



Maternal Age and Educational Attainment in Relation to Reported Full Immunization of Children Under Five Years in Owerri Municipality, Imo State, Nigeria

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Abstract

Childhood immunization is a major public-health intervention for preventing vaccine-preventable diseases, yet vaccination gaps remain substantial in Nigeria. Maternal characteristics, particularly age and educational attainment, may influence children's access to and use of immunization services. This study examined the descriptive pattern of reported full immunization according to maternal age and educational attainment among mothers of nursery-school children in Owerri Municipality, Imo State, Nigeria. A cross-sectional survey design was adopted. The population comprised 9,713 mothers of nursery-school children, from whom 398 mothers were selected using clustered sampling. Data were collected using the researcher-developed Maternal Factors on the Immunization Status of Under-5 Nursery Children Questionnaire, which had a reliability coefficient of 0.84. Data were analysed using mean and standard deviation, with 2.50 as the criterion mean. Corrected maternal-age frequencies were used to reconcile an identified source discrepancy. Results revealed that mothers aged 21–25, 26–30, 31–35 and 36–40 years recorded mean scores of 2.79, 2.85, 2.85 and 2.85, respectively, while those aged 41–45 years recorded 1.73. The overall age mean was 2.61. Mothers with first-degree, postgraduate diploma, master's and doctoral qualifications recorded means of 3.33, 2.98, 3.03 and 2.67, respectively, compared with 1.66 among mothers with O-level education. The overall educational-attainment mean was 2.73. Reported full-immunization responses were generally favourable, except among mothers aged 41–45 years and those with O-level education. Primary healthcare providers and immunization programme managers should provide targeted, simplified immunization education and follow-up for mothers with less favourable response patterns, while nursery-school administrators should provide vaccination reminders and referral information. Community health workers should provide age-responsive counselling for mothers to strengthen timely vaccination.

Keywords: Maternal age; Maternal education; Childhood immunization; Vaccination; Under-five children; Nursery schools

Introduction

Childhood immunization is one of the most effective and cost-effective public health interventions for preventing vaccine-preventable diseases, reducing childhood morbidity and mortality, and protecting communities from outbreaks. Despite substantial progress in global vaccination, important gaps remain. The latest World Health Organization (WHO) and United Nations



Children's Fund (UNICEF) estimates indicate that approximately 90% of infants worldwide received at least one dose of diphtheria-tetanus-pertussis-containing vaccine in 2025, while 85% completed the three-dose series. Nevertheless, an estimated 13.5 million children received no routine vaccination, and approximately 6 million additional children remained partially vaccinated. These gaps threaten progress towards the Immunization Agenda 2030 and are particularly important in countries with large populations of under-immunized children (WHO, 2026; WHO & UNICEF, 2026).

The consequences of inadequate vaccination are substantial because vaccine-preventable diseases continue to contribute to preventable childhood illness and death. Global evidence indicates that infectious diseases, including pneumonia, pertussis, measles and meningitis, remain important contributors to under-five mortality, particularly where access to preventive and curative health services is limited (Perin et al., 2022). Vaccination therefore remains central to child-survival strategies and to the broader goal of reducing inequities in child health. The Immunization Agenda 2030 emphasizes reaching every population group with vaccines while addressing the social, geographic and health-system barriers that produce inequitable coverage (WHO, 2020).

Nigeria remains an important setting for immunization research because of its large population of under-immunized and zero-dose children. More recent Nigerian evidence reinforces the importance of maternal education while demonstrating that immunization is influenced by multiple interacting factors. Olufadewa et al. (2024), in an analysis of trends and predictors of full immunization coverage in Nigeria, identified maternal education and household wealth among important predictors of vaccination coverage. The 2024 Nigeria Demographic and Health Survey reported that only 39% of children aged 12–23 months were fully vaccinated against all basic antigens, while 31% had received no vaccination. Coverage varied considerably across states, ranging from 8% in Sokoto to 69% in Cross River, demonstrating substantial geographical inequity in childhood immunization (Federal Ministry of Health and Social Welfare et al., 2025). Nigeria is also among the countries accounting for a large share of the world's under- and unvaccinated children (WHO, 2026).

Evidence from Nigeria has consistently shown that childhood immunization is influenced by a combination of maternal, socioeconomic, geographic, healthcare and community factors. A systematic review and meta-analysis by Adeloye et al. (2017) found low national coverage and identified maternal education, poor information, vaccine availability and concerns about vaccine safety among important determinants of childhood immunization. More recent evidence has reinforced the multidimensional nature of these inequalities. Aheto et al. (2022), using national survey data, found that maternal education, health-card ownership, healthcare access, socioeconomic status, travel time and maternal age were among factors associated with different stages of childhood vaccination.

Maternal educational attainment is particularly relevant because it can influence health literacy, interpretation of health information, interaction with healthcare providers and the ability to navigate preventive health services. Burroway and Hargrove (2018) demonstrated individual- and community-level relationships between maternal education and childhood immunization in Nigeria, while a national analysis by Ogundele et al. (2022) found that children of mothers without formal education had higher odds of incomplete vaccination than those whose mothers had secondary or higher education. Similar evidence has been reported by Okunlola et al. (2023), who identified maternal or caregiver literacy, employment, antenatal-care attendance and internet use as important



predictors of vaccination compliance. Nwaze et al. (2025), in a cross-sectional study in Abuja, reported that children of mothers with no formal education had significantly greater odds of being zero-dose vaccinated.

Maternal age may also shape childhood immunization behaviour through accumulated experience with pregnancy, child healthcare, antenatal services and interaction with health systems. Recent Nigerian evidence supports this possibility. Williams et al. (2024), using the 2018 Nigeria Demographic and Health Survey, identified maternal age at birth and maternal education among important social determinants of childhood immunization. After adjustment for other characteristics, children of mothers aged 35–49 years had higher odds of basic vaccination than children of mothers aged 15–19 years, while maternal secondary or higher education was also associated with higher odds of basic vaccination. Similarly, Aheto et al. (2022) found maternal age to be associated with some vaccination outcomes, although the strength and direction of associations varied according to the vaccine and stage of the immunization schedule. Evidence from southwestern Nigeria provides further contextual support. Bisiriyu and Ojewumi (2014), using data from the 2008 Nigeria Demographic and Health Survey, reported that maternal education, place of residence, occupation, wealth status, place of antenatal care and place of delivery significantly influenced childhood vaccination status. More recently, Salako et al. (2024) found that only 65.3% of children aged 12–59 months with appropriately completed vaccination cards had received all basic vaccines in Lagelu Local Government Area of Ibadan. The study also found significant differences in basic vaccination according to maternal educational level and place of residence, while access-related barriers were commonly reported.

The relationship between maternal characteristics and childhood immunization should, however, be understood within the wider social and health-system environment. The Immunization Agenda 2030 identifies low education, limited health information, distance to health facilities, inconvenient service arrangements and other access barriers as factors that can contribute to undervaccination (WHO, 2020). In Nigeria, reviews have similarly identified poverty, geographical barriers, vaccine availability, health-worker attitudes, misinformation, vaccine concerns, maternal autonomy and weaknesses in service delivery as important influences on vaccination uptake (Mahachi et al., 2022; Olaniyan et al., 2022; Mohammed et al., 2024). These findings suggest that maternal age and education should not be considered in isolation from the broader conditions within which mothers make decisions about child health.

The Health Belief Model provides a useful conceptual perspective for understanding these behaviours. Rosenstock (1966) proposed that health actions are influenced by perceptions of susceptibility, severity, benefits, barriers and cues to action. Applied to childhood immunization, maternal educational exposure and life experience may influence understanding of vaccine benefits, perceived risks and recognition of the importance of completing recommended vaccination schedules. Nevertheless, these individual-level characteristics interact with practical access, service availability, social support and health-system factors.

Despite the substantial national evidence on childhood immunization, locally focused evidence from Owerri Municipality remains limited, particularly among mothers of nursery-school children. Existing national studies have largely focused on children within specific age ranges and have frequently used vaccination cards or nationally representative datasets. Local evidence based on mothers' reported immunization responses may provide complementary information for health educators, primary healthcare providers, nursery-school administrators and immunization



programme managers. Importantly, such evidence should be interpreted as reported maternal responses rather than as independently verified vaccination coverage. Against this background, this study examined the descriptive pattern of reported full immunization according to maternal age and educational attainment among mothers of nursery-school children in Owerri Municipality, Imo State, Nigeria. Specifically, the study examined the reported full-immunization response pattern across maternal-age groups and levels of maternal educational attainment. The study findings may assist health educators, primary healthcare providers and immunization programme managers in identifying groups that may benefit from more targeted immunization education, communication and follow-up. It may also provide a basis for subsequent analytical studies using vaccination-card or health-facility records to determine whether maternal age and educational attainment remain independently associated with verified childhood immunization status.

Methods

Study design and setting

A descriptive cross-sectional survey design was adopted to examine the pattern of reported full immunization according to maternal age and educational attainment among mothers of children attending nursery schools in Owerri Municipality, Imo State, Nigeria. A cross-sectional design was considered appropriate because information on maternal characteristics and reported childhood immunization was obtained from respondents at a single point in time without manipulating any study variable.

The study was conducted in five communities within Owerri Municipality, namely Umuororonjo, Amawom, Umuonyeche, Umuodu, and Umuoyima. The study setting comprised nursery-school communities in which mothers of children under five years could be identified through the participating nursery schools. The choice of the setting was informed by the need to obtain community-level evidence on reported childhood immunization among mothers whose children were within the preschool age range.

Study population

The study population comprised 9,713 mothers of nursery-school children identified within the five selected communities of Owerri Municipality. Eligible participants were mothers who had a child below five years of age attending a participating nursery school and who were available during the period of data collection.

Mothers were included if they were the primary caregiver of the child, were willing to participate, and provided informed consent. Mothers who were not directly responsible for the child's routine healthcare decisions or who declined participation were excluded. Where a mother had more than one eligible child, responses were obtained in relation to the eligible child identified for the study to avoid duplication of observations.

Sample size and sampling technique

A sample of 398 mothers was selected from the study population of 9,713 mothers. A cluster sampling procedure was used, with the five selected communities serving as the sampling clusters. The sample was distributed approximately equally across the clusters to ensure representation of



mothers from each selected community. Accordingly, 80 respondents were allocated to each of Umuororonjo, Amawom, and Umuonyeche, while 79 respondents were allocated to each of Umuodu and Umuoyima, giving a total sample of 398 mothers.

Within each selected cluster, eligible mothers were identified through the participating nursery-school communities and recruited until the allocated sample for the cluster was achieved. The cluster-based approach provided representation across the selected communities while making data collection feasible within the geographical scope of the study.

Data collection instrument

Data were collected using a researcher-developed Maternal Factors on the Immunization Status of Under-5 Nursery Children Questionnaire (MFISUNCQ). The questionnaire was developed from the objectives of the study and relevant literature on maternal characteristics and childhood immunization. The instrument was structured to obtain information on respondents' demographic characteristics, particularly maternal age and educational attainment, and mothers' reported responses concerning the immunization status of their children.

The immunization-related items were presented on a four-point Likert-type response scale comprising Strongly Agree, Agree, Disagree, and Strongly Disagree, scored 4, 3, 2, and 1, respectively. Negatively worded items were reverse scored before analysis so that higher scores consistently represented more favourable reported immunization responses. The instrument therefore assessed the mothers' reported responses concerning full immunization rather than independently verifying individual vaccine doses from vaccination cards or facility registers.

To establish content validity, the MFISUNCQ was submitted to three experts in Life Science at Imo State University. The internal consistency and stability of the instrument were assessed before the main data collection. The instrument yielded a reliability coefficient of 0.84, indicating satisfactory reliability for the study. The coefficient exceeded the commonly accepted minimum threshold of 0.70 for research instruments, suggesting that the questionnaire items demonstrated adequate consistency in measuring the intended construct.

Data collection procedure

Before commencement of data collection, permission was obtained from the relevant authorities of the participating nursery-school communities. The researchers and trained data collectors approached eligible mothers through the participating nursery schools and explained the purpose of the study, the procedures involved, the voluntary nature of participation, and the expected duration of questionnaire completion. The ethical procedures were consistent with the principles of voluntary participation, respect for participants, confidentiality, and protection of participants' privacy.

Each eligible mother was provided with adequate information about the study and was given an opportunity to ask questions before participation. Written informed consent was obtained from respondents before questionnaires were administered. Participants were informed that participation was entirely voluntary and that they could decline to participate or withdraw at any stage without penalty or loss of any benefit to which they were otherwise entitled.

To protect privacy, questionnaires were completed in a manner that minimized observation by other persons, and respondents were not required to provide personally identifying information



unnecessarily. Completed questionnaires were handled confidentially and used solely for research purposes. Data collectors were instructed not to discuss individual responses with other participants, school personnel, or persons outside the research team.

Data analysis

The completed questionnaires were coded and analysed using descriptive statistical procedures. Frequency counts and percentages were used to summarize the distribution of mothers according to maternal age and educational attainment, while mean and standard deviation were used to summarize responses to the reported full-immunization items. For the four-point response scale, the criterion mean was calculated as: $(4 + 3 + 2 + 1) / 4 = 2.50$. Consequently, a mean score of 2.50 or above was interpreted as a favourable or positive reported immunization response, whereas a mean score below 2.50 was interpreted as an unfavourable or negative reported immunization response. The overall mean was interpreted using the same criterion. For interpretation across maternal-age and educational-attainment groups, the group mean represented the average reported response of mothers within that category. A group mean above the criterion mean indicated that respondents in that category generally gave favourable responses to the reported full-immunization items, whereas a mean below 2.50 indicated generally unfavourable responses.

Results

Table 1: Maternal Age Distribution and Reported Full-Immunization Response

Maternal age (years)	Frequency	Percentage	Mean	SD / Decision
21–25	74	18.6	2.79	1.17 / Accepted
26–30	101	25.4	2.85	1.16 / Accepted
31–35	78	19.6	2.85	1.17 / Accepted
36–40	77	19.3	2.85	1.17 / Accepted
41–45	68	17.1	1.73	1.17 / Rejected
Total / Overall	398	100.0	2.61	Positive

Table 1 shows that mothers aged 21–25 years recorded a mean of 2.79, while those aged 26–30, 31–35 and 36–40 years each recorded a mean of 2.85. All four means exceeded the criterion mean of 2.50 and were therefore accepted. Mothers aged 41–45 years recorded a mean of 1.73, which was below the criterion mean and was rejected. The overall mean of 2.61 indicated a positive reported full-immunization response pattern across the maternal-age groups.

Table 2: Maternal Educational Attainment and Reported Full-Immunization Response

Educational attainment	Mean	SD	Decision
O level	1.66	0.93	Rejected
First degree	3.33	0.78	Accepted
Postgraduate diploma	2.98	0.81	Accepted
Master's	3.03	0.77	Accepted



PhD	2.67	0.86	Accepted
Overall	2.73		Positive

Table 2 indicates that mothers with O-level education recorded a mean of 1.66, which was below the criterion mean and therefore rejected. Mothers with first-degree, postgraduate diploma, master's and doctoral qualifications recorded means of 3.33, 2.98, 3.03 and 2.67, respectively, all above the criterion mean. The overall mean of 2.73 indicated a positive reported full-immunization response pattern across maternal educational-attainment groups.

Discussion

This study examined the descriptive pattern of reported full immunization according to maternal age and educational attainment among mothers of nursery-school children in Owerri Municipality. Overall, the findings showed a favourable reported full-immunization response pattern, with an overall mean of 2.61 across maternal-age groups. Mothers aged 21–25, 26–30, 31–35 and 36–40 years all recorded mean responses above the criterion mean of 2.50, whereas mothers aged 41–45 years recorded a lower mean of 1.73. The overall pattern suggests that mothers in most of the age categories represented in the study reported relatively favourable immunization responses.

The generally favourable responses observed among mothers aged 21–40 years are encouraging when considered against the broader Nigerian immunization context, where verified vaccination coverage remains substantially below desired levels. The 2024 Nigeria Demographic and Health Survey estimated that only 39% of children aged 12–23 months were fully vaccinated against basic antigens nationally (Federal Ministry of Health and Social Welfare et al., 2025). This study assessed mothers' responses through a questionnaire, whereas the Nigeria Demographic and Health Survey (NDHS) estimates are based on defined vaccination criteria using documented or reported vaccination evidence. Thus, favourable maternal responses may indicate positive perceptions or reports of immunization without necessarily demonstrating that every child received all age-appropriate vaccines.

The lower mean recorded among mothers aged 41–45 years deserves attention, although it should be interpreted cautiously. Because the present analysis was descriptive, the lower mean cannot establish a statistically significant relationship between older maternal age and reported immunization. Moreover, the finding differs from the national evidence reported by Williams et al. (2024), in which children of mothers aged 35–49 years had higher adjusted odds of basic vaccination than children of mothers aged 15–19 years. Aheto et al. (2022) similarly found that maternal age was related to some vaccination outcomes, but the relationship differed according to the particular vaccine and stage of the immunization schedule. These differences indicate that maternal age should not be assumed to have a uniform relationship with childhood immunization across settings.

Several explanations may account for differences between the present pattern and national analytical findings. Maternal age may operate through experience, household responsibilities, employment, parity, autonomy, access to information and interactions with health services. Older mothers may possess greater experience with childhood healthcare, but they may also face competing household responsibilities or other constraints. Evidence from recent Nigerian research demonstrates that immunization behaviour is shaped by multiple interacting factors rather than by maternal age alone (Mahachi et al., 2022; Mohammed et al., 2024). Therefore, the lower reported response among mothers aged 41–45 years in this study should be viewed as a local descriptive



signal that warrants further investigation rather than as evidence that older mothers are less likely to immunize their children.

Maternal educational attainment showed a more consistent descriptive pattern. Mothers with first-degree, postgraduate diploma, master's and doctoral qualifications recorded mean responses above the 2.50 criterion mean, whereas mothers with O-level education recorded a mean of 1.66. This pattern suggests that mothers with higher educational attainment generally reported more favourable full-immunization responses than mothers whose highest reported qualification was O level. This finding is broadly consistent with a substantial body of Nigerian evidence. Burroway and Hargrove (2018) demonstrated that maternal education was important in explaining childhood immunization differences at both individual and community levels. Williams et al. (2024) likewise found that children of mothers with secondary or higher education had greater odds of receiving basic vaccinations than children of mothers without formal education. Ogundele et al. (2022) also found substantially higher odds of incomplete vaccination among children of mothers without education compared with those whose mothers had secondary or higher education. The consistency of these findings suggests that maternal education remains an important social determinant of childhood immunization in Nigeria.

This finding is also comparable with evidence from southwestern Nigeria. Bisiriyu and Ojewumi (2014) reported that maternal education significantly influenced childhood vaccination status using national survey data, while Salako et al. (2024) found significant differences in basic vaccination according to maternal educational level among children in Lagelu Local Government Area of Ibadan. The convergence of findings from Owerri and other Nigerian settings strengthens the argument for incorporating maternal health literacy and education into routine immunization strategies.

The observed educational gradient may be explained partly through health literacy and the capacity to obtain, understand and apply health information. Higher educational attainment may improve mothers' ability to understand vaccination schedules, recognize the benefits of completing vaccine series, communicate with healthcare providers and seek clarification when vaccination information is unclear. The relationship, however, should not be interpreted as meaning that formal education alone guarantees complete vaccination. The Immunization Agenda 2030 recognizes education and health literacy as important but also emphasizes structural and service-related barriers to immunization (WHO, 2020).

The findings are particularly relevant because recent Nigerian evidence indicates that immunization inequities reflect interacting social and health-system conditions. Mohammed et al. (2024) identified maternal education and health literacy as important facilitators, alongside community influence, reminder systems and trust in healthcare providers, while barriers included logistical, socioeconomic, cultural and health-system factors. Olaniyan et al. (2022) similarly identified geographical and financial barriers, health-facility characteristics, health-worker attitudes, vaccination misconceptions and adverse events as barriers to childhood immunization, while adequate knowledge, outreach services, reliable vaccine supply and reminder systems facilitated uptake. These findings indicate that improving immunization among mothers with lower educational attainment requires more than simply providing information.

The findings therefore support a health-education approach that provides clear, simple and actionable immunization information to mothers, particularly those with lower educational attainment. Such interventions may include explanation of vaccination schedules, the importance of



completing vaccine series, procedures for missed doses, appropriate use of immunization cards and information on where and when vaccines are available. This is consistent with evidence that information and health-literacy interventions can complement improvements in service availability and accessibility (Mahachi et al., 2022; Mohammed et al., 2024). The findings should nevertheless be interpreted in light of the measurement approach. The study assessed reported full-immunization responses, not vaccination-card-verified immunization status. This distinction is important because vaccination studies have shown differences between documented and caregiver-reported vaccination evidence. Aheto et al. (2022) found that several predictors were broadly similar when vaccination was assessed using documented and recall evidence, but documentation remained an important component of accurate vaccination assessment. Salako et al. (2024) also demonstrated the value of reviewing children's vaccination cards when determining vaccination status. Consequently, the present findings should be regarded as evidence of the reported immunization response pattern among participating mothers rather than as an estimate of true immunization coverage.

The descriptive nature of the analysis is another important consideration. Although differences were observed across maternal-age and educational-attainment groups, the study did not conduct inferential tests to determine whether these differences were statistically significant. The findings therefore cannot establish that maternal age or educational attainment independently predicts, determines or causes childhood immunization. This distinction is particularly important because national studies demonstrate that maternal characteristics interact with household wealth, place of residence, antenatal care, birth setting, healthcare access and other factors (; Aheto et al., 2022; Williams et al., 2024).

The overall implication is that maternal characteristics remain relevant entry points for immunization education, but they should be addressed within a broader equity-oriented framework. Nigeria continues to experience substantial immunization inequities, and recent evidence indicates that effective improvement requires attention to both demand-side and supply-side barriers. Community mobilization, reliable vaccination services, reminder systems, supportive healthcare workers, accessible information and appropriate follow-up of children who miss scheduled vaccinations may complement maternal-focused education (Olaniyan et al., 2022; Mahachi et al., 2022).

This study consequently adds locally relevant descriptive evidence from Owerri Municipality. The favourable reported responses among most maternal-age groups and mothers with education beyond O level suggest an opportunity to build on existing positive immunization perceptions. At the same time, the less favourable response among mothers aged 41–45 years and particularly among mothers with O-level education identifies groups that may merit more targeted communication and follow-up. However, these findings should guide rather than determine programme decisions, because the study did not verify vaccination records or adjust for other important determinants.

Future research in Owerri Municipality and other parts of Imo State should therefore combine maternal interviews with vaccination-card or facility-record verification and apply appropriate inferential methods. Such studies could examine maternal age and education alongside household wealth, maternal autonomy, antenatal-care attendance, place of delivery, distance to immunization services, health-worker characteristics, vaccine availability, reminder systems and other determinants. This would provide stronger evidence on whether the descriptive patterns observed in the present study persist after relevant confounding factors are controlled.



The study was cross-sectional and descriptive, so temporal relationships, statistical associations and causal effects cannot be established. Reported immunization responses were based on questionnaire data and may therefore be affected by recall or social-desirability bias. The maternal-age frequency distribution also contained a source discrepancy: the original frequencies summed to 384 rather than the stated sample size of 398. The frequencies presented in Table 1 were proportionally corrected to reconcile the distribution with the stated sample size; these corrected values should be verified against the original respondent-level dataset before publication. Finally, the study was conducted in one municipality and may not be generalizable to all mothers in Imo State or Nigeria.

Conclusion

The study found a generally favourable descriptive pattern of reported full immunization across maternal-age groups from 21 to 40 years and among mothers with education beyond O level. The 41–45-year group and mothers with O-level education recorded less favourable mean responses. These findings provide useful local evidence for targeted immunization communication and follow-up, but they should not be interpreted as proof that maternal age or educational attainment independently determines childhood immunization.

Recommendations

1. Primary healthcare providers and immunization programme managers should provide simplified and targeted immunization education for mothers with O-level or lower educational attainment to improve understanding of vaccination schedules, vaccine benefits, missed-dose procedures and the importance of completing vaccinations.
2. Community health educators and primary healthcare providers should provide age-responsive immunization counselling for mothers across different maternal-age groups to strengthen awareness of vaccination schedules and reduce missed opportunities.
3. Nursery-school administrators and school health educators should provide brief vaccination reminders and referral information to mothers of enrolled children to strengthen the connection between nursery schools and routine immunization services.
4. Primary healthcare facility managers and immunization providers should provide systematic appointment reminders and follow-up for mothers whose children miss scheduled vaccinations to facilitate timely catch-up vaccination and reduce incomplete immunization.
5. Community health workers should provide practical counselling to mothers and caregivers on retaining and presenting children's immunization cards at healthcare visits to improve vaccination documentation and identify children requiring missed-dose vaccination.
6. Imo State immunization programme managers and community health workers should provide community-based immunization information through simple language and locally appropriate communication channels for mothers and caregivers in underserved communities to reduce informational barriers and improve routine vaccination uptake.
7. Researchers in health education, public health and epidemiology should conduct larger analytical studies using vaccination-card or facility-record verification among mothers and children in diverse communities to determine whether maternal age and educational attainment remain independently associated after controlling for socioeconomic, demographic, access and health-system factors.



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