



INCOME DISPARITIES AND EDUCATIONAL DIFFERENTIALS IN COVID-19 VACCINATION ACCEPTANCE IN NASARAWA STATE, NIGERIA



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Abstract

The COVID-19 pandemic constituted one of the most significant public health emergencies of the twenty-first century, with vaccination emerging as the primary strategy for pandemic control. In Nigeria, despite substantial vaccine procurement and distribution efforts, acceptance rates varied considerably across states and population subgroups. Nasarawa State achieved notable success in overall vaccination coverage, ranking among the top-performing states in the national vaccination campaign. However, aggregate coverage figures mask profound disparities in vaccine acceptance shaped by income and educational differentials. This article examines the relationship between socioeconomic status, educational attainment, and COVID-19 vaccination acceptance in Nasarawa State. Drawing on primary survey data collected from 1,247 respondents across the state's 13 Local Government Areas, secondary data from the National Bureau of Statistics COVID-19 High-Frequency Phone Survey, and semi-structured interviews with health officials, community leaders, and vaccine recipients, the study developed a Socioeconomic Determinants of Vaccine Acceptance Framework. The findings indicated that household income, educational attainment, and geographic location constitute significant predictors of COVID-19 vaccination acceptance. Respondents with tertiary education were substantially more likely to accept vaccination compared to those with no formal education. Higher-income households demonstrated significantly greater vaccine acceptance than lower-income households. Rural residents reported lower acceptance rates and greater barriers to access compared to their urban counterparts. The article concluded by proposing targeted interventions that address income and education-based disparities, including community-based health education programmes, mobile vaccination units for rural areas, and enhanced engagement with traditional and religious leaders to build vaccine confidence among underserved populations.

Keywords: COVID-19 vaccination, Vaccine acceptance, Income disparities, Educational differentials, Nasarawa State, Health equity

Introduction

The coronavirus disease 2019 (COVID-19) pandemic represents one of the most consequential public health crises of the modern era, inflicting profound health, economic, and social costs across the globe. The World Health Organization reported that over 651 million cases and 6.6 million deaths were attributed to COVID-19 globally (WHO, 2022). In Nigeria, the Nigeria Centre for Disease Control documented 266,057 confirmed cases with 3,155 deaths as of 2022, though these figures likely understate the true burden of the pandemic given the country's limited testing capacity (NCDC, 2022; Adebisi et al., 2021). All 36 states and the Federal

Capital Territory were affected, with Lagos and the FCT reporting the highest case numbers (Ojo et al., 2023).

Vaccination emerged as the cornerstone of the global response to the pandemic, with multiple vaccines developed, authorised, and deployed at unprecedented speed (Krammer, 2020). In Nigeria, the vaccination campaign commenced in March 2021 with the arrival of COVAX facility vaccine doses, followed by subsequent deliveries through bilateral agreements and African Union procurement mechanisms (NPHCDA, 2022). The National Primary Health Care Development Agency, in collaboration with state governments and international partners, implemented a phased vaccination strategy that prioritised health workers, frontline workers, and vulnerable populations before expanding to the general adult population (NPHCDA, 2023).

According to the World Health Organization (WHO), all countries including Nigeria were expected to align with the global COVID-19 eradication goal which was to vaccinate 40% of its population at the end of year 2021 and attain a 70% vaccine threshold in year 2022 (WHO, 2022). Nasarawa State, situated in the North Central geopolitical zone of Nigeria, emerged as one of the standout performers in the national vaccination campaign. By late 2023, the state had achieved 100 per cent vaccination of its target eligible population, ranking alongside Jigawa, Osun, Kaduna, Kano, and Adamawa as states that had fully vaccinated their target populations (NPHCDA, 2023; Nairametrics, 2023). The Federal Government formally ranked Nasarawa as the best-performing state in the COVID-19 mass vaccination campaign (Newspot, 2022). This achievement reflected a combination of effective state-level leadership, robust primary healthcare infrastructure, community engagement strategies, and the dedication of health workers across the state.

However, aggregate success at the state level conceals important variations in vaccine acceptance across different population subgroups. International evidence consistently demonstrates that vaccine acceptance is shaped by a complex interplay of sociodemographic factors, with income and education emerging as particularly significant determinants (Lazarus et al., 2021; Sallam, 2021). In high-income countries, studies have documented disparities in vaccine uptake along lines of socioeconomic status, educational attainment, race, and geographic location (Nguyen et al., 2022; Syed et al., 2023). In low- and middle-income countries, including Nigeria, the evidence base is more limited but similarly points to the importance of socioeconomic factors in shaping vaccination decisions (Adeyanju et al., 2025; Ogunleye et al., 2022).

Nasarawa State presents a particularly instructive case for examining income and education-based disparities in vaccine acceptance. The state is characterised by significant socioeconomic heterogeneity, with a predominantly rural population, substantial agricultural economic base, and marked disparities in educational attainment and income across its 13 Local Government Areas (Nasarawa State Government, 2020). The state's population is estimated at approximately 2.5 million, with a poverty rate of 57.3 per cent and mean years of education of 7.07 years for the population aged 20 and above (Global Data Lab, 2021; National Bureau of Statistics, 2022). These conditions create a natural laboratory for examining how income and education shape health behaviours, including vaccine acceptance.

In Nigeria, Adedeji et al. (2022) observed that most studies on vaccine hesitancy have primarily examined broad or generalized determinants, with limited application of multivariate analytical models capable of disentangling the independent and combined effects of key socioeconomic factors such as education and income. This methodological limitation constrains

the generation of robust evidence needed to inform targeted and context-specific policy interventions. Consequently, there is a need for more rigorous analytical approaches that examine both the individual and interactive influences of these critical socioeconomic determinants on vaccine acceptance. Addressing this gap is essential not only for strengthening evidence-based communication and intervention strategies in Nasarawa State but also for advancing broader health equity objectives by improving understanding of how structural socioeconomic factors shape access to and acceptance of essential public. Furthermore, the persistence of income and education-based disparities in vaccine acceptance despite the state's overall success raises important questions for health policy and pandemic preparedness. Understanding the mechanisms through which income and education influence vaccination decisions is essential for designing interventions that reach underserved populations and achieve equitable health outcomes. This is particularly urgent given the likelihood of future pandemics and the ongoing need for booster vaccinations and routine immunisation programmes (World Bank, 2022; UNDP, 2023).

This article proceeds from the premise that vaccine acceptance is not solely a function of individual health beliefs but is profoundly shaped by structural factors including income, education, and access to health information. The COVID-19 vaccination campaign in Nasarawa State, while successful in aggregate, provides an opportunity to examine how these structural factors operate in a specific subnational context and to derive lessons for future health interventions.

The objectives of the study are threefold: first, to assess the relationship between household income and COVID-19 vaccination acceptance in Nasarawa State; second, to examine the association between educational attainment and vaccine acceptance; and third, to identify the pathways through which income and education influence vaccination decisions, including access to information, trust in health institutions, and exposure to misinformation. The scope is restricted to the period 2021 to 2026, capturing the main phases of the COVID-19 vaccination campaign in Nigeria and the subsequent period of booster dose administration.

Literature Review

Conceptualising Vaccine Acceptance and Hesitancy

The academic literature on vaccine acceptance and hesitancy has expanded substantially since the onset of the COVID-19 pandemic, building on earlier work on routine immunisation and vaccine-preventable diseases. Vaccine hesitancy, defined by the World Health Organization's Strategic Advisory Group of Experts as a "delay in acceptance or refusal of vaccination despite availability of vaccination services," has been recognised as a complex and context-specific phenomenon (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015, p. 4163). The WHO identified vaccine hesitancy as one of the top ten threats to global health even before the COVID-19 pandemic, underscoring the longstanding nature of the challenge (WHO, 2019).

The determinants of vaccine hesitancy are typically conceptualised through the 3C model, which identifies confidence, complacency, and convenience as the three core dimensions influencing vaccination decisions (Betsch et al., 2018). Confidence refers to trust in the safety and effectiveness of vaccines, the health system that delivers them, and the motivations of policy makers who recommend them. Complacency relates to the perceived risk of vaccine-preventable diseases; when individuals perceive low personal risk, they may be less motivated to vaccinate. Convenience encompasses the structural and practical barriers to vaccination, including physical access, affordability, and the time required to receive vaccination.

Building on the 3C model, subsequent scholarship has expanded the framework to include additional dimensions, including calculation (individuals' engagement in extensive information seeking), collective responsibility (willingness to protect others through vaccination), and confidence in the specific vaccine product (Betsch et al., 2018; Geiger et al., 2021). These dimensions are not mutually exclusive and often interact in complex ways to shape individual vaccination decisions. For instance, an individual with low confidence in vaccines may be particularly susceptible to complacency about disease risk, while an individual facing significant convenience barriers may be discouraged from vaccinating even if they have high confidence in vaccine safety.

In the Nigerian context, vaccine hesitancy has a well-documented history predating COVID-19. The country has experienced persistent challenges with routine immunisation coverage, with only 32 per cent of children receiving all recommended vaccines in the North Central zone, and significant regional and socioeconomic disparities in coverage (National Bureau of Statistics, 2023). The polio eradication campaign in Nigeria faced substantial hesitancy, particularly in northern states, driven by rumours about vaccine safety, distrust of government health programmes, and religious and cultural concerns (Jegede, 2007; Renne, 2010). These historical patterns of hesitancy have important implications for understanding COVID-19 vaccine acceptance, as they reflect deeper dynamics of trust, information environments, and structural barriers that shape health behaviours.

Income, Education, and Health Behaviours

The relationship between socioeconomic status and health behaviours is a longstanding concern in public health scholarship, with extensive evidence demonstrating that income and education are among the most powerful predictors of health outcomes across a wide range of conditions and contexts (Marmot, 2005; Adler & Stewart, 2010). The fundamental cause theory, articulated by Link and Phelan (1995), provides a compelling framework for understanding this relationship. The theory posits that socioeconomic status is a "fundamental cause" of health disparities because it shapes access to resources, knowledge, power, and social connections that can be used to avoid risks and adopt protective behaviours. When new health threats emerge or new interventions become available, those with higher socioeconomic status are better positioned to benefit, thereby reproducing health disparities.

Applied to vaccine acceptance, the fundamental cause theory suggests that income and education shape vaccination decisions through multiple pathways. Higher-income individuals have greater access to health information, can more easily navigate health systems, and face fewer structural barriers to vaccination (Phelan et al., 2010). More educated individuals tend to have greater health literacy, more sophisticated information-processing skills, and stronger social networks that can provide reliable health information (Cutler & Lleras-Muney, 2010). Education also shapes health beliefs and values, including trust in scientific authority and the perceived importance of preventive health behaviours.

The health belief model provides a complementary framework for understanding how income and education influence vaccine acceptance at the individual level (Rosenstock, 1974; Champion & Skinner, 2008). The model identifies perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy as the key determinants of health behaviours. Income and education can influence each of these dimensions. For example, individuals with higher education may have a more accurate understanding of disease susceptibility and severity, while those with higher income may perceive fewer barriers to vaccination given their greater resources and flexibility. Studies applying the health belief model to COVID-19 vaccine acceptance in Nigeria have found that modifying factors

including geographic location, age, gender, and socioeconomic status significantly influence vaccine hesitancy (Adeyanju et al., 2025; Olutola et al., 2023).

Empirical Evidence on Socioeconomic Determinants of COVID-19 Vaccine Acceptance

The empirical literature on COVID-19 vaccine acceptance in Nigeria has grown rapidly, though much of the evidence comes from online surveys that may overrepresent urban, educated, and higher-income populations. A scoping review of 25 studies on COVID-19 vaccine hesitancy and uptake in Nigeria found that 90 per cent of the studies documented low vaccine acceptance, with barriers related to vaccine availability, misinformation, cultural and religious influences, socioeconomic factors, and lack of trust in the health system (Adeyanju et al., 2025). Sociodemographic factors including gender, age, education, and income were consistently identified as key influences on vaccine acceptance.

A cross-sectional national survey conducted between November 2021 and January 2022 found that only 32.8 per cent of respondents had been vaccinated against COVID-19 (Ojo et al., 2023). The study identified educational attainment as a significant predictor of vaccine uptake, with respondents with primary education (OR 1.72), secondary education (OR 1.77), and tertiary education (OR 3.03) all more likely to be vaccinated compared to those with no formal education. Income, measured through access to health insurance, was also a significant predictor (OR 1.68). Geographic location mattered as well, with respondents in the North Central region having higher odds of vaccination compared to other regions.

A study specifically focused on North Central Nigeria found that 29.5 per cent of respondents were unwilling to receive the COVID-19 vaccine (Olutola et al., 2023). Post-secondary education was associated with lower levels of hesitancy (AOR 0.51, 95% CI 0.37–0.69), as was household income above the minimum wage of 30,000 Naira per month (AOR 0.68, 95% CI 0.50–0.94). The dominant reasons for hesitancy were concerns about side effects (37.5%), doubt about the existence of COVID-19 (11.0%), and the perception of time required to receive the vaccine (9.6%). Hesitant respondents relied primarily on health workers (33.0%) and social media (23.3%) as trusted sources of health information, with less than a third following the advice of religious and community leaders.

An online survey conducted among the general Nigerian population found that 28 per cent of participants had received one or more doses of the COVID-19 vaccine (Chutiyami et al., 2022). Unemployed individuals were significantly less likely to be vaccinated than government employees (AOR 0.37, 95% CI 0.15–0.89), and those of intermediate socioeconomic status were less likely to be vaccinated than those of high socioeconomic status (AOR 0.47, 95% CI 0.26–0.88). The study identified five main themes regarding reasons for hesitancy: fear related to vaccine content, negative effects on the body, distrust of the system or government, psychological concerns, and misconceptions. These findings underscore the importance of socioeconomic factors in shaping vaccination decisions and highlight the need for targeted interventions that address the specific concerns of disadvantaged populations.

Nasarawa State: Socioeconomic Profile and Health System Context

Nasarawa State, created in 1996 from the old Plateau State, is located in the North Central geopolitical zone of Nigeria. The state shares borders with Kaduna State to the north, Plateau State to the east, Taraba and Benue States to the south, and the Federal Capital Territory and Kogi State to the west. The state capital is Lafia, with other major urban centres including Karu, Keffi, and Nasarawa town. The state is divided into 13 Local Government Areas: Akwanga, Awe, Doma, Karu, Keana, Keffi, Kokona, Lafia, Nasarawa, Nasarawa Eggon, Obi,

Toto, and Wamba (Nasarawa State Government, 2020). The state's population is estimated at approximately 2.5 million, making it the second least populous state in Nigeria despite its substantial land area (National Population Commission, 2016). The population is ethnically diverse, encompassing over 25 ethnic groups including the Eggon, Gwandara, Alago, Egbira, Hausa, Fulani, Tiv, and Koro peoples (EUAA, 2024). The state is religiously diverse, with approximately 60 per cent of the population being Muslim, 30 per cent Christian, and the remaining 10 per cent following traditional ethnic religions (National Population Commission, 2016). This ethnic and religious diversity has important implications for health communication and vaccine acceptance, as trust in health institutions and responses to health messages often vary across cultural and religious communities.

Nasarawa State faces significant socioeconomic challenges. The poverty rate stands at 57.3 per cent, with 90.9 per cent of households classified as poor according to the International Wealth Index, and 69.3 per cent as poorer (Global Data Lab, 2021). The mean years of education for the population aged 20 and above is 7.07 years, with women having lower educational attainment (5.58 years) compared to men (8.73 years) (Global Data Lab, 2021). The state has a substantial rural population, with agriculture serving as the mainstay of the economy. These socioeconomic characteristics create conditions in which income and education-based disparities in health behaviours, including vaccine acceptance, are likely to be pronounced. The health system in Nasarawa State comprises a network of primary health centres, secondary health facilities, and tertiary referral facilities. The state has made significant progress in strengthening primary healthcare in recent years, with the establishment of functional primary health centres in most wards and improvements in immunisation coverage and other health indicators (Leadership, 2025). However, challenges remain, including limited health workforce, inadequate equipment and supplies, and geographic barriers to access in rural and remote areas (Agwai & Bage-John, 2025). These challenges are particularly acute in the context of COVID-19 vaccination, which required substantial cold chain capacity, health worker training, and community engagement to achieve high coverage.

Theoretical Framework

This study is anchored in the Socioeconomic Determinants of Health Framework, which recognises that health outcomes, including vaccine acceptance, are shaped by the social and economic conditions in which people live, work, and age (Marmot & Wilkinson, 2006; WHO, 2008). The framework identifies income, education, occupation, and social class as the core dimensions of socioeconomic status that influence health through multiple pathways, including material resources, psychosocial factors, behavioural patterns, and access to health services.

Applied to vaccine acceptance, the framework suggests that income and education influence vaccination decisions through four primary pathways. First, material resources: higher-income individuals have greater financial resources to overcome barriers to vaccination, including transportation costs, time away from work, and other practical obstacles. Second, knowledge and information: more educated individuals tend to have greater health literacy, better access to reliable health information, and stronger skills for evaluating health claims. Third, psychosocial factors: socioeconomic status shapes health beliefs, values, and attitudes, including trust in scientific authority and the perceived importance of preventive health behaviours. Fourth, social networks: socioeconomic status influences the composition of social networks, which in turn shape exposure to health information, social norms regarding vaccination, and access to social support for health behaviours.

This study extends the Socioeconomic Determinants of Health Framework by incorporating insights from the health belief model and the 3C model of vaccine hesitancy. The resulting conceptual framework posits that income and education influence vaccine acceptance through their effects on perceived susceptibility and severity, perceived benefits and barriers, confidence in vaccines and health institutions, complacency about disease risk, and convenience of access. These pathways are in turn shaped by contextual factors including geographic location, access to health information, exposure to misinformation, and community norms regarding vaccination.

Methodology

Research Design

This study employed a convergent mixed methods design, collecting quantitative and qualitative data in parallel and integrating them during analysis and interpretation (Creswell & Creswell, 2023). The quantitative component involved a cross-sectional survey of 1,247 respondents across Nasarawa State's 13 Local Government Areas, assessing COVID-19 vaccination acceptance, income, educational attainment, and related variables. The qualitative component comprised semi-structured interviews with 32 key informants, including health officials, community leaders, and vaccine recipients in Lafia, Karu, and Keffi Local Government Areas, as well as analysis of policy documents and programme reports.

The decision to adopt a mixed methods approach was driven by the nature of the research question. Assessing the relationship between income, education, and vaccine acceptance requires both measurement of associations and their statistical significance, and interpretation of the mechanisms and contextual factors that shape those associations. Quantitative methods alone could establish whether income and education predict vaccine acceptance, but qualitative methods are needed to understand why and how these relationships operate in the specific context of Nasarawa State.

The study was conducted across all 13 Local Government Areas of Nasarawa State. These LGAs were selected to capture the full range of socioeconomic and geographic diversity within the state, including urban and rural areas, agriculturally dependent and more diversified economies, and areas with varying levels of health infrastructure and vaccination coverage. For the qualitative component, three LGAs were purposively selected: Lafia (the state capital, with relatively higher urbanisation and health infrastructure), Karu (a peri-urban LGA adjacent to the Federal Capital Territory, with significant economic activity and population mobility), and Keffi (a semi-urban LGA with a mix of urban and rural characteristics and a substantial student population).

Data Collection

The survey was conducted between March and May 2026, targeting adults aged 18 years and above residing in Nasarawa State. The sample size was drawn using the Cochran formula (1977) for sample size determination. The formula was used because even though the population of Nasarawa State was known, the target population (≥ 18 years) was unknown. The study considered a prevalence of 50% for COVID-19 acceptance and 50% for non-acceptance. Thus, the formula was appropriate and was expressed as:

$$N = \frac{Z^2 pq}{d^2}$$

N= Sample size desired

Z = Standard normal deviate at the required confidence level at 95% (1.96)

p = Proportion in the target population estimated to have characteristics of interest = 50%.

$q = 1 - p = (1 - 0.50 = 0.5)$.

d = level of statistical significance = margin of error (0.03)

Applying the formula, the sample size will be determined as:

$$n = \frac{1.962 \times 0.50 \times 0.5}{0.032}$$

$$n = 1067$$

An additional 20% of the participants was assumed as non-response, missing or incomplete data and was calculated as follows:

Non-response = 20% of 1067 = 213.4

Final sample size $N = n + NRR = 1067 + 213.4 = 1280.4 = 1281$

1281 was however adopted to give room for integers. The sample size for the study was therefore **1,281**

A multi-stage sampling technique was employed. In the first stage, all 13 LGAs were included. In the second stage, wards were selected within each LGA using probability proportional to population size. In the third stage, households were selected using systematic random sampling, and within each household, one adult was randomly selected for interview. A total of 1,247 respondents completed the survey, yielding a response rate of 97.3 per cent.

The survey instrument was adapted from the WHO SAGE vaccine hesitancy scale and validated in the Nigerian context in previous studies (Olutola et al., 2023; Ojo et al., 2023). The instrument covered five domains: sociodemographic characteristics (age, gender, LGA of residence, household income, educational attainment, occupation, religion); COVID-19 vaccination status (whether vaccinated, number of doses received, reasons for vaccination or non-vaccination); vaccine acceptance (willingness to accept vaccination if not yet vaccinated, or reasons for accepting); health beliefs (perceived susceptibility to COVID-19, perceived severity, perceived vaccine benefits and barriers); and information sources (primary sources of health information, trust in different information sources).

Income was measured through self-reported monthly household income, categorised into four bands: below 30,000 Naira (below the national minimum wage), 30,000–50,000 Naira, 50,001–100,000 Naira, and above 100,000 Naira. Educational attainment was measured through self-reported highest level of education completed, categorised into four levels: no formal education, primary education, secondary education, and tertiary education (including polytechnic, college of education, and university).

Qualitative Interviews: Semi-structured interviews were conducted with 32 key informants across the three selected LGAs. The sample included: state and LGA health officials involved in COVID-19 vaccination planning and implementation ($n = 8$); primary health centre coordinators and frontline health workers ($n = 10$); traditional and religious leaders ($n = 6$); community-based organisation representatives ($n = 4$); and vaccinated and unvaccinated community members ($n = 4$). Interviews were conducted in English, Hausa, or Pidgin English according to respondent preference, and lasted between 30 and 60 minutes. The interview protocol covered perceptions of COVID-19 and the vaccine, experiences with the vaccination

campaign, barriers and facilitators to vaccination, views on income and education-based disparities, and recommendations for improving vaccine acceptance among underserved populations.

Document Analysis: Policy documents and programme reports were obtained from the Nasarawa State Ministry of Health, the National Primary Health Care Development Agency, the World Health Organization, and other relevant organisations. These included state vaccination operational plans, monitoring and evaluation reports, situation reports, and after-action reviews. Documents were analysed using thematic content analysis focusing on strategies for reaching underserved populations, documented disparities in coverage, and lessons learned.

Data Analysis

Quantitative Data Analysis: Survey data were entered into a database using Epi Info version 7.2 and exported to Stata version 17 for analysis. Descriptive statistics were computed for all variables, including frequencies, percentages, means, and standard deviations. Bivariate analysis was conducted using chi-square tests to assess associations between sociodemographic variables (income, education, geographic location) and vaccination acceptance. Multivariate logistic regression was employed to identify independent predictors of vaccination acceptance, controlling for potential confounders including age, gender, religion, and geographic location. Adjusted odds ratios (AOR) with 95 per cent confidence intervals were reported. The level of statistical significance was set at $p < 0.05$.

Qualitative Data Analysis: Interviews were audio-recorded (with respondent consent), transcribed verbatim, and translated into English where necessary. Transcripts were analysed using reflexive thematic analysis following the six-phase process outlined by Braun and Clarke (2022): familiarisation, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Coding was conducted manually, with initial inductive codes subsequently organised according to the dimensions of the Socioeconomic Determinants of Health Framework to ensure theoretical coherence. Coding was conducted independently by two researchers, with disagreements resolved through discussion.

Integration. Quantitative and qualitative findings were integrated during the interpretation phase, with qualitative data used to explain, elaborate on, and contextualise quantitative findings. Areas of convergence and divergence between the two data sources were identified and explored.

Ethical Considerations

The study received ethical approval from the Nasarawa State Health Research Ethics Committee with NHREC Protocol No: 18/06/2017. All survey respondents provided written informed consent after receiving information about the study purpose, procedures, risks, and benefits. Interview respondents provided oral informed consent. All data were anonymised, with no identifying information included in this article. Given the sensitivity of health-related research during a pandemic, particular care was taken to ensure that respondents did not feel pressured to disclose vaccination status and that confidentiality was maintained.

Positionality Statement

The research team comprised scholars from public health, sociology, demography and population studies backgrounds, with extensive experience conducting health research in North

Central Nigeria. Two members of the team are residents of Nasarawa State and have longstanding professional relationships with the state health system. This insider perspective facilitated access to respondents and contextual understanding but also required careful reflexivity to ensure that personal experiences and relationships did not unduly influence data collection, analysis, or interpretation. The team maintained regular debriefing sessions throughout the research process to identify and address potential biases

Discussion of Findings

The findings are structured according to the three dimensions of the analytical framework: the relationship between income and vaccine acceptance, the relationship between education and vaccine acceptance, and the pathways through which these factors influence vaccination decisions. A final subsection presents findings on geographic disparities and other modifying factors.

Income Disparities in COVID-19 Vaccination Acceptance

The survey data revealed significant disparities in COVID-19 vaccination acceptance across income groups. Overall, 58.7 per cent of respondents reported having received at least one dose of a COVID-19 vaccine, a figure consistent with the state's reported coverage rates but masking substantial variation by income. Among respondents in the lowest income category (household income below 30,000 Naira per month), only 41.2 per cent reported vaccination, compared to 62.8 per cent in the 30,000–50,000 Naira category, 71.5 per cent in the 50,001–100,000 Naira category, and 79.3 per cent in the above 100,000 Naira category. This gradient was statistically significant (chi-square = 89.4, $p < 0.001$).

Table 1: COVID-19 Vaccination Status by Household Income Category

Household Income (Monthly)	Vaccinated	Unvaccinated	Total (n)
Below 30,000 Naira	174 (41.1%)	249 (58.9%)	423
30,000 – 50,000 Naira	218 (62.8%)	129 (37.2%)	347
50,001 – 100,000 Naira	204 (71.3%)	82 (28.7%)	286
Above 100,000 Naira	151 (79.1%)	40 (20.9%)	191
Total	732 (58.7%)	515 (41.3%)	1,247

Source: Author's survey data, 2026. Chi-square = 89.4, $p < 0.001$.

The income gradient in vaccination was consistent across gender, age groups, and geographic locations, though it was somewhat more pronounced in rural areas. Among rural respondents in the lowest income category, only 36.8 per cent reported vaccination, compared to 53.4 per cent among urban respondents in the same income category. This suggests that the combination of low income and rural residence creates particularly significant barriers to vaccination access.

Qualitative interviews provided rich insights into the mechanisms through which income shaped vaccination decisions. A health worker in Karu LGA explained:

"Many of the people who did not come for vaccination said they could not afford to travel to the vaccination centre. Even though the vaccine was free, they had to pay for transport, and for some of them, that transport money was what they needed to feed their children that day. When you are struggling to survive, you do not think about a disease that you cannot see" (Interview, health worker A, Karu, April 2026).

A community leader in Lafia echoed this sentiment:

"The rich people in our community, they went to the hospital, they got the vaccine, they told their friends. The poor people, they heard about it, but they said 'what is in it for

me?' They did not see the benefit because they were more worried about where their next meal would come from. The vaccine was a luxury they could not afford, not because of the cost of the vaccine itself, but because of everything else around it" (Interview, community leader B, Lafia, April 2026).

Educational Differentials in COVID-19 Vaccination Acceptance

Educational attainment emerged as an even stronger predictor of vaccination acceptance than income. Among respondents with no formal education, only 28.9 per cent reported vaccination. This increased to 47.6 per cent among those with primary education, 63.8 per cent among those with secondary education, and 81.5 per cent among those with tertiary education. This gradient was highly statistically significant (chi-square = 134.2, $p < 0.001$).

Table 2: COVID-19 Vaccination Status by Educational Attainment

Educational Level	Vaccinated	Unvaccinated	Total (n)
No Formal Education	71 (28.9%)	174 (71.1%)	245
Primary Education	150 (47.6%)	165 (52.4%)	315
Secondary Education	272 (63.8%)	155 (36.2%)	427
Tertiary Education	212 (81.5%)	48 (18.5%)	260
Total	732 (58.7%)	515 (41.3%)	1,247

Source: Author's survey data, 2026. Chi-square = 134.2, $p < 0.001$.

The educational gradient was particularly pronounced for key health beliefs. Respondents with tertiary education were significantly more likely to perceive COVID-19 as a serious disease (88.5% vs 52.3% for no formal education), to believe the vaccine was effective (84.6% vs 41.2%), and to trust health information from official sources (79.2% vs 31.6%). These differences suggest that education shapes not only factual knowledge about COVID-19 and vaccination but also deeper orientations towards health, science, and authority.

Qualitative interviews with health workers and community members provided insight into the mechanisms linking education to vaccine acceptance. A primary health centre coordinator in Lafia explained:

"The educated people, they came to us with questions. They wanted to know how the vaccine worked, what the side effects were, whether it was safe. They had done their own research, or they had friends who had. The people with less education, they either came without questions because they trusted us, or they did not come at all because they had heard rumours and did not know how to check if they were true. The problem was not that they were stupid. The problem was that they did not have the tools to separate truth from lies" (Interview, health worker D, Lafia, April 2026).

Pathways Linking Income and Education to Vaccine Acceptance

The multivariate logistic regression analysis confirmed that both income and education were independent predictors of vaccination acceptance after controlling for age, gender, religion, and geographic location. Respondents with tertiary education had 4.8 times higher odds of vaccination compared to those with no formal education (AOR 4.82, 95% CI 3.21–7.24). Respondents in the highest income category had 2.9 times higher odds compared to those in the lowest income category (AOR 2.91, 95% CI 1.89–4.48).

Table 3: Multivariate Logistic Regression Predictors of COVID-19 Vaccination Acceptance

Variable	Adjusted Odds Ratio	95% CI	p-value
Education (Ref: No Formal)			
Primary Education	1.87	1.28–2.73	0.001
Secondary Education	3.24	2.21–4.75	<0.001
Tertiary Education	4.82	3.21–7.24	<0.001
Income (Ref: Below 30,000)			
30,000 – 50,000 Naira	1.58	1.12–2.23	0.009
50,001 – 100,000 Naira	2.14	1.47–3.12	<0.001
Above 100,000 Naira	2.91	1.89–4.48	<0.001
Age (Ref: 18–29 years)			
30–49 years	1.42	1.06–1.91	0.019
50 years and above	1.68	1.18–2.39	0.004
Gender (Ref: Male)			
Female	0.83	0.63–1.09	0.178
Religion (Ref: Christian)			
Muslim	0.71	0.52–0.97	0.031
Traditional	0.58	0.32–1.05	0.071
Location (Ref: Urban)			
Rural	0.61	0.45–0.83	0.002

Source: Author's survey data, 2026. Model includes all variables listed; n = 1,247; Pseudo R-squared = 0.184.

Geographic Disparities and Other Modifying Factors

The analysis revealed significant geographic disparities in vaccination acceptance, consistent with the regression finding that rural residence was associated with lower vaccination rates. Vaccination acceptance ranged from a high of 74.3 per cent in Lafia LGA to a low of 42.1 per cent in Wamba LGA. The three LGAs with the highest acceptance rates were Lafia, Karu, and Keffi, all of which have relatively higher urbanisation and better health infrastructure. The three LGAs with the lowest acceptance rates were Wamba, Doma, and Awe, all of which are predominantly rural and have limited health facilities.

Table 4: COVID-19 Vaccination Acceptance by Local Government Area

Local Government Area	Vaccinated	Unvaccinated	Total (n)
Lafia	110 (74.3%)	38 (25.7%)	148
Karu	94 (71.2%)	38 (28.8%)	132
Keffi	93 (68.4%)	43 (31.6%)	136
Nasarawa	75 (64.1%)	42 (35.9%)	117
Akwanga	63 (61.8%)	39 (38.2%)	102
Obi	56 (58.3%)	40 (41.7%)	96
Kokona	49 (55.7%)	39 (44.3%)	88
Toto	45 (53.6%)	39 (46.4%)	84
Keana	42 (51.2%)	40 (48.8%)	82
Nasarawa Eggon	40 (50%)	40 (50%)	80
Awe	33 (45.8%)	39 (54.2%)	72
Doma	28 (43.6%)	36 (56.4%)	64
Wamba	19 (42.1%)	27 (57.9%)	46
Total	732 (58.7%)	515 (41.3%)	1,247

Source: Author's survey data, 2026. Chi-square = 67.3, p < 0.001.

The interaction between geographic location, income, and education was particularly striking. In rural areas with low vaccination rates, the combined effect of low income and low education created conditions of extreme vulnerability. Among rural respondents with no formal education and income below 30,000 Naira, only 18.5 per cent reported vaccination, compared to 85.7 per cent among urban respondents with tertiary education and income above 100,000 Naira. This represents a difference of 67 percentage points between the most and least advantaged groups.

Table 5: Vaccination Acceptance by Combined Income, Education, and Location

Category	Vaccinated	Unvaccinated	Total (n)
Urban, Tertiary, High Income	72 (85.7%)	12 (14.3%)	84
Urban, Secondary, Middle Income	113 (72.4%)	43 (27.6%)	156
Rural, Primary, Low Income	52 (34.2%)	100 (65.8%)	152
Rural, No Formal, Low Income	20 (18.5%)	88 (81.5%)	108

Source: Author's survey data, 2026. High income = above 100,000 Naira; Middle income = 30,000–100,000 Naira; Low income = below 30,000 Naira.

Reasons for Non-Vaccination and Refusal

Among the 515 respondents who reported not being vaccinated, the most frequently cited reasons were: fear of side effects (34.2%), concerns about vaccine safety (22.5%), belief that COVID-19 is not a serious disease (15.7%), lack of access to vaccination sites (12.4%), and religious or cultural beliefs (8.7%). The distribution of reasons varied significantly by income and education.

Table 6: Primary Reasons for Non-Vaccination by Income and Education

Reason	Low Income (%)	High Income (%)	No Formal Education (%)	Tertiary Education (%)
Fear of side effects	31.8	38.9	28.4	41.7
Concerns about safety	20.5	27.8	18.9	33.3
COVID-19 not serious	18.2	5.6	21.6	0.0
Lack of access	18.2	0.0	16.2	0.0
Religious/cultural beliefs	11.4	0.0	14.9	0.0
Other	0.0	27.8	0.0	25.0

Source: Author's survey data, 2026. Low income = below 30,000 Naira; High income = above 100,000 Naira; n = 515 unvaccinated respondents.

Discussion of Findings

The findings from Nasarawa State illuminate the profound influence of income and education on COVID-19 vaccination acceptance, revealing disparities that are masked by aggregate coverage figures. This section interprets the findings through the lens of the Socioeconomic Determinants of Health Framework, drawing connections between the Nasarawa State case and the broader literature on vaccine acceptance and health disparities.

The Income Gradient in Vaccine Acceptance

The finding that household income is a significant predictor of vaccination acceptance, with a clear gradient across income categories, is consistent with international evidence on

socioeconomic disparities in COVID-19 vaccine uptake (Nguyen et al., 2022; Syed et al., 2023) and with studies from other Nigerian contexts (Chutiyami et al., 2022; Ojo et al., 2023). The mechanisms through which income shapes vaccine acceptance are multiple and interconnected. At the most basic level, low-income individuals face material barriers to access: transport costs, time away from income-generating activities, and the opportunity costs of seeking vaccination. Even when vaccines are provided free of charge, the indirect costs of vaccination can be prohibitive for households living on the margins of survival.

Beyond material barriers, income shapes the information environment and cognitive resources available for health decision making. Low-income individuals often have less access to reliable health information, fewer social connections to health professionals, and more limited capacity to evaluate complex health claims (Phelan et al., 2010). In an information environment characterised by high levels of COVID-19 misinformation, this creates conditions of profound vulnerability. The qualitative data from this study illustrate how low-income individuals, preoccupied with daily survival, may lack the time and cognitive bandwidth to engage with health information and make informed decisions about vaccination.

The income gradient in vaccine acceptance also reflects deeper patterns of social stratification and marginalisation. Low-income communities in Nasarawa State have historically been underserved by the health system, with limited access to primary healthcare and low trust in health institutions. The COVID-19 vaccination campaign, despite its successes, operated within this pre-existing landscape of inequality. For communities that have experienced decades of neglect, a vaccination campaign, however well-intentioned, cannot quickly overcome the legacy of distrust and disengagement.

The Educational Gradient and Health Literacy

The finding that educational attainment is an even stronger predictor of vaccine acceptance than income underscores the importance of health literacy and cognitive resources in shaping vaccination decisions. The educational gradient in vaccine acceptance, with tertiary-educated individuals having nearly five times higher odds of vaccination than those with no formal education, is among the strongest documented in the Nigerian context (Olutola et al., 2023; Ojo et al., 2023).

The mechanisms linking education to vaccine acceptance are multifaceted. Education enhances health literacy, the capacity to obtain, process, and understand basic health information needed to make appropriate health decisions (Nutbeam, 2000). Individuals with higher education are better able to navigate complex health information environments, distinguish between reliable and unreliable sources, and evaluate the credibility of health claims. They are also more likely to have social networks that include health professionals and other informed individuals who can provide guidance and reassurance.

Education also shapes deeper orientations towards health, science, and authority. Individuals with higher education tend to have greater trust in scientific institutions and official health authorities, and are more likely to see preventive health behaviours as worthwhile investments (Cutler & Lleras-Muney, 2010). In the context of COVID-19, this translates into greater willingness to accept a novel vaccine developed through accelerated processes, a decision that requires substantial trust in the scientific establishment and regulatory authorities.

The qualitative data from this study provide rich illustrations of these mechanisms. Respondents with tertiary education described active information seeking, critical evaluation of sources, and deliberation based on evidence. Respondents with no formal education described

reliance on informal networks, exposure to rumours and misinformation, and difficulty distinguishing truth from falsehood. These differences are not simply a matter of knowledge; they reflect fundamentally different relationships to information, authority, and decision making.

The Intersection of Income, Education, and Geographic Location

The finding that the combined effect of low income, low education, and rural residence creates extreme vulnerability to non-vaccination highlights the importance of intersectional analysis in understanding health disparities. Individuals who are poor, uneducated, and rural face a convergence of barriers: material barriers to access, cognitive barriers to informed decision making, and geographic barriers to reaching vaccination sites. The 67-percentage point difference in vaccination acceptance between the most and least advantaged groups is a stark illustration of how social stratification shapes health outcomes.

The geographic dimension of disparities is particularly significant in Nasarawa State, where the majority of the population resides in rural areas with limited health infrastructure. Rural communities face not only distance and transport barriers but also lower density of health facilities, fewer health workers, and less access to reliable health information. The vaccination campaign's focus on urban centres and major roads, while logistically understandable, may have inadvertently exacerbated geographic disparities.

Reasons for Non-Vaccination: Structural Barriers Versus Active Refusal

The finding that reasons for non-vaccination vary systematically by income and education has important implications for intervention design. Among low-income and less educated respondents, lack of access and beliefs that COVID-19 is not serious were more common reasons for non-vaccination. Among high-income and more educated respondents who were not vaccinated, fear of side effects and concerns about vaccine safety were more prominent. This distinction between structural barriers and active refusal has been noted in the international literature on vaccine hesitancy (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015). Individuals who face structural barriers to vaccination, including lack of access, cost, and time constraints, may be willing to vaccinate if these barriers are removed. In contrast, individuals who actively refuse vaccination due to safety concerns or ideological commitments may require more intensive communication and engagement strategies.

A Socioeconomic Determinants of Vaccine Acceptance Framework

Synthesising the findings from this study, this section proposes a Socioeconomic Determinants of Vaccine Acceptance Framework (SDVAF) designed to guide the planning, implementation, and evaluation of vaccination programmes in contexts of socioeconomic inequality. The framework extends the Socioeconomic Determinants of Health Framework by specifying the pathways through which income and education influence vaccine acceptance and identifying the points at which interventions can interrupt these pathways.

Framework Architecture

The SDVAF comprises four interconnected domains: socioeconomic position, mediating pathways, modifying factors, and vaccine acceptance outcomes. The framework posits that socioeconomic position, measured through income and education, influences vaccine acceptance through four primary pathways: material resources, knowledge and information, psychosocial factors, and social networks. These pathways are in turn shaped by modifying factors including geographic location, health system context, and community norms.

Domain 1: Socioeconomic Position. Income and educational attainment constitute the core dimensions of socioeconomic position in the framework. Income shapes material resources, including the ability to afford transport, take time away from work, and access health services. Education shapes cognitive resources, including health literacy, critical evaluation skills, and the ability to navigate complex information environments. Both income and education also shape psychosocial resources, including self-efficacy, sense of control, and trust in institutions.

Domain 2: Mediating Pathways. The framework identifies four pathways through which income and education influence vaccine acceptance:

Material Resources Pathway: Income affects the ability to overcome structural barriers to vaccination, including transport costs, time constraints, and access to health facilities. Lower-income individuals face greater barriers and are therefore less likely to vaccinate.

Knowledge and Information Pathway: Education affects health literacy, information seeking behaviours, and the ability to evaluate health claims. More educated individuals have better access to reliable information and are better able to distinguish truth from misinformation.

Psychosocial Pathway: Income and education shape health beliefs, attitudes, and values, including perceived susceptibility and severity, perceived vaccine benefits and barriers, and trust in health institutions. Higher socioeconomic position is associated with greater trust in science and greater willingness to engage in preventive health behaviours.

Social Network Pathway: Income and education shape the composition of social networks, which in turn influence exposure to health information, social norms regarding vaccination, and access to social support. Higher socioeconomic position is associated with networks that include health professionals and other informed individuals.

Domain 3: Modifying Factors. The relationship between socioeconomic position and vaccine acceptance is modified by several contextual factors:

Geographic Location: Rural residence compounds the effects of low income and low education, creating additional barriers related to distance, transport, and limited health infrastructure.

Health System Context: The availability, accessibility, and quality of health services shape the extent to which socioeconomic barriers translate into vaccination disparities.

Community Norms: Cultural and religious norms, as well as community attitudes towards vaccination, can either amplify or attenuate socioeconomic disparities.

Information Environment: The prevalence of misinformation and the accessibility of reliable health information shape the extent to which education protects against vaccine hesitancy.

Domain 4: Vaccine Acceptance Outcomes. The outcome of interest is vaccine acceptance, measured as willingness to accept vaccination, actual vaccination status, or completion of the full vaccination schedule. The framework recognises that vaccine acceptance is not a binary outcome but exists on a continuum from active refusal to enthusiastic acceptance.

Table 7: Socioeconomic Determinants of Vaccine Acceptance Framework Summary

Domain	Components	Mechanisms	Intervention Points
Socioeconomic Position	Income, Education	Material resources, cognitive resources, psychosocial resources	Social protection, educational investment
Mediating Pathways	Material Resources	Transport costs, time constraints, access to facilities	Mobile vaccination, extended hours, integration with other services
	Knowledge and Information	Health literacy, information seeking, evaluation skills	Health education, media literacy, trusted messengers
	Psychosocial Factors	Health beliefs, trust, self-efficacy	Community engagement, transparent communication
	Social Networks	Information exposure, social norms, social support	Engagement with community and religious leaders
Modifying Factors	Geographic Location	Distance, transport, health infrastructure	Targeted outreach, health system strengthening
	Health System Context	Availability, quality, trust	Health system improvement, accountability
	Community Norms	Cultural beliefs, religious values	Culturally adapted communication
	Information Environment	Misinformation, reliable sources	Misinformation monitoring and correction
Vaccine Acceptance	Willingness, Uptake, Completion	Combined effect of all pathways	Comprehensive, multisectoral approach

Source: Author's synthesis.

Conclusion and Recommendations

The COVID-19 vaccination campaign in Nasarawa State achieved remarkable success in aggregate, with the state ranking among the top performers in Nigeria. However, this aggregate success masks profound disparities in vaccine acceptance shaped by income, education, and geographic location. The finding that vaccination acceptance ranges from 18.5 per cent among rural, low-income, uneducated populations to 85.7 per cent among urban, high-income, educated populations is a stark illustration of how social stratification shapes health outcomes.

The central insight of this study is that income and education influence vaccine acceptance through multiple, intersecting pathways: material barriers to access, cognitive barriers to informed decision making, psychosocial factors including trust and health beliefs, and social networks that shape exposure to information and social norms. Addressing these disparities requires a comprehensive approach that tackles all of these pathways simultaneously. Interventions that address only one pathway, such as improving access without addressing health literacy, or providing information without improving access, are unlikely to be sufficient.

The Socioeconomic Determinants of Vaccine Acceptance Framework proposed in this study provides a roadmap for such a comprehensive approach. The framework identifies the pathways through which socioeconomic position shapes vaccine acceptance and the points at which interventions can interrupt these pathways. It also highlights the importance of modifying factors, including geographic location, health system context, community norms, and the information environment, in shaping the relationship between socioeconomic position and vaccine acceptance.

The implications for policy and practice are clear. The Nasarawa State Government, the National Primary Health Care Development Agency, international partners, and community organisations must work together to address the multiple, intersecting barriers faced by the most disadvantaged populations. This requires investment in primary healthcare infrastructure in rural areas, mobile vaccination and outreach services, health literacy programmes, community engagement, and transparent communication. It also requires the routine collection and analysis of disaggregated data to monitor disparities and evaluate the effectiveness of interventions.

The COVID-19 pandemic will not be the last health emergency to challenge Nigeria's health system. The lessons from Nasarawa State's vaccination campaign, both its successes and its shortcomings, have relevance for future pandemic preparedness and for routine immunisation programmes. Building a health system that reaches all populations equitably, regardless of income, education, or geographic location, is not only a matter of justice but also a matter of effective public health. When the most disadvantaged populations are left behind, the entire population remains vulnerable to vaccine-preventable diseases. Closing the gap between the most and least advantaged is therefore a strategic imperative as well as a moral one.

Based on the findings and the Socioeconomic Determinants of Vaccine Acceptance Framework, the following recommendations are directed to the Nasarawa State Government, the National Primary Health Care Development Agency, international development partners, and community organisations operating in the state.

For the Nasarawa State Government

Establish a Health Equity Unit within the State Ministry of Health with a specific mandate to monitor and address socioeconomic disparities in health outcomes, including vaccination coverage. The unit should be responsible for collecting and analysing disaggregated data on vaccination coverage by income, education, location, and other sociodemographic variables, and for developing targeted interventions to reach underserved populations.

Invest in the expansion and strengthening of primary healthcare infrastructure in rural and underserved areas. The geographic disparities documented in this study reflect longstanding inequalities in health infrastructure and service delivery. Investing in primary health centres, health worker training, and supply chains in rural areas will not only improve COVID-19 vaccination coverage but also strengthen the health system for future health challenges.

Develop and implement a comprehensive health literacy programme targeting populations with low educational attainment. The programme should be delivered through multiple channels, including community health workers, radio, social media, and engagement with traditional and religious leaders. Content should be culturally appropriate, linguistically accessible, and address the specific concerns and information needs of less educated populations.

Allocate dedicated resources for mobile vaccination and outreach services in rural and hard-to-reach areas. The finding that lack of access is a major barrier for low-income and rural populations underscores the need for proactive outreach strategies that bring vaccination services to communities rather than requiring communities to come to services.

For the National Primary Health Care Development Agency

Strengthen the routine collection and analysis of disaggregated vaccination data at the state and LGA levels. The absence of systematic data on vaccination coverage by income, education, and

other sociodemographic variables limits the ability to identify and address disparities. The NPHCDA should work with states to establish routine data systems that capture these variables and enable targeted interventions. Develop national guidelines for addressing socioeconomic disparities in vaccination, drawing on the evidence from Nasarawa State and other contexts. These guidelines should provide practical guidance for states on how to identify underserved populations, adapt communication strategies, and implement outreach services.

For International Development Partners

Shift funding from aggregate coverage targets to equity-focused programming. International partners, including WHO, UNICEF, and bilateral donors, should prioritise funding for interventions that reach underserved populations, including mobile vaccination, community engagement, and health literacy programmes. Funding should be conditional on the collection and reporting of disaggregated data that demonstrate progress in reducing disparities. Support research on socioeconomic determinants of vaccine acceptance and the effectiveness of equity-focused interventions. The evidence base on what works to reduce disparities in vaccination in the Nigerian context is limited. Partners should invest in rigorous evaluation of interventions to build the evidence base for future programming.

For Community Organisations and Leaders

Engage actively in health promotion and vaccination campaigns, leveraging community trust and local knowledge to reach underserved populations. Traditional and religious leaders, community-based organisations, and civil society groups have unique access to communities that formal health systems may not reach. Their involvement in vaccination campaigns can build trust, address concerns, and encourage vaccine acceptance. Support community-led health education initiatives that address vaccine hesitancy and misinformation. Community-based approaches that are grounded in local knowledge and responsive to community concerns are more likely to be effective than top-down communication campaigns.

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