Vaccine Preventable Disease: State-Of-The-Art Appraisal of Impact and Challenges Across Fragile, Conflict-Affected and Vulnerable (FCV) Communities in Northern Nigeria

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ABSTRACT

This paper is a Systematic Literature Review (SLR) that appraised the impact of vaccine-preventable diseases (VPDs) and associated immunization challenges in fragile, conflict-affected and vulnerable (FCV) communities of Northern Nigeria. The paper draw on 18 empirical studies published between 2015 and 2025. The papers were sourced through a rigorous PRISMA-guided search across major databases and grey literature. The review synthesizes evidence on three focal areas: the effects of ongoing conflict on vaccination coverage, socio-cultural and logistical barriers to vaccine uptake and strategies employed to improve immunization outcomes challenges in FCV communities. The findings revealed that armed conflicts, particularly the Boko Haram insurgency, substantially disrupt vaccination programmes by damaging healthcare infrastructure, displacing populations and impeding access to routine immunization services. The disruption resulted in marked declines in vaccine coverage and increased outbreak risks. Socio-cultural factors such as misinformation, religious skepticism and low health literacy intensify vaccination hesitancy, while inadequate cold chain facilities and transportation barriers associated with logistic further hinder vaccine delivery. The review showed the promising adaptive strategies including mobile clinics, community engagement leveraging local leaders, targeted health communication campaigns and government-led integrated outreach, which collectively mitigate these challenges and enhance vaccine acceptance. The diverse methodological approaches—quantitative, qualitative and mixed methods—adopted by the included studies ensured a robust understanding of the context-specific barriers and facilitators. This review indicated the necessity of multifaceted, culturally sensitive and contextually tailored interventions combining policy reforms with grassroots participation to improve immunization equity in FCV communities in Northern Nigeria. The evidences synthesized in this review aims to inform policymakers, health practitioners and stakeholders in designing effective, sustainable vaccination programmes amidst persistent insecurity and fragility in fragile, conflict-affected and vulnerable (FCV) communities of Northern Nigeria.

Keywords: Vaccine Preventable Disease, Vaccine impacts, Vaccines challenges, Fragile, Conflict-affected and Vulnerable (FCV) Communities, Northern Nigeria.

INTRODUCTION

Vaccine-preventable diseases (VPDs) remain a significant public health challenge worldwide particularly in fragile, conflict-affected and vulnerable (FCV) communities [1,2,3]. Historically, immunization programmes have contributed to major reductions in morbidity and mortality from VPDs, such as measles, polio and diphtheria, through widespread vaccination coverage and the establishment of herd immunity [4,5]. However, the distribution of these gains are uneven with FCV regions disproportionately affected due to disruptions in health services, insecurity and population displacement [6]. The Northern part of Nigeria, characterized by ongoing conflict, poverty and weak health infrastructures exemplifies a good case of struggling region where vaccine uptake remains critically low and VPD outbreaks persist [7,8,9].

The nexus between conflict and healthcare delivery in Northern Nigeria creates complex barriers to effective immunization [8]. Bliss and Burke [10] posited that armed conflicts undermine immunization efforts by destroying health infrastructure, depleting healthcare personnel, limiting humanitarian access and displacing vulnerable populations thereby obstructing routine vaccination schedules. Additionally, conflict settings often present heightened risks of disease outbreaks due to overcrowded living conditions and poor sanitation among internally displaced persons (IDPs) and host communities [11]. Sabahelzain *et al*. [12] observed that efforts to deliver vaccines in conflict environments require innovative strategies, including negotiated ceasefires and community engagement, yet these remain challenging to sustain.

Multiple studies have identified socio-cultural determinants influencing vaccine hesitancy and refusal in Northern Nigeria's FCV zones [8,9,13]. Religious beliefs, misinformation, mistrust in government programmes and low health literacy contribute substantially to low immunization rates in affected communities [14,15]. The World Health Organization listed vaccine hesitancy as one of the top global health threats [6,16]. This is particularly entrenched in fragile areas where the health system is weak and rumors about vaccine safety proliferate unchecked [6]. Therefore, addressing vaccine hesitancy requires culturally sensitive health education and trust-building interventions tailored to local realities [8,17].

Besides socio-cultural challenges, logistical and operational constraints significantly hinder immunization programmes in FCV region of Northern Nigeria [8,18]. These include inadequate vaccine supply chains, insufficient cold chain infrastructure, poor transportation networks and financial barriers that limit access to health facilities [18,19]. The combination of long distances to healthcare centers and the cost of transportation discourages caregivers from seeking vaccination services for their children and it often led to missed opportunities for immunization [19]. Additionally, inconsistent availability of vaccines and trained healthcare workers exacerbates the problem, resulting in irregular immunization schedules and incomplete vaccine coverage [20].

The impact of these challenges is evident in the recurrence of outbreaks of measles and polio diseases in Northern Nigeria despite global efforts toward eradication [21]. Conflict-affected communities carry a disproportionate burden of VPDs, which not only results in preventable morbidity and mortality but also strains the already fragile healthcare system [6,21]. Furthermore, outbreaks in these regions pose risks of cross-border transmission that might threaten public health security beyond local communities [24]. Thus, understanding the multifaceted impact of conflict on immunization and the subsequent challenges is essential for designing effective interventions.

This systematic literature review (SLR) provide a detailed appraisal of the current state of vaccine-preventable diseases, their impacts and immunization challenges in FCV communities of Northern Nigeria. The SLR synthesised evidence from diverse sources and highlighted the gaps in policy and practice, inform strategic responses and identify best practices from similar fragile areas. This work aims to support stakeholders' efforts to strengthen vaccination programmes and reduce the burden of VPDs in conflict-affected and vulnerable populations.

Review Objectives and Rationale

The review objectives focus on assessing the impact and challenges of vaccine-preventable diseases in fragile, conflict-affected and vulnerable (FCV) communities in Northern Nigeria, particularly against the backdrop of ongoing insecurity and insurgency. The rationale for this review stems from the urgent need to understand how persistent conflict such as the Boko Haram insurgency, armed banditry and herders-farmers clashes significantly disrupts vaccination services, healthcare infrastructure, and trust in immunization programs, thereby exacerbating disease outbreaks in the region [21,23]. Equally important is to identify socio-cultural, economic, and political barriers, including misinformation, vaccine hesitancy, and low literacy levels, that hinder vaccine acceptance among displaced and vulnerable populations [23]. Finally, the review aims to appraise adaptive strategies and delivery innovations such as mobile clinics and community engagement that can improve immunisation coverage despite the operational complexities posed by conflict [8,24]. This systematic appraisal is important to informing approaches to tailored public health interventions, policy decisions and resource allocation to mitigate the burden of vaccine-preventable diseases in these hard-to-reach populations.

Table 1: Research Questions (RQ) and Rationale

Research Area	Research Question	Rationale
Impact of Conflict on Vaccination	How does ongoing conflict and insecurity in Northern Nigeria's fragile and conflict-affected communities impact vaccination coverage and uptake?	To understand the extent to which conflict disrupts immunization services, reduces healthcare access, and contributes to vaccine-preventable disease outbreaks in FCV areas.
Barriers to Vaccination Uptake	What socio-cultural, economic, and political barriers affect vaccine acceptance and uptake in vulnerable communities affected by Boko Haram insurgency?	To identify key factors such as mistrust, misinformation, poverty, and low literacy that hinder vaccination efforts, essential for designing context-sensitive interventions.
Strategies for Improving Immunisation	What adaptive strategies and delivery mechanisms have proven effective in increasing vaccine coverage in FCV settings of Northern Nigeria?	To evaluate the effectiveness of mobile clinics, community engagement, and targeted campaigns in overcoming conflict-related barriers and improving vaccination outcomes.

METHODOLOGY

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method is an evidence-based set of guidelines designed to improve transparency and completeness in reporting systematic reviews and meta-analyses. The PRISMA framework guides authors to document the rationale for the review, the methods employed, and the findings obtained. It comprises a checklist of essential reporting items and a flow diagram depicting the review process, including search results, articles screening and study selection. The PRISMA guidelines are adaptable to various types of systematic reviews, with extensions available for specific research areas. This systematic literature review (SLR) on vaccine-preventable diseases in FCV communities in Northern Nigeria, the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) framework was adopted. PRISMA-ScR aims to clarify information and enhance the scoping review protocol, addressing key sections such as the title, abstract, objectives, research questions, evidence source selection, result summaries, and expected outcomes. It includes a checklist of 20 essential reporting items and 2 optional items.

Search Strategy

A structured, Systematic and replicable literature search was conducted across multiple electronic databases including PubMed, Scopus, Web of Science and African Journals Online (AJOL). Grey literature were explored through sources such as WHO reports, government health policies and relevant NGO publications. The search covered articles published from January 2015 to the present to capture recent and relevant data reflecting contemporary challenges and interventions. Search terms included keywords such as "vaccine hesitancy," "immunization barriers," "conflict-affected populations" and Medical Subject Headings (MeSH) related to vaccine-preventable diseases, immunization, conflict zones, FCV settings, Northern Nigeria and associated impacts or challenges. Boolean operators (AND, OR) and truncations were used to refine the search.

Inclusion and Exclusion Criteria

Studies were included based on the following criteria. Conducted in or relevant to Northern Nigeria FCV communities or comparable conflict-affected settings. Focus on vaccine-preventable diseases (for example, measles, polio, diphtheria) and immunization uptake, impact, or challenges. Empirical research including quantitative, qualitative, and mixed-methods studies published in English. The exclusion criteria included studies not focused on vaccine-preventable diseases or immunization. Research outside the geographical or contextual

scope unless providing relevant comparative insights. Non-empirical articles such as editorials, opinion pieces and commentaries without original data.

Data Extraction

A standardized data extraction form was developed and pilot-tested. Extracted data included in the study characteristics were author, year of publication, study design and location where the study was carryout. The population details, intervention or exposure, outcomes related to vaccination coverage and VPD impact, reported barriers and facilitators, and key findings relevant to FCV regions. Dual independent reviewers performed data extraction to ensure accuracy, with discrepancies resolved through discussion and third party reviewer.

Quality Assessment

The methodological quality and risk of bias in studies inclusion were assessed using validated tools appropriate for study design, such as the Joanna Briggs Institute (JBI) Critical Appraisal Checklists for qualitative and quantitative studies. This evaluated aspects such as sample representativeness, data collection methods, confounding factors and analysis rigor.

Data Synthesis

A narrative synthesis approach was employed to integrate findings across heterogeneous study designs and outcomes. Themes were organized around vaccination impact, immunization coverage rates, contextual challenges (for example, security, logistics, socio-cultural factors), and programmatic responses. Where quantitative data allow, meta-analysis was conducted for vaccination coverage statistics. Evidence gaps and research priorities were identified to inform policy and practice.

Reporting

The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and completeness in reporting. A PRISMA flow diagram (Figure 1) was documented to show the study selection process. Since the systematic review focuses on understanding the impact of conflict on immunisation coverage and the challenges faced in Northern Nigeria's FCV settings, where health infrastructure is often compromised, and vaccine hesitancy and misinformation are prevalent. The PRISMA flow diagram was used to display the process of study identification, screening, eligibility assessment and inclusion to ensure transparency in literature selection and synthesis.

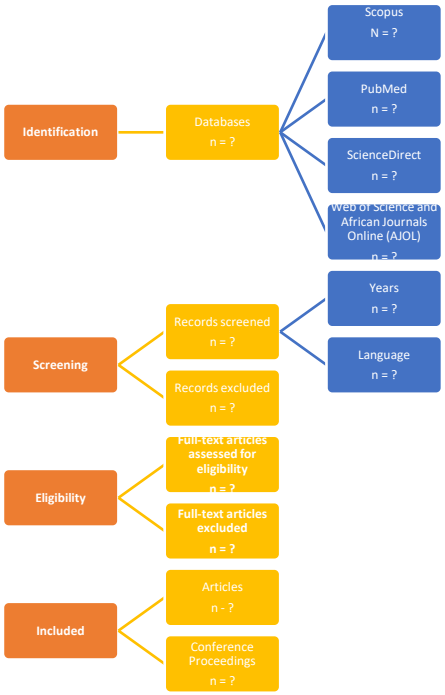

Figure 1: PRISMA Flowchart Developed for SLR Methodology

PRESENTATION OF FINDINGS

Figure 2 shows result of a standard searches using PRISMA framework with 1,842 records identified from four databases: Scopus (1,049), PubMed (315), ScienceDirect (364), and Web of Science and African Journals Online (114). The records were screened through region and year filters and 1,711 records were excluded, leaving 131 records for closer examination. Out of the 131 articles, only 27 were full-length articles and assessed for eligibility, while 104 excluded for various reasons. Ultimately, the 18 studies included in the review were 12 articles and 6 conference proceedings, while 9 opinion pieces articles were excluded.

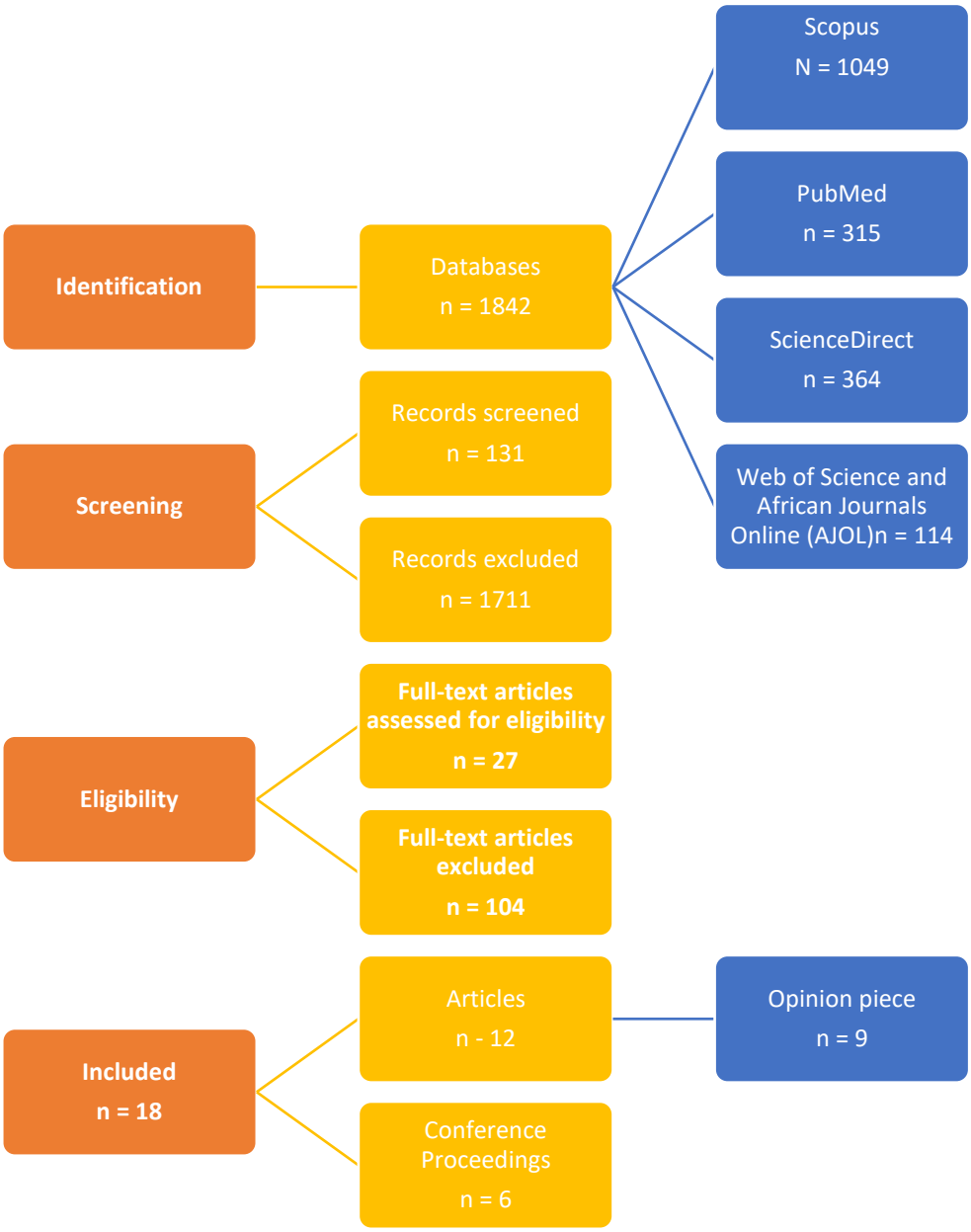

Figure 2: Result of the SLR Using PRISMA Flowchart

Figure 3 illustrates the distribution of research studies on immunization in Nigeria across three main areas. The result revealed that impact of conflict on vaccination (33 %, 6 studies), barriers to vaccination uptake (39 %, 7 studies), and strategies for improving immunisation (28 %, 5 studies). The largest focus on barriers highlights the significant attention given to understanding challenges of vaccine uptake. Studies on the impact of conflict emphasize the detrimental effects of armed conflicts like Boko Haram on vaccine availability and healthcare utilization, while a relatively smaller proportion of studies concentrate on strategic interventions to improve immunization uptake. The findings indicate the importance of balanced research to inform effective policies and programmes aimed at increasing vaccine coverage and equity in Nigeria.

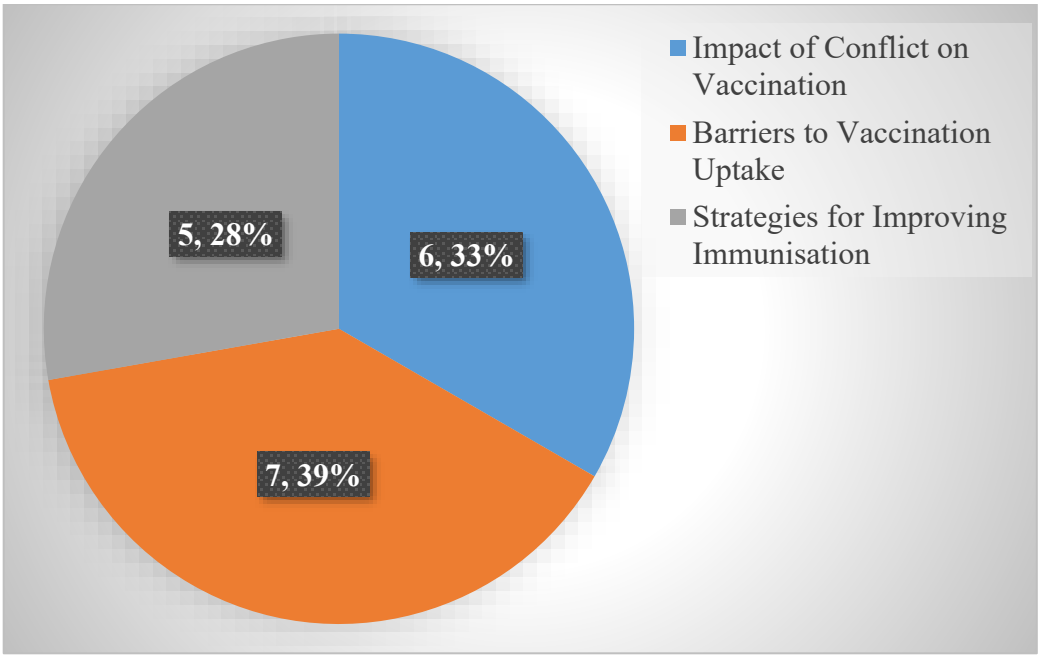

Figure 3: Classification of the Selected Papers Base on the Review Objectives

Table 2 outlines the selected studies on vaccination and immunization across fragile, conflict-affected and vulnerable (FCV) communities in Northern Nigeria. The studies explore vaccine hesitancy in specific populations, such as mothers in Minna [9], urban healthcare workers in Benue State [25] and communities affected by cultural and religious beliefs [26], which reflected the challenges in vaccine acceptance. Others assess childhood immunization barriers, low coverage in nomadic and farming communities and factors influencing vaccine uptake across regions [27,28], which highlighted the sociocultural and logistical determinants of vaccine acceptance. A distinct group of studies addresses the effects of armed conflict, particularly in northeastern Nigeria and the Sahel region, on vaccination coverage, healthcare utilization and vaccine access [21,29,30,31,32,33]. These studies illustrated the compounded challenges across FCV communities in Northern Nigeria. Additionally, government campaign evaluation and community engagement strategies [17,34], which showcased the efforts to improve immunization through public health initiatives and trust-building. The studies revealed that Northern Nigeria faces the challenges of vaccine hesitancy as a result of sociocultural and logistical barriers, and the impact of armed conflict on immunization coverage.

Table 2: Selected Studies and their Focus Areas and Sources

S/N	Authors	Year	Title	Focus	Source / Notes
1	Abdulkadir, K.	2021	Measles Information Vaccine Hesitancy-Case Study of Mothers in Minna, Niger State	Vaccine Hesitancy, Measles	http://irepo.futminna.edu.ng:8080/jspui/handle/123456789/14337, Doctoral dissertation
2	Asekun, A.	2025	*Factors affecting childhood immunization across communities in Sokoto State, Nigeria, and recommendations to improve vaccine uptake*	Childhood Immunization Barriers	https://indigo.uic.edu, Doctoral dissertation
3	Data Project NG	2023	Appraisal of government immunization	Government Campaign Evaluation	ResearchGate, Online report, https://www.researchgate.net/publication/332499870_

			campaigns in Niger State, Nigeria		
4	Duburu, D. J.	2019	Achieving maternal and child access to vaccines in Nigeria	Vaccine Access	Doctoral dissertation, general Nigeria
5	Itodo, S. O., *et al*.	2024	COVID-19 Vaccine Hesitancy among Urban Healthcare Workers in Benue State, Nigeria	COVID-19 Vaccine Hesitancy	Researchgate
6	Kakwi, J. D., *et al*.	2024	Evaluating health communication effects on COVID-19 vaccination uptake in Plateau State, Nigeria	Health Communication, Vaccine uptake	*JMIR Preprints*
7	Nwachukwu, B. C., *et al*.	2023	Low immunization completion in nomadic & farming communities in North Central Nigeria	Immunization Coverage	*Nigerian Journal of Clinical Practice*
8	Otojareri, K. A., *et al*.	2023	Effect of immunization information on vaccine acceptance in Niger State, Nigeria	Immunization Information Impact	https://www.cabidigitallibrary.org/doi/full/10.5555/20230289344
9	Usman, S., *et al*.	2019	The CORE Group Partners Project in North East Nigeria: community engagement strategies to combat skepticism and build trust for vaccine acceptance	Community Engagement for Vaccination	*The American journal of tropical medicine and hygiene, PubMed.*
10	Sato, R.	2019	Effect of armed conflict on vaccination: evidence from the Boko Haram insurgency in northeastern Nigeria	Impact of armed conflict on vaccination coverage	*Conflict and health, Springer.*
11	Sabahelzain, M. M., *et al*.	2025	Implications of conflict on vaccination in the Sahel region.	Implications of conflict on vaccination efforts	*BMJ global health*
12	Sato, R.	2021	Differential effect of conflicts on vaccination: Boko Haram insurgency vs. other conflicts in Nigeria	Differential impact of conflicts on vaccination	*Medicine, Conflict and Survival, Taylor and Francis*

13	Ojeleke, O. *et al*.	2022	The impact of armed conflicts on health-care utilization in Northern Nigeria: A difference-in-differences analysis	Effects of armed conflicts on healthcare utilization	*World Medical & Health Policy, Wiley Online Library.*
14	Oladunni, A. A. *et al*.	2022	Will people in conflict-affected zones in Africa have access to COVID-19 vaccine? A case of Nigeria	Vaccine access in conflict zones	*The International Journal of Health Planning and Management, Wiley Online Library.*
15	Ojeleke, O. A.	2025	Health outcomes and health service use during armed conflicts: a comparison of conflict and non-conflict areas in Northern Nigeria	Health outcomes and service use in conflict settings	https://cris.maastrichtuniversity.nl/files/271119192/c8843.pdf
16	Bamidele *et al*.	2019	Cultural and religious beliefs influencing vaccine hesitancy in Nigeria	Cultural barrier to childhood Immunization	Researchgate
17	Nnadi, C., *et al*.	2017	Approaches to vaccination among populations in areas of conflict.	Strategy on improving vaccine uptakes	*The Journal of infectious diseases, Academia.oup.com*

Table 3 presents the impact of conflict on vaccination and health service utilization in conflict-affected areas of Northern Nigeria. The findings revealed that the selected studies adopted diverse but complementary methodological approaches with converging findings. Methodologically, the studies predominantly employed quantitative techniques to evaluate vaccination coverage data pre- and during conflict periods, statistically [29,30] and econometric difference-in-differences analyses comparing healthcare utilization in conflict versus non-conflict zones [31]. These rigorous quantitative methods enable causal inference regarding the adverse effects of armed conflict on health service delivery. In contract, Sabahelzain *et al*. [21] adopted mixed-methods approaches that provided a richer contextual understanding by combining policy reviews with field data from conflict-affected areas. Similarly, Oladunni *et al*. [33] employed surveys and qualitative interviews that add a valuable dimension by capturing real-world barriers faced by populations in accessing COVID-19 vaccines amid insecurity.

Findings across these studies consistently revealed detrimental effects of armed conflict on vaccination coverage and healthcare access. Sato [29] found a pronounced 47.2 % reduction in vaccination odds for children living near conflict events, with greater impacts among uneducated populations. Sabahelzain *et al*. [21] documented severe impairment of immunization programmes because of population displacement and destruction of health infrastructure in conflict-affected regions. The result of comparative analyses showed that Boko Haram insurgency exerted a more severe negative impact than other conflicts [30]. Further, the econometric analyses by Ojeleke *et al*. [31] revealed significant declines in healthcare utilization especially for maternal and child health services in conflict zones. The study of Oladunni *et al*. [33] highlighted that insecurity and logistical challenges caused substantial barriers to COVID-19 vaccine access in the affected areas. Finally, Ojeleke [32] noted worse health outcomes and lower service usage in conflict-affected areas compared to non-conflict regions. The methodologies robustly elucidated the multifaceted impacts of conflicts on vaccination and the findings showed severe consequences of conflict on vaccination and health service delivery in Northern Nigeria.

Table 3: Summary of studies on the impact of conflict on vaccination and health service utilization in Conflict Affected Areas of Northern Nigeria

	Article Title	Methodology	Findings
Impact of Conflict on Vaccination	Effect of armed conflict on vaccination: evidence from the Boko Haram insurgency in northeastern Nigeria [29]	Quantitative analysis using vaccination coverage data before and during insurgency; statistical evaluation	Armed conflict significantly reduced vaccination coverage due to access issues and disrupted health services.
	Implications of conflict on vaccination in the Sahel region [21]	Mixed-methods including policy review and field data from conflict-affected areas	Conflict severely impairs vaccination programs through displacement of populations and destruction of health infrastructure.
	Differential effect of conflicts on vaccination: Boko Haram insurgency vs. other conflicts in Nigeria [30]	Comparative quantitative study analyzing vaccination rates across different conflict zones	Boko Haram insurgency had a more pronounced negative effect on vaccination than other regional conflicts.
	The impact of armed conflicts on health-care utilization in Northern Nigeria: A difference-in-differences analysis [32]	Econometric analysis comparing pre/post-conflict health service use in affected versus non-affected areas	Significant decline in healthcare utilization in conflict zones, especially for maternal and child health services.
	Will people in conflict-affected zones in Africa have access to COVID-19 vaccine? A case of Nigeria [33]	Survey and qualitative interviews assessing COVID-19 vaccine access in conflict zones	Conflict zones face substantial barriers to COVID-19 vaccine access due to insecurity and logistical challenges.
	Health outcomes and health service use during armed conflicts: a comparison of conflict and non-conflict areas in Northern Nigeria [32]	Cross-sectional comparison using health surveys and conflict data	Conflict areas show worse health outcomes and lower health service usage compared to non-conflict areas.

Table 4 summarized studies on barriers to vaccination uptake in Northern Nigeria employing different but complementary methodologies. The studies of Abdulkadir [9] and Adedin *et al*. [35] utilize in-depth exploration of mothers' and communities' perceptions and the findings revealed that socio-cultural factors, misinformation, fear of side effects and religious skepticism as core drivers of vaccine hesitancy. These qualitative designs approach provided rich-contextual insights into attitudinal barriers. Conversely, Asekun [27] and Nwachukwu *et al*. [28] adopt cross-sectional quantitative survey approaches that analysed immunization records to identify structural barriers such as low education, poverty, limited healthcare access, nomadic lifestyles, and insufficient outreach affecting immunization completion. Mixed-method designs combining surveys approach with ethnographic data was adopted by Bamidele *et al*. [26], which added to distinction understanding of the complex role of cultural and religious beliefs in fostering vaccine hesitancy and refusal behaviors. Systematic reviews by Itodo *et al*. [25] highlighted institutional and professional barriers including safety concerns, misinformation and distrust in authorities, while the experimental approaches by Otojareri *et al*. [36] further showed the positive impact of targeted information campaigns in improving vaccine acceptance and reducing hesitancy.

Consistently, findings across these studies pinpoint misinformation about vaccine safety, cultural and religious misconceptions, and systemic access challenges as key barriers to vaccination uptake in across conflict-affected areas of Northern Nigeria. The synthesis of qualitative and quantitative methodologies enriches understanding by combining personal-level beliefs with population-level determinants. More importantly, intervention studies revealed the critical role of accurate information dissemination in addressing hesitancy. These methodologically

diversity employed in these studies provided a robust and evidence-base findings that advocated for culturally sensitive messaging system, multifaceted strategies to enhance immunization coverage in the region.

Table 4: Summary of the studies related to barriers to vaccination uptake in Northern, Nigeria

	Article Title	Methodology	Findings
Barriers to Vaccination Uptake	Measles Information Vaccine Hesitancy-Case Study of Mothers in Minna, Niger State [9].	Qualitative interviews exploring mothers' perceptions and attitudes	Vaccine hesitancy primarily driven by misinformation, fear of side effects, and cultural beliefs among mothers.
	Qualitative research on vaccine hesitancy in Kano State [36]	In-depth qualitative study using focus groups and interviews	Revealed societal mistrust, religious and cultural skepticism, and concerns about vaccine safety as key barriers.
	Factors affecting childhood immunization in Sokoto State [27]	Cross-sectional survey and analysis of immunization records	Identified low education, poverty, and limited access to healthcare facilities as significant barriers to immunization completion.
	Cultural and religious beliefs influencing vaccine hesitancy in Nigeria [26]	Mixed-method study combining surveys and ethnographic methods	Religious beliefs and cultural misconceptions were major factors that foster vaccine hesitancy and refusal.
	COVID-19 Vaccine Hesitancy among Urban Healthcare Workers in Benue State [25]	Systematic review and survey research among healthcare workers	High hesitancy linked to safety concerns, misinformation, fear of side effects, and distrust in government and health authorities.
	Low Immunization Completion in Nomadic and Farming Communities in North Central Nigeria [28]	Community-based cross-sectional survey with structured questionnaires	Nomadic lifestyle, poor health infrastructure, and inadequate immunization outreach programs majorly reduce vaccine completion rates.
	Effect of immunization information on vaccine acceptance in Niger State [36]	Experimental study assessing impact of information campaigns	Providing accurate vaccine information significantly improved vaccine acceptance and reduced hesitancy.

Table 5 presents studies on strategies for improving immunization in conflict-affected zone of Nigeria. The methodologies span policy and program document reviews with rapid local assessments [17], program evaluations [37], mixed-method surveys and qualitative interviews [38], qualitative case studies involving interviews and focus groups [34] and field-based evaluations and case studies in conflict zones [8]. These approaches reflected integrated evidence synthesis, field data collection and stakeholder perspectives to assess both broad systemic initiatives and localized community-level efforts in improving vaccine uptake.

Findings across these studies collectively highlighted the importance of multi-dimensional strategies to improve immunization coverage and acceptance. Government-led campaigns benefit from intensified outreach, integrated service delivery and accountability frameworks, yet require continuous improvement to address persistent gaps [17]. Also, enhancing maternal and child vaccine access depends significantly on community-based interventions and strengthening primary healthcare systems. Duburu [37], who posited that active stakeholder engagement, is important to community-based interventions.

Furthermore, targeted health communication effectively counteracts misinformation and builds trust necessary for increasing COVID-19 vaccine uptake [38]. Community engagement initiatives demonstrated success when leveraging local leaders and culturally appropriate messaging to enhance vaccine acceptance [34]. This finding revealed the necessity of contextualized strategies in improving vaccine uptake in conflict-affected areas. In

addition, adaptive strategies including mobile clinics, collaboration with security personnel and negotiation with local communities facilitate continued vaccine delivery despite insecurity [8]. The varied but complementary evidences revealed that effective immunization strategies in context-sensitive must blend top-down programmatic reforms with bottom-up community engagement, communication and adaptive service models that are specific to conflict settings. This holistic approach is essential for overcoming multifaceted barriers preventing improved vaccine coverage and equity.

Table 5: Summary of Selected studies on Strategies for Improving Immunisation in Nigeria

	Article Title	**Methodology**	**Findings**
Strategies for Improving Immunisation	Appraisal of government immunization campaigns in Niger State [17]	Policy and program document review combined with rapid local assessments	Identified successes and gaps; key strategies include intensified outreach, integrated service delivery and accountability frameworks.
	Achieving maternal and child access to vaccines in Nigeria [37]	Program evaluation and review of maternal and child vaccination initiatives	Improved access through community-based interventions, strengthening PHC and stakeholder engagement.
	Evaluating health communication effects on COVID-19 vaccination uptake in Plateau State [38]	Mixed-methods: surveys and qualitative interviews assessing campaign impact	Health communication significantly boosted vaccine uptake by countering misinformation and building trust.
	Community engagement strategies for vaccine acceptance in NE Nigeria [34]	Qualitative case study using interviews and focus groups with community stakeholders	Community engagement leveraging local leaders and culturally tailored messaging enhanced vaccine acceptance.
	Approaches to vaccination among populations in areas of conflict [8]	Case study and field evaluation of vaccination programs in conflict zones	Use of mobile clinics, security collaboration, and community negotiation improved vaccine delivery amid insecurity.

DISCUSSION

The systematic review on vaccination and immunization uptake across fragile, conflict-affected and vulnerable (FCV) communities in Northern Nigeria using PRISMA framework, focusing on barriers to vaccination uptake, the impact of conflict on vaccination and strategies to improve immunization showed significant strength. Bohannon [39] and Grgic *et al*. [40] demonstrated that systematic review methodology is a strong approach to comprehensive and structured literature searches that minimizes bias through explicit, reproducible inclusion and exclusion criteria. The rigorous methodological approach of SLR ensures a thorough aggregation and critical appraisal of all relevant empirical available evidence and provide high level of reliability and robustness in summarizing existing research findings. Additionally, SLR exemplify the use of systematic methods for quality assessment of included studies, which enhanced the validity of synthesized conclusions and strengthens the evidence base practical recommendations.

This SLR review found that 39 % of the selected studies focus on barriers, 33 % on conflict impacts and 28 % on strategies; showed the complexity of challenges and responses necessary to enhance vaccination coverage. This data suggests the importance of meta-analysis. Grgic *et al*. [40] posited that the inclusion of meta-analytic techniques allows for quantitative synthesis, which provide precise effect that increase the statistical power beyond individual studies, while Bohannon [39] illustrated how systematic reviews can identify clinically meaningful thresholds in physical therapy research. The tripartite division in this SLR highlighted that a successful immunization programme must simultaneously address demand-side issues related to vaccine hesitancy and sociocultural factors, supply-side challenges presented by conflict and insecurity, and implementation of tailored improvement strategies.

The SLR showed that vaccine hesitancy remains a major barrier in fragile, conflict-affected communities in Northern Nigeria. This hesitancy is predominantly shaped by a combination of accessibility, sociocultural and logistical barriers including impact of widespread misinformation, entrenched religious and cultural beliefs and inadequate access to healthcare infrastructure [9,25,26]. These factors not only reduce vaccine acceptance but also exacerbate inequities in immunization coverage. Studies by Harrington [41]; Tiwana and Smith [14] and Vatwani [42] have shown that fear of side effects, mistrust of Western medicine, and skepticism fueled by religious and cultural narratives collectively undermine vaccine uptake, particularly among vulnerable populations with limited access to credible health information.

Additionally, this SLR revealed the deleterious impact of armed conflict, especially the Boko Haram insurgency, Herders-Farmer clashes and banditry on childhood vaccination and healthcare utilization in northern Nigeria is well-documented. Empirical evidence indicates that regions affected by Boko Haram face severe disruptions in routine vaccination services, which led to reduced vaccination coverage and adverse health outcomes in conflict zones relative to non-conflict areas [29,31]. The destruction of health infrastructure, displacement of populations and insecurity create formidable obstacles for healthcare delivery. It exacerbated the already fragile healthcare systems in these regions and heightened the risk of resurgence of vaccine-preventable disease outbreaks.

Also, methodological diversity of the studies, which mostly employed quantitative, qualitative and mixed-methods approaches validates the SLR findings. The convergence of the findings by Sato [29] and Sabahelzain *et al*. [21] showed that proximity to Boko Haram conflict events results in a roughly 47.2 % decrease in vaccination odds among children. Moreover, this reduction is disproportionately greater among less educated populations, which highlighted how conflict and social determinants of health interact to magnify vaccination inequalities. The extensive displacement of communities and damage to healthcare facilities further compound these challenges by interrupting cold chain logistics and immunization outreach. These agreed with the broader view shared by Comes *et al*. [43] and Adeyemo *et al*. [44] on the role of cold chain logistics in vaccine distribution.

The successful approaches to improving immunization in fragile, conflict-affected and vulnerable (FCV) communities necessitate multifaceted intervention strategies. Study by Data Project NG [17] revealed that government-led campaigns have efficacy when outreach efforts are intensified with integrate service delivery and implementation of accountability mechanisms. Complementary community engagement strategies that mobilize local leaders and utilize culturally sensitive messaging are pivotal in building public trust and countering misinformation that fuels vaccine hesitancy [34,38]. These community-centered efforts not only improve vaccine acceptance but also foster resilience against the socio-political challenges characterizing conflict-affected regions.

Collectively, these findings emphasize that addressing immunization challenges in conflict-affected areas requires integrated and context-specific interventions that tackles both structural barriers posed by insecurity and infrastructural deficits and cultural barriers involving vaccine skepticism, simultaneously. Only through a holistic approach that blends top-down policy and programme reforms with bottom-up community participation can sustainable progress be made towards equitable vaccine coverage and herd immunity in fragile settings [34,45]. Obregón and Waisbord [45] and Shedeed [46] posited that such approaches are essential to protecting vulnerable populations from vaccine-preventable diseases and advancing public health goals amid persistent conflict and instability.

CONCLUSION

The systematic literature review (SLR) using the PRISMA framework demonstrated superior records extraction with 1,842 records identified from databases and filtered to 18 relevant studies through rigorous screening and eligibility assessment. Barriers to vaccine uptake (39%) accounted for more publications among the three selected areas base on review objectives. The impact of armed conflict on vaccination and health service utilization (33%) and strategies to improve immunization coverage (28%) were all equally significant. Sociocultural and logistical barriers posed significant challenges to vaccine uptake, which are compounded by the detrimental effects of armed conflicts such as the Boko Haram insurgency. Armed conflicts and banditry severely disrupted vaccination programmes and access the healthcare in Northern Nigeria. However, government

campaigns and community engagement initiatives are in place, and they provide promising approaches to improve immunization uptake through trust-building, integrated service delivery, and culturally tailored communication strategies. Improving vaccine uptake across FCV communities in Northern Nigeria requires a holistic, context-sensitive approach combining policy reforms, community involvement and adaptive service models to overcome vaccination challenges in fragile and conflict-affected areas of Nigeria.

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