Research Article

Factors Associated With Noncompliance With the Prenatal Vaccination Schedule Among Pregnant Women in Kamina, DRC

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Background: Vaccination is a key strategy for reducing maternal and neonatal morbidity and mortality. However, adherence to antenatal vaccination remains insufficient in many resource-limited areas. This study aimed to identify factors associated with nonadherence to vaccination schedules among pregnant women in Kamina, DRC.

Methods: This analytical cross-sectional study was conducted between January and July 2025 among 422 pregnant women attending antenatal clinics. Data were collected via a structured questionnaire, administered face-to-face, and analyzed via SPSS 26 and Jamovi 2.5.5 software. Multivariate logistic regression was used to identify factors associated with noncompliance with the vaccination schedule.

Results: The prevalence of noncompliance with the vaccination schedule was 63.7%. The factors significantly associated with noncompliance were being married (ORa = 7.116; 95% CI [3.963-12.776]), a lack of education (ORa = 4.121; 95% CI [2.422-7.012]), the presence of natural obstacles to the health center (ORa = 4.833; 95% CI [2.089-11.184]) and the perception of a long waiting time (ORa = 3.734; 95% CI [2.251-6.194]).

Conclusion: The results highlight sociodemographic, geographic, and health care delivery factors influencing vaccination adherence. Targeted, community-based, and multisectoral interventions are needed to improve antenatal vaccination coverage in this setting.

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Introduction

Vaccination is recognized as one of the fundamental pillars of modern public health, saving millions of lives each year. It plays a central role not only in protecting children but also in preventing serious diseases in adults, especially pregnant women [1] .

Despite the promotion of medical advances and vaccination policies globally, compliance with the vaccination schedule among certain vulnerable populations, such as pregnant women, remains insufficient in several regions of the world [2] . This deficit complicates the fight against preventable maternal–neonatal infections and compromises the transmission of passive immunity to the newborn, particularly for pathologies such as neonatal tetanus [3] .

Globally, despite targeted programs, including the WHO-UNICEF-led Maternal and Neonatal Tetanus Elimination Initiative, millions of pregnant women still do not complete their recommended pregnancy vaccination schedule. Structural, social, cultural, or organizational causes are often cited, but their precise identification remains a challenge for many countries [4] . The COVID-19 pandemic has exacerbated this situation, disrupting routine immunization services, including those for pregnant women [5] .

In Africa, despite efforts by expanded immunization programs (EPRs) to integrate maternal vaccination into antenatal care, data reveal incomplete coverage among pregnant women. The WHO estimates that approximately one in three pregnant women in sub-Saharan Africa does not receive all the doses scheduled for tetanus vaccination. This situation contributes to the persistence of neonatal tetanus cases, even though the disease is preventable by a safe, effective, and inexpensive vaccine [6] .

In the Democratic Republic of Congo, the maternal vaccination strategy, including tetanus vaccination integrated into antenatal consultations, is an important component of the EPI. However, many pregnant women do not complete their vaccination schedule. In 2022, only 57% of pregnant women received two doses of the tetanus vaccine (VAT2+), which is well below the 80% target set by the national EPI [5] . Failure to adhere to this schedule exposes newborns to avoidable risks, particularly in rural areas where home births are common and health care is less accessible.

The city of Kamina, the capital of Haut-Lomami Province, illustrates this reality. Despite the presence of health infrastructure, many pregnant women do not keep their vaccination appointments or do not complete the required doses during pregnancy. Several socioeconomic, geographic, cultural, or healthcare-related factors could explain this situation. However, few local studies have been conducted to

document them rigorously. This study was conducted to identify the factors associated with noncompliance with the vaccination schedule among pregnant women in Kamina.

Methods

Study framework

This study was conducted in the Kamina health zone, which is located in the Haut–Lomami provincial division of the Democratic Republic of the Congo. The total population is estimated at 366,557 inhabitants distributed across 24 health areas, with an economy based primarily on agriculture and small-scale trade. The target population consisted of pregnant women attending local health facilities.

Type, period and study population

This was a cross-sectional analytical observational study conducted between January and July 2025. The survey focused on pregnant women attending prenatal consultations in public and private health facilities in Kamina. The statistical unit was the pregnant woman, and the response unit was the participant herself.

Sample size

The minimum sample size was calculated from the Lorenz formula for cross-sectional studies:

$$n = Z^2 \times p \times (1 - p)/d^2$$

where n is the minimum required sample size; Zα is the value of the normal distribution corresponding to a 95% confidence level, i.e., 1.96; and p is the anticipated proportion of the event of interest, i.e., noncompliance with the vaccination schedule in pregnant women. In the absence of precise local data in Kamina, we used the national proportion of 55.4% reported in the DRC [7] . Hence, n = (1.96) ^{2} × 0.55 × (1 – 0.55)/(0.05) ^{2} = 380 pregnant women

To limit bias related to absences and refusals, a 10% increase was applied to cover the anticipated nonresponse rate. The adjusted calculation then becomes n adjusted = n/1 - r, with r = the anticipated nonresponse rate (10%). Hence, the adjusted sample size n = 380/1 - 0.10 = 422.

Ultimately, the sample size retained for this study was 422 pregnant women, which guarantees sufficient statistical power and acceptable precision to estimate the prevalence of factors associated with

noncompliance with the vaccination schedule in the target population.

Sampling

Participant selection was carried out via a proportional stratified sampling plan by health facility. The overall sample size was distributed proportionally to the number of pregnant women in the four selected facilities (Katuba IV, RVA, Shungu and Mère du Sauveur Health Centers) on the basis of the average annual attendance of pregnant women, as extracted from the CPN registers of the year preceding the study via the REDCap (Research Electronic Data Capture) platform, which allowed us to configure separate strata corresponding to each health facility and to set up automated random draws proportional to the size of each stratum.

Data collection tools and techniques

Data were collected via a structured, face-to-face questionnaire configured with the DHIS2 Capture tool (web version and mobile application). The mobile application enabled offline collection. The questionnaire covered sociodemographic characteristics, accessibility to care, and perceptions of vaccination services.

Ethical considerations

The study was approved by the Ethics Committee of the School of Public Health of the University of Lubumbashi (ref. UNILU/CEM/18/2025), in accordance with the Declaration of Helsinki. Electronic consent was obtained from all participants after information on the objectives, benefits, and confidentiality of the study was obtained. Participation was voluntary, with guarantees of confidentiality and anonymity of the data.

Processing and analysis of statistical data

The data were analyzed via IBM SPSS version 26 and Jamovi version 2.5.5 software. The internal consistency of the data was assessed via Cronbach's alpha coefficient. In the flat-sorted analyses, qualitative variables were summarized as frequencies and percentages, and quantitative variables were summarized as the means ± standard deviations or medians ± interquartile ranges according to the normality of the distribution (Kolmogorov–Smirnov test).

For bivariate analysis, associations between the dependent variable (noncompliance with the vaccination schedule) and the independent variables were assessed via Pearson's chi-square test or Fisher's exact test, as appropriate. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to estimate the strength of the associations. Variables with $p \leq 0.20$ were included in a multivariate logistic regression (Wald's ascending method) to identify factors associated with noncompliance with the vaccination schedule. Model fit was assessed via the Hosmer–Lemeshow test, and performance was assessed via the receiver operating characteristic (ROC) curve (AUC).

Results

Variables	Frequency (%)
Compliance with the vaccination schedule	
No	269 (63.7)
Yes	153 (36.3)
Age of the woman, mean ± standard deviation	29.52±7.98; CI95%=[28.75 - 30.28]
≤ 19 years old	45(10.7)
20-35 years old	261(61.8)
> 35 years old	116(27.5)
Civil status of the pregnant woman	
Bride	324(76.8)
Unmarried	98(23.2)
Instruction for pregnant women	
Uneducated	302(71.6)
Educated	120(28.4)
Profession of pregnant women	
Farmer	73(17.3)
Employee	57(13.5)
Liberal	136(32.2)
Housewife	156(37.0)

Table 1. Proportion of pregnant women who did not comply with the vaccination schedule and sociodemographic characteristics

The frequency of **noncompliance with the vaccination schedule** in our population was **63.7%** (**Table 1**).

The mean age of the participants was **29.52 ± 7.98 years**, reflecting **relatively wide variability** in age within the sample. The 95% CI around this mean was **[28.75-30.28] years, suggesting that in the source population, the actual mean age of women would most likely fall within this range. Married** women represented **76.8%** of the total number of women. A majority of the participants, **71.6%,** were **uneducated, and 37.0%** were **housewives.** (**Table 1**).

Variables	Frequency (%)
Distance between CS and household	
≥ 2 km	17(4.0)
< 2 km	405(96.0)
Natural obstacles between the CS and the household	
Yes	77(18.2)
No	345(81.8)
Assessment of waiting time at the health center	
Long	211(50.0)
Short	211(50.0)
Assessment of the reception at the health center	
Bad	16(3.8)
Good	406(96.2)
Assessment of the quality of care at the health center	
Bad	10(2.4)
Good	412(97.6)

Table 2. Distribution of pregnant women according to geographical accessibility as well as perceptions of waiting time and reception at the health center

With respect to geographical accessibility, **96.0%** of pregnant women lived within 2 km of the health

center. Natural obstacles between home and the health center were reported by **18.2%** of the participants. Half of the women (**50.0%**) considered the waiting time at the health center to be long. The reception was considered good by **96.2%** of them, and the quality of care was considered satisfactory by **97.6%.** (**Table 2**).

Parameters studied	Compliance with the vaccination schedule		OR [95% CI]	P
	No n=269(%)	Yes n=153(%)		
Age of the woman				
≤ 19 years old	1[2][2]	44(97.8)	0.014[0.001-0.101]	0.000
20-35 years old	163(62.5)	98(37.5)	1	
˃ 35 years old	105(90.5)	11(9.5)	5,739 [2,937-11,212]	0.000
Marital status				
Bride	242(74.7)	82(25.3)	7,761 [4,665-12,911]	0.000
Unmarried	27(27.5)	71(72.5)		
Women's education				
Uneducated	224(74.2)	78(25.8)	4,786 [3,050-7,510]	0.000
Educated	45(37.5)	75(62.5)		

Table 3. Relationships between noncompliance with the vaccination schedule and sociodemographic characteristics

Bivariate analysis revealed that women aged less than 19 years were more compliant with the vaccination schedule than other age groups were. In contrast, those over 35 years were significantly more at risk of noncompliance (OR = 5.739; 95% CI [2.937-11.212]; $p < 0.001$). Married women were nearly eight times more likely to be noncompliant than unmarried women were (OR = 7.761; 95% CI [4.665-12.911]; $p < 0.001$). Uneducated women were also more likely to be noncompliant with the vaccination schedule (OR = 4.786; 95% CI [3.050-7.510]; $p < 0.001$) (**Table 3**).

Parameters studied	Compliance with the vaccination schedule		OR [95% CI]	P
	No n=269(%)	Yes n=153(%)		
Distance between CS and household				
≥ 2 km	8(47.1)	9(52.9)	0.490 [0.185-1.299]	0.144
< 2 km	261(64.4)	144(35.6)		
Natural obstacles between the CS and the household				
Yes	68(88.3)	9(11.7)	5,413 [2,615-11,203]	0.000
No	201(58.3)	144(41.7)		
Assessment of waiting time at the health center				
Long	170(80.6)	41(19.4)	4,691 [3,036-7,249]	0.000
Short	99(46.9)	112(53.1)		
Assessment of the reception at the health center				
Bad	10(62.5)	6(37.5)	0.946 [0.337-2.655]	0.916
Good	259(63.8)	147(36.2)		
Assessment of the quality of care at the health center				
Bad	6(60.0)	4(40.0)	0.850 [0.236-3.060]	0.803
Good	263(63.8)	149(36.2)		

Table 4. Relationships between noncompliance with the vaccination schedule and geographical accessibility as well as perceptions of waiting time and reception at the health center

Geographically and organizationally, the presence of natural barriers between home and the health center was strongly associated with noncompliance with the schedule (OR = 5.413; 95% CI [2.615-11.203]; p < 0.001). Similarly, women who perceived waiting time as long had almost five times the risk of noncompliance (OR = 4.691; 95% CI [3.036-7.249]; p < 0.001) (**Table 4**).

Explanatory variables	B	ES	Exp(B) [95% CI]	Sig
Marital Status (Married vs. Unmarried)	1,962	0.299	7,116 [3,963 - 12,776]	0.000
Women's education (Uneducated vs. Educated)	1,416	0.271	4,121 [2,422 - 7,012]	0.000
Natural barriers between household and health center (Yes vs. No)	1,576	0.428	4,833 [2,089 - 11,184]	0.000
Perceived waiting time at the health center (Long vs. Short)	1,318	0.258	3,734 [2,251 - 6,194]	0.000
Constant	-3,592	0.457	0.028	0.000

Table 5. Logistic regression of the different factors associated with noncompliance with the vaccination schedule of pregnant women

After adjusting for the odds ratio in a binary logistic regression model, the main factors associated with noncompliance with the vaccination schedule among pregnant women were married marital status (aOR = 7.116; 95% CI [3.963-12.776]), low education level (aOR = 4.121; 95% CI [2.422-7.012]), the presence of natural barriers between the household and the health center (aOR = 4.833; 95% CI [2.089-11.184]), and the perception of a long waiting time at the health center (aOR = 3.734; 95% CI [2.251-6.194]) **(Table 5).**

The logistic regression model developed from these variables made it possible to estimate the probability of noncompliance with the vaccination schedule at 93.6% for a woman combining these four factors. The predictive performance of the model, as evaluated by the ROC curve, presented an AUC of 0.814 (95% CI: 0.766-0.862), with good fit according to the Hosmer–Lemeshow test (p = 0.62). The sensitivity was 78%, and the specificity was 72% (**Figure 1**).

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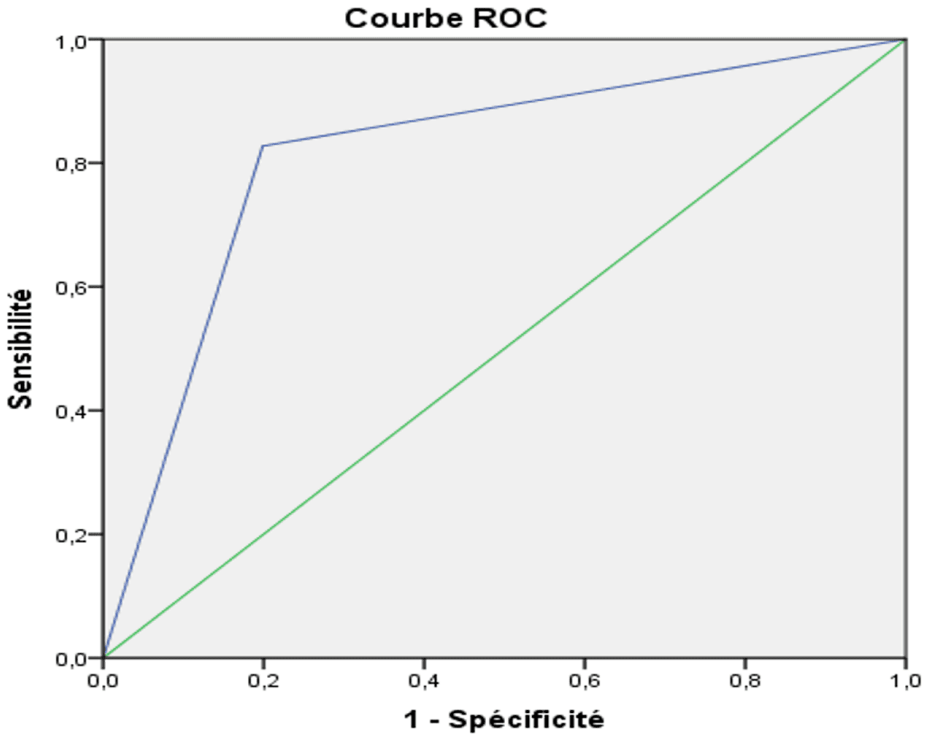

Figure 1. ROC curve of the different factors associated with noncompliance with the vaccination schedule of pregnant women

Discussion

This study highlighted a worrying frequency of noncompliance with the vaccination schedule among pregnant women, estimated at 63.7% (**Table 1**). This particularly high rate highlights notable failures in adherence to national recommendations for antenatal vaccination. This finding suggests not only the underutilization of available preventive services but also increased exposure to risks associated with nonimmunization in a particularly vulnerable population. These findings are part of a regional trend already documented in several low- and middle-income countries, where antenatal vaccination coverage often remains insufficient. According to combined WHO and UNICEF data, nearly 40 million pregnant women worldwide do not benefit from full vaccination protection each year, with noncoverage rates exceeding 50% in some sub-Saharan African settings [8].

The mean age of the participants was 29.52 ± 7.98 years, with a 95% CI between 28.75 and 30.28 years, reflecting a relatively wide dispersion of ages within the sample (**Table 1**). This variability is methodologically important to highlight, as it implies heterogeneity in maternal profiles, which may

influence vaccination service use behaviors. This distribution is similar to that observed in other African contexts, notably Burkina Faso and Ethiopia, where the mean age of mothers is approximately 28-30 years [9][10].

Low maternal education has been shown to be a major determinant of noncompliance with the vaccination schedule (**Table 3**). This finding is not without public health implications, as maternal education is widely recognized as a major determinant of access to and adherence to preventive services, particularly those related to vaccination. This finding is consistent with data from several studies. A survey conducted in Nigeria by Babalola et al. [11] revealed that illiterate women were 4 times less likely to have their children fully vaccinated than women with at least a secondary education. According to UNICEF [12], education plays a key role in understanding health messages, interpreting medical recommendations, and planning and organizing the skills needed to keep vaccination appointments. It also promotes greater decision-making autonomy for women, reducing their dependence on their spouse or other family members to access health services.

An inverted U-shaped relationship was observed between maternal age and adherence to the vaccination schedule (**Table 3**). Adolescent girls (<19 years) were significantly less likely to adhere to the vaccination schedule, probably because of factors such as social stigma, financial dependence, and lack of information. This finding is consistent with the results of Yaya and Bishwajit [13], as well as Tekeba et al. [14], who reported lower vaccination coverage among adolescent mothers in sub-Saharan Africa.

Married women had a significantly greater risk of noncompliance with the vaccination schedule (**Table 3**). Although this result may seem counterintuitive, it is explained by the potential reduction in decision-making autonomy in patriarchal contexts. Studies by Singh et al. [15] and Bulcha et al. [16] highlighted that increased domestic responsibilities and a lack of autonomy in health decisions may limit married women's access to preventive care.

Geographic barriers, such as natural obstacles (rivers, degraded roads, hills), were also strongly associated with nonadherence to the schedule (**Table 4**). Women facing such constraints were nearly five times more likely to not receive the recommended doses. This finding is consistent with studies in Zambia and other rural African settings, where physical access is a major barrier to maternal health care [17].

Furthermore, women who considered the waiting time to be excessive were nearly four times more likely to not keep recommended vaccination appointments (**Table 4**). This finding is consistent with the

literature, which highlights that **delays and waiting times at health facilities** represent significant barriers to adherence to preventive health services, particularly in resource-limited settings. This finding is consistent with the WHO literature [18] , which states that long waiting times can deter patients, generate frustration, and increase the risk of abandonment of follow-up care, particularly for infants and prenatal vaccinations. Improving patient flow management, reducing queues and establishing dedicated time slots could be effective strategies to improve user satisfaction and strengthen compliance with the vaccination schedule.

Limitations of the Study

This study has several limitations. First, the cross-sectional nature of the study design does not allow for the establishment of causal links between the identified factors and noncompliance with the vaccination schedule. Second, since the data collected were self-reported, they may be subject to social desirability or recall bias. Finally, the study focused on a specific urban setting (Kamina), which may limit the generalizability of the results to other rural or urban areas of the country.

Conclusion

This study revealed a high prevalence of noncompliance with prenatal vaccination schedules among pregnant women in Kamina city, estimated at 63.7%. This high rate highlights the persistent challenges related to access, information, and adherence to vaccination services in resource-limited settings.

Multivariate analysis revealed four factors independently associated with noncompliance with the vaccination schedule: marital status (being married), low educational attainment, the presence of natural barriers between home and the health center, and the perception of a long waiting time. These determinants confirm the multifactorial nature of adherence to vaccination services.

These findings call for the implementation of differentiated, multisectoral strategies aimed at removing geographical barriers, improving the organization of care, and strengthening women's autonomy. In particular, it is important to target women with low levels of education, those who are married, or those living in hard-to-reach areas through strengthened community interventions and appropriate health education.

Finally, the data from this study could inform public health decision-makers' thinking about more equitable and inclusive vaccination coverage. They contributed to the national effort to strengthen the

Expanded Program on Immunization (EPI) and reduce health inequalities among pregnant women in the Democratic Republic of the Congo.

Statements and Declarations

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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Declarations

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