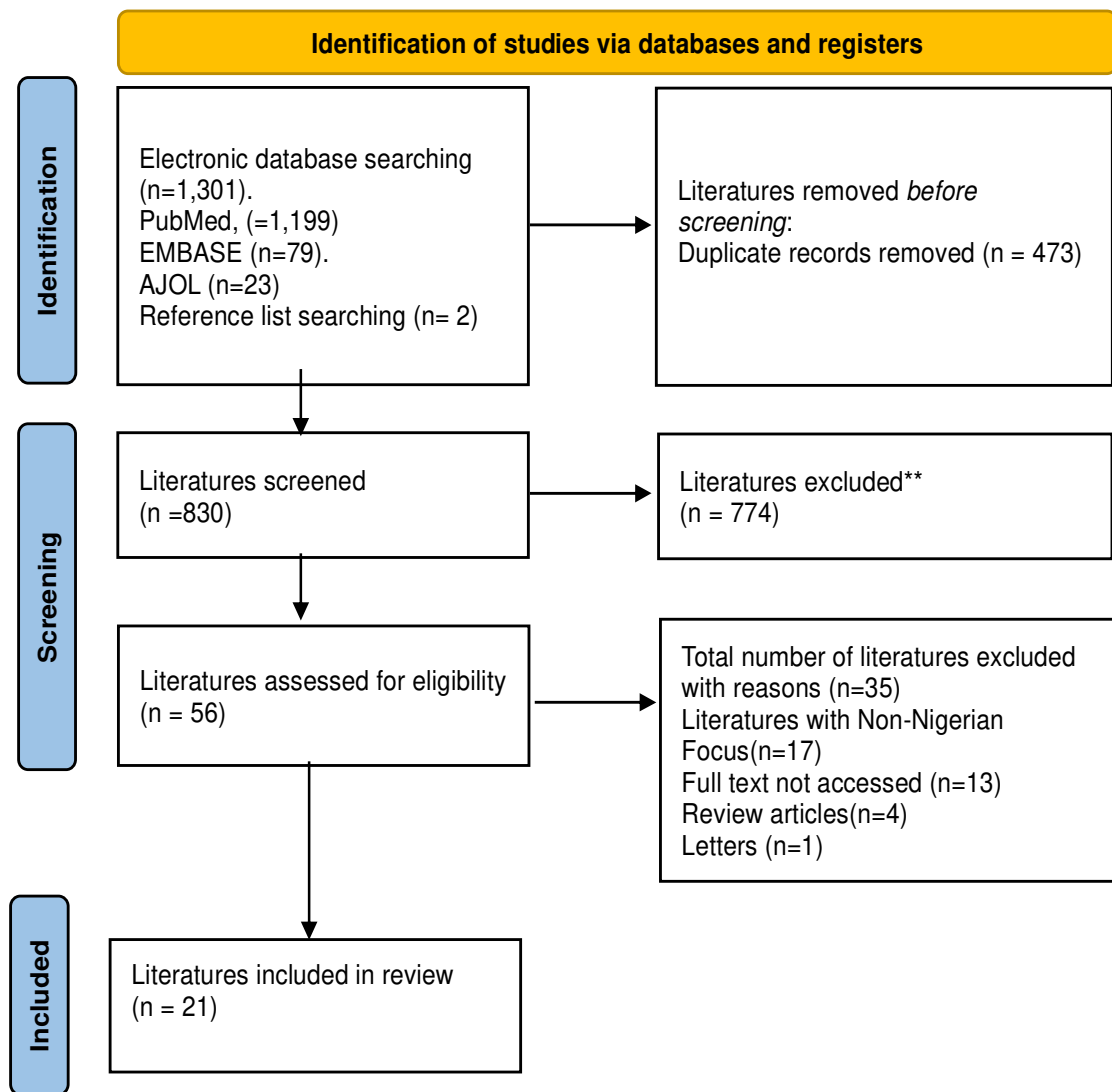


Figure 1 PRISMA Literature selection flow diagram

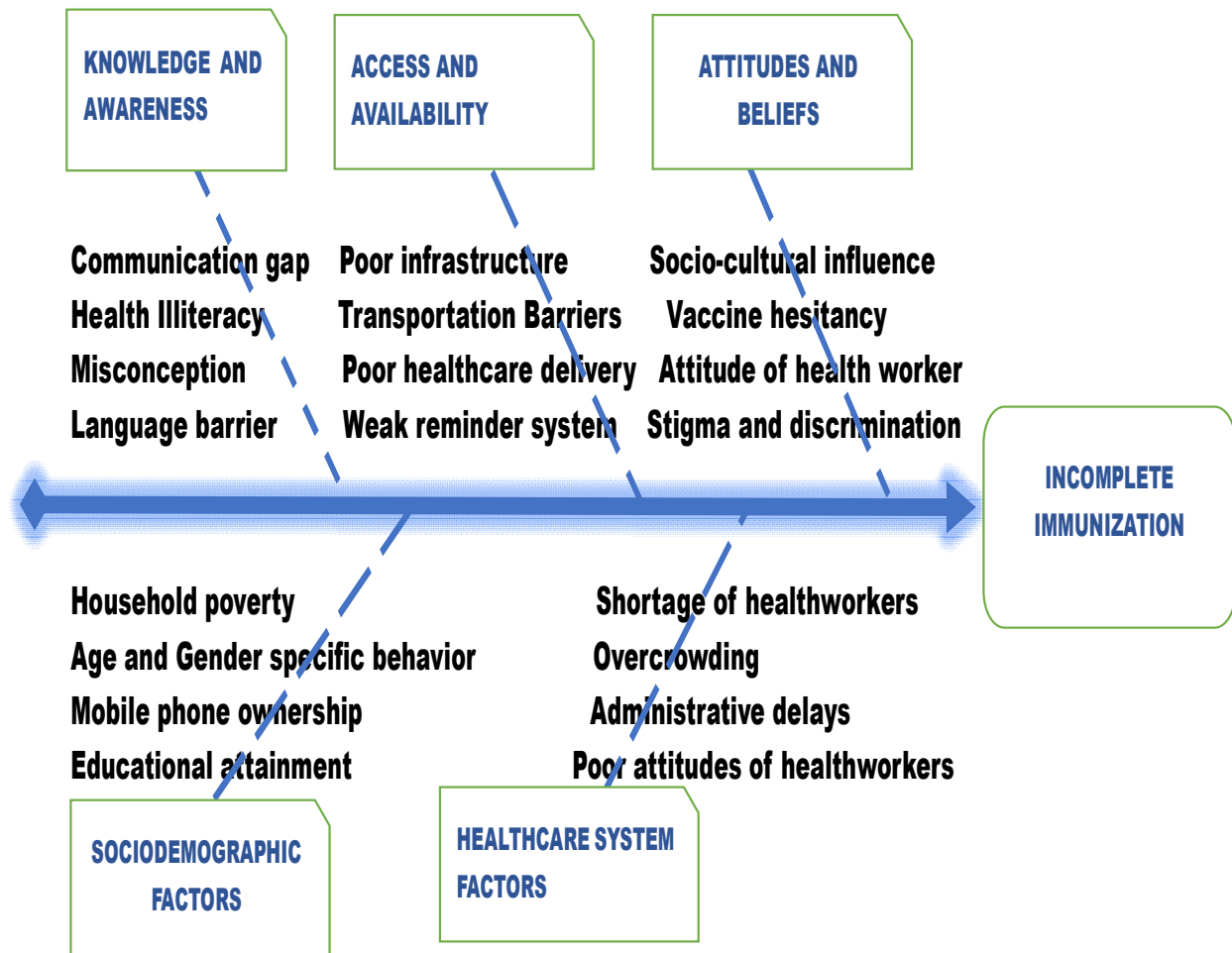


Figure 2 Fig. 2 Fishbone Analysis of Barriers associated with immunization among under-5 children

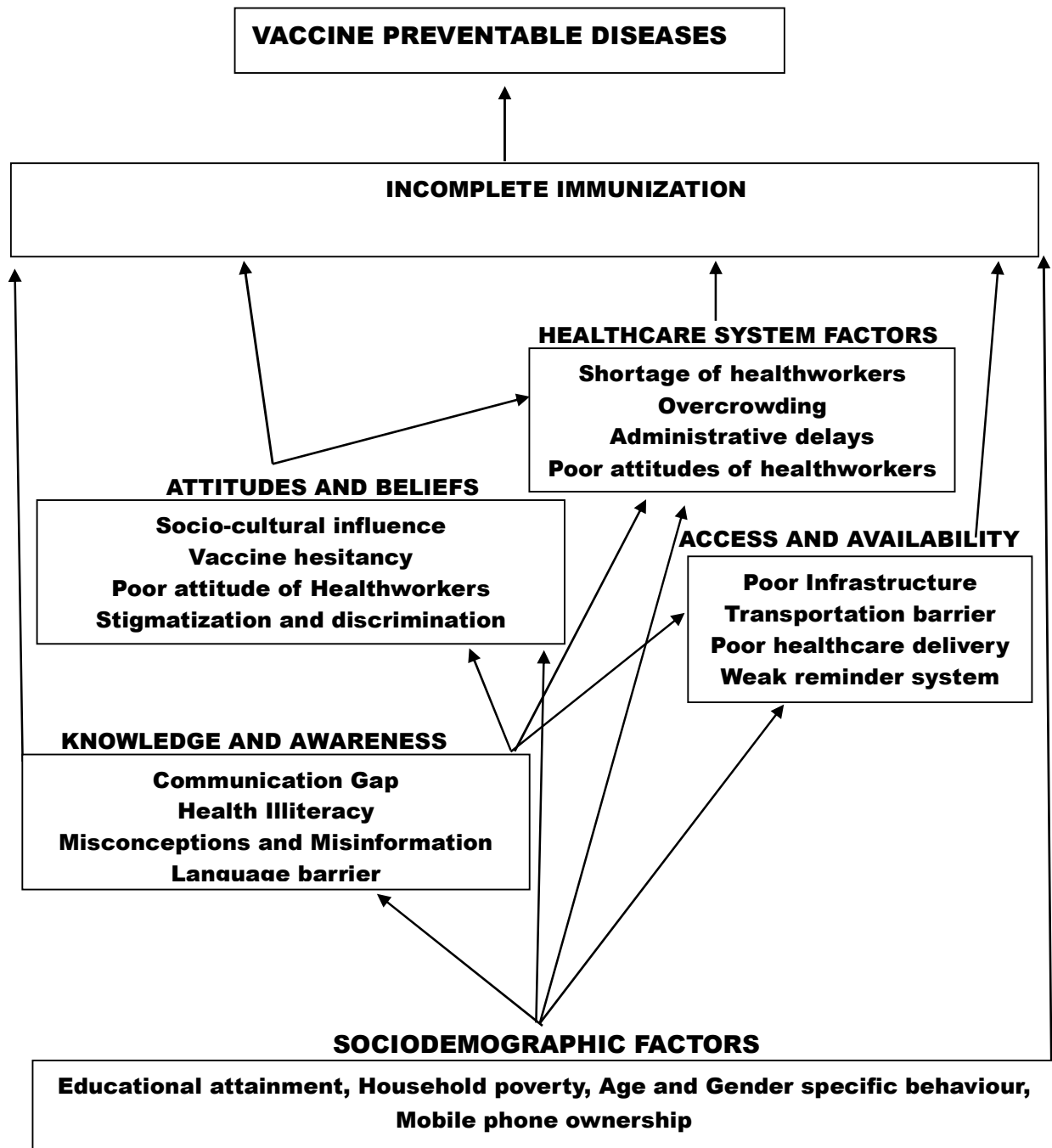


Figure 3: Thematic Relationships of Barriers associated with immunization among under-5 children

Thematic Relationship of Barriers Associated with Childhood Immunization

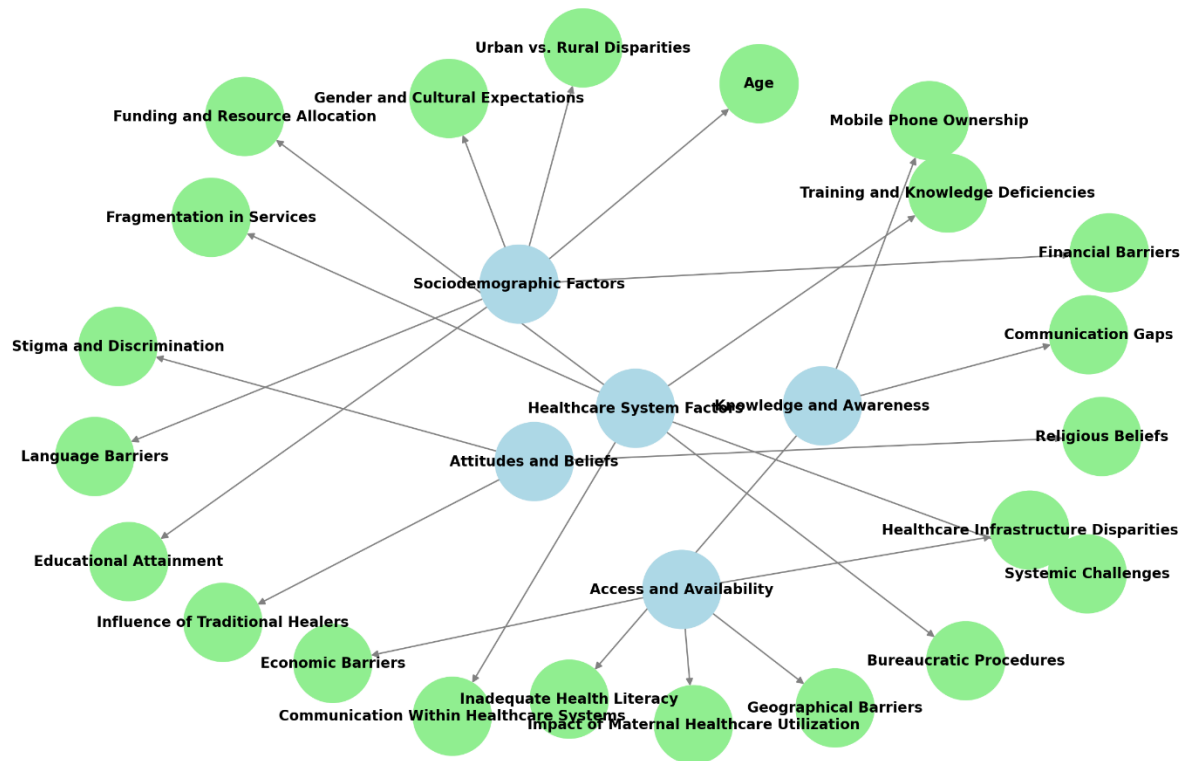


Figure 4 Thematic relationship matrix

Supplementary Files

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