

**ORIGINAL RESEARCH ARTICLE**

# The coverage of the second dose of the measles-containing vaccine: A cross-sectional survey in a rural health district of Cameroon

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## Abstract

Measles remains a significant public health challenge in sub-Saharan Africa, including Cameroon, where vaccination coverage (77%) falls below the World Health Organization target of 95%. This study assessed the coverage of the second dose of measles-containing vaccine (MCV2) and identified factors influencing vaccination uptake in Ngog-Mapubi Health District (HD), Cameroon. A community-based cross-sectional survey was conducted in this rural HD in March 2024, involving 140 parents or guardians of children aged 15–23 months. Data were collected using a pre-tested questionnaire, covering sociodemographic characteristics, vaccination status, and barriers to uptake. Determinants of MCV2 vaccination were identified through logistic regression. Data were analyzed using R statistics version 4.4.2.  $p < 0.05$  was considered statistically significant. The study revealed a MCV2 vaccination coverage of 46.4% (95% confidence interval [CI]: 38.0–55.0). Among unvaccinated children, 85.3% (95% CI: 75.3–92.4) of caregivers expressed willingness to vaccinate, indicating high acceptance but persistent barriers. Distance to health facilities (43%), lack of information about vaccine availability (37%), and missed opportunities during health visits (25%) were the most cited obstacles. Awareness of MCV2 was high (89%), but knowledge gaps persisted, with 61% of respondents demonstrating poor understanding of vaccination schedules. Multivariate analysis identified the absence of advanced vaccination strategies (e.g., outreach programs) as the strongest predictor of non-vaccination (adjusted odds ratio = 7.15; 95% CI: 3.19–17.2;  $p < 0.001$ ). Despite a high MCV2 acceptance rate, low MCV2 coverage in this rural district underscores the need for improved access through advanced vaccination strategies and targeted community education. Addressing structural and informational barriers is essential to achieving equitable immunization coverage.

**Keywords:** Measles-containing vaccine; Second dose of measles-containing vaccine; Vaccination coverage; Rural health; Cameroon; Immunization barriers; Advanced strategy

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## 1. Introduction

In 2015, the United Nations General Assembly established the Sustainable Development Goals, which mandate that by 2030, all countries reduce their under-5 mortality rate to no more than 25 deaths/1,000 live births and their neonatal mortality rate to no more than 12 deaths/1,000 live births (Sharrow *et al.*, 2022). To achieve this global health objective, vaccines are one of the most powerful tools used to prevent disease among children and save millions of lives each year (WHO, 2025c). Since the launch of global vaccination programs in 1974, an estimated 154 million deaths have been prevented (146 million of these among children under 5 years), including 101 million infants under one (Shattock *et al.*, 2024). There are vaccines for over 30 life-threatening diseases, enabling people of all ages to live longer and healthier by protecting them against illnesses, such as diphtheria, tetanus, pertussis (whooping cough), pneumonia, diarrhea, and measles (WHO, 2025c).

Measles remains a highly contagious viral disease that primarily affects children, characterized by severe symptoms, including high fever, anorexia, cough, rash, and potentially fatal complications, such as pneumonia and blindness (WHO, 2025b). In the pre-vaccine era before 1963, global measles epidemics occurred every few years, causing an estimated 2.6 million deaths annually worldwide (WHO, 2024). Sub-Saharan Africa continues to experience the world's highest measles burden, with 4.23 deaths and 355.68 disability-adjusted life years lost per 100,000 population (Parpia *et al.*, 2020). The region witnessed a dramatic resurgence in 2022, particularly in Ethiopia, Somalia, and the Democratic Republic of Congo (Nchasi *et al.*, 2022). The COVID-19 pandemic severely disrupted measles prevention efforts by overwhelming healthcare systems and suspending routine immunization programs (Amani *et al.*, 2022; Cheuyem *et al.*, 2025a). As a result, 23 million children in the region missed essential vaccines, including the measles-containing vaccine (MCV), a non-obligatory vaccine, leaving them vulnerable to preventable outbreaks (WHO, 2024).

Despite global progress in measles control, Cameroon continues to face recurrent outbreaks affecting several regions, including the Center Region, Littoral Region, Southwest Region, and Northern Region (Eyong *et al.*, 2023; Parpia *et al.*, 2020). As of November 26, 2023, 6,054 measles cases and 31 measles-related deaths had been confirmed since the beginning of the year, with the Center Region being the most affected (Annick *et al.*, 2024). To strengthen immunity in children under five, the World Health Organization (WHO) initially recommended in 2009 that the second dose of MCV (MCV2) be introduced into routine immunization only after achieving  $\geq 80\%$

of first-dose MCV (MCV1) coverage nationally for 3 consecutive years (WHO, 2009). However, this policy was updated in April 2017 to recommend MCV2 inclusion in all national vaccination schedules, regardless of MCV1 coverage levels (WHO, 2019).

Cameroon's vaccination coverage (77% in 2017) remains below the WHO's 95% target, with high regional disparities (Parpia *et al.*, 2020). Estimates of the MCV2 coverage have decreased further to 28%, according to recent 2022 reports from the Center Region (Cheuyem *et al.*, 2024a). These coverage gaps create outbreak-prone areas, particularly in rural areas, which typically experience disparities in health workforce availability compared to urban areas (Cheuyem *et al.*, 2024b). This coverage depends on various factors, including the level of acceptance or hesitancy toward vaccines in the community. In this regard, previous reports have identified several factors that could influence MCV uptake. Such factors include education, which plays a crucial role in vaccination uptake, with lower maternal or caregiver educational attainment consistently reducing the likelihood of a child being vaccinated, while higher education levels progressively increase vaccine acceptance (Ibrahim *et al.*, 2024). Significant barriers to healthcare access also impede immunization efforts; longer travel times to health facilities and prior experiences of vaccine stockouts actively deter future visits (Ibrahim *et al.*, 2024; Woyessa *et al.*, 2024). Furthermore, home deliveries, as opposed to births in health facilities, are associated with reduced subsequent immunization rates (Ibrahim *et al.*, 2024). Active engagement with healthcare services positively influences vaccination compliance; mothers attending postnatal care visits show higher adherence. Proper knowledge of required vaccination visits is also vital for improving adherence (Ibrahim *et al.*, 2024; Mamuti *et al.*, 2022). Within household dynamics, families with multiple young children are less likely to be vaccinated (Woyessa *et al.*, 2024). Critically, knowledge gaps contribute to lower uptake, as a limited understanding of vaccine-preventable diseases and unawareness of required MCV decrease compliance (Mamuti *et al.*, 2022). Structural challenges, such as rural residence, are associated with reduced access to vaccination services, and younger caregivers tend to contribute to lower vaccination rates than their older counterparts. Finally, economic status is a significant factor, with lower household income decreasing the likelihood of vaccination, and competing priorities in large families potentially diverting resources from preventive care (Woyessa *et al.*, 2024). There is limited evidence on MCV2 vaccination uptake and related factors in Cameroon (Cheuyem *et al.*, 2024a; Parpia *et al.*, 2020). The present study aims to provide an insight into

MCV2 coverage and factors influencing its consistent uptake in a rural health district (HD) in the Center Region of Cameroon.

## 2. Methodology

### 2.1. Study design and data collection period

In March 2024, we conducted a community-based cross-sectional study with descriptive and analytical purposes in the health areas of the Ngog-Mapubi HD in the Center Region of Cameroon.

### 2.2. Study setting

The HD represents the operational level of the health system pyramid in Cameroon and constitutes the unit of implementation for national priority health programs. Ngog-Mapubi is located in the Nyong-et-Kélé Division, and it is one of the 32 HDs in the Center Region. The district comprises five subdivisions, including Bot-Makak, Dibang, Matomb, Ngog-Mapubi, and Nguibassal. In 2024, the population was estimated to be 59,545, including 13,402 women of reproductive age and an estimated 1,705 children aged 12–59 months, all distributed across 14 health areas. The HD’s healthcare map encompasses 28 health facilities, including one district hospital, four subdivisional medical centers, 15 integrated health centers, three private secular health facilities, and five private religious health facilities. It is a rural HD with a predominantly Basa ethnic group whose main activity is agriculture.

### 2.3. Study participants

The study population consisted of parents and legal guardians of children aged 15–23 months within the Ngog-Mapubi HD community. The study participants encompassed all eligible community members who agreed to participate in the study. Those who provided informed consent were included in the study. A household located in the Ngog-Mapubi HD represented the sampling unit of this study.

### 2.4. Sampling

All 14 health areas of the HD were sampled for the study. The minimum sample size, calculated using the Cochran formula, was 303 households, based on an estimated MCV2 coverage proportion of 27.9% (Cheuyem *et al.*, 2024a). To distribute the number of households across the different health areas, we proportionately allocated the sample size among them using Equation I.

$$\frac{\text{Total number of households} \times \text{Size of the population}}{\text{Total population}} \quad (I)$$

Systematic random sampling was used to select the households to be surveyed. The sampling interval (increment) observed was two. The initial direction was determined by throwing a pen in the air from a central point in the neighborhood, typically represented by the chief’s house in each surveyed village. In each selected household, one eligible child was randomly chosen from all children aged 15–23 months within that household for the assessment of vaccination status and the collection of other relevant information.

### 2.5. Data collection tool and procedures

A pretested data collection tool was developed for this study. It comprised sociodemographic characteristics, MCV2 vaccination coverage and acceptance, awareness of the MR2 vaccine availability, and common barriers to vaccination. Data collection was conducted by trained community health workers from the Ngog-Mapubi HD.

### 2.6. Variable and operational definition

A child was considered vaccinated based on the parents’ or legal guardians’ verbal report or the presentation of a vaccination booklet. Vaccine acceptance was defined as answering “yes” to the question, “Are you willing to get your eligible child vaccinated with the MCV2 if it is proposed to you?”

Advanced vaccination strategy refers to vaccination activities brought closer to the community residing more than 5 km from the nearest health facility providing immunization services.

The dependent variable for the logistic regression was the child’s MCV2 vaccination status, and the risk was having an eligible unvaccinated child against the disease. Independent variables included the parents’ or legal guardians’ marital status, education level, ethnic group, religion, the number of children in the household, and monthly average income. We also assessed the participants’ awareness of the MCV2 vaccine and their knowledge regarding this specific vaccine.

### 2.7. Data processing and analysis

Data were recorded, processed, and then analyzed using R statistics version 4.4.2 (R Core Team, 2024). Fisher’s exact test was used to compare proportions. Non-normally distributed continuous variables were described using medians and interquartile ranges. A score of 1 was attributed to each good answer on the three questions assessing knowledge. The participant’s knowledge was categorized as poor (0–1/3), fair (2/3), and good (3/3). Simple and multiple binomial logistic regressions were used to identify determinants of vaccine uptake, and adjusted

odds ratios (aORs) were used to establish the strength of the association between the variables and to eliminate potential confounding factors. The selection of predictors that best fit the model was performed stepwise using the Akaike Information Criterion. The model with the lowest index was then selected (Cheuyem *et al.*, 2025b).  $p < 0.05$  was considered statistically significant, and confidence intervals (CI) were estimated at the 95% confidence level.

### 3. Results

#### 3.1. Sociodemographic characteristics of respondents

A total of 390 eligible households were visited during this study. A total of 167 parents or legal guardians were available for the interview, among whom 140 agreed to participate (response rate 84%). All 14 health areas belonging to the HD were sampled. Most respondents were 20–39 years old (82%), had a secondary-level education (62%), and were female (85%). They were mostly from the Center Region (94%), of Basa ethnicity (84%), Catholic (63%), housekeepers by occupation (55%), and had an average monthly income of <50,000 Central African CFA Franc (86%) (Table 1).

The median distance between the household and the health facility providing immunization service was 4 km (interquartile range: 2–8 km), with distances ranging from <1 km to a maximum of 50 km.

#### 3.2. Vaccination coverage and acceptance of the MCV2

Nearly half of the eligible children had received MCV2 (46.4%; 95% CI: 38.0–55.0). Most of the respondents with unvaccinated children declared their acceptance of vaccinating them (85.3%; 95% CI: 75.3–92.4). Most respondents who reported adherence to the expanded program on immunization (EPI) generally had their children vaccinated at a nearby immunization service (93.6%; 95% CI: 88.1–97.0). The lowest vaccine coverage was significantly observed in Makak, Kikot-Mbebe, and Ntouleng health areas (<10%), while the lowest acceptance rate among households with unvaccinated eligible children was recorded in the Nguibassal health area (0%) (Tables S1-S3).

#### 3.3. Communication channels for the second dose of the MSV (MCV2)

A majority of respondents (89%) reported having heard about MCV2, with no statistically significant association with sociodemographic characteristics (Tables S4 and S5). However, despite this high reported exposure, most respondents had poor knowledge (61%) regarding MCV2 (Table 2 and Table S6).

**Table 1. Sociodemographic profile of study participants (n=140)**

Characteristic	Count (n)	Frequency (%)
Health area		
Bot Makak	11	7.9
Boumnyebel	30	21.4
Dibang	10	7.1
Hegba	10	7.1
Mandoumba	11	7.9
Matomb	5	3.6
Mbanda	5	3.6
Kikot-Mbebe	3	2.1
Mintaba	5	3.6
Ndongo	12	8.6
Ngog-Mapubi	14	10.0
Nguibassal	9	6.4
Ntouleng	11	7.9
Sombo	4	2.9
Age group (years)		
≤24	41	29.3
25–34	57	40.7
≥35	42	30.0
Sex		
Female	119	85.0
Male	21	15.0
Marital status		
Single	57	40.7
Cohabitation	58	41.4
Married	23	16.4
Widow (er)	2	1.4
Educational level		
None	16	11.4
Primary	32	22.9
Secondary	87	62.1
Tertiary	5	3.6
Region of origin		
Center	132	94.3
East	1	0.7
Far North	2	1.4
Northwest	3	2.1
South	2	1.4
Ethnic group		
Local tribe	118	84.3
Other tribes	22	15.7

(Cont'd...)

Table 1. (Continued)

Characteristic	Count (n)	Frequency (%)
Religion		
Animist	3	2.1
Catholic	88	62.9
Muslim	3	2.1
Other Christian	8	5.7
Pentecostal	2	1.4
Protestant	36	25.7
Occupation		
Farmer	24	17.1
Shopkeeper	12	8.6
Student	12	8.6
Civil servant	6	4.3
Housekeeper	77	55.0
Other	9	6.4
Number of children		
0-3	51	36.4
3-5	53	37.9
5-8	36	25.7
Number of 15-23-month-old children		
0	3	2.1
1	123	87.9
2	10	7.1
3	3	2.1
4	1	0.7
Household members surveyed		
Grandmother	1	0.7
Mother	118	84.3
Father	21	15.0
Average monthly income (XAF)		
<50,000	121	86.4
50,000-150,000	18	12.9
>150,000	1	0.7

Abbreviation: XAF: Central African CFA franc.

The most commonly reported communication channels included healthcare workers during and outside vaccination sessions (Figure 1).

The most commonly reported barriers to MCV2 vaccination included the distance to the immunization service (43%), the lack of information about the administration of the vaccination in the health facility (37%), and the that some eligible children were brought to the health facility but return without receiving the vaccine (25%) (Figure 2). Distance was also mentioned as the main

Table 2. Knowledge related to MCV2 among community members in Ngog-Mapubi HD, Cameroon (n=140)

Knowledge	Count (n)	Frequency (%)
Period of the EPI eligibility (months)		
0-3	7	5.0
0-6	50	35.7
0-23 (Yes)	10	7.1
0-59	73	52.1
Required dose of MCV		
1	11	7.9
2 (Yes)	58	41.4
3	5	3.6
4	2	1.4
I don't know	64	45.8
Best time to receive the MCV2 (months)		
3	8	5.7
6	5	3.6
9	27	19.3
12	27	19.3
15 (Yes)	73	52.1
Overall level of knowledge <sup>l</sup>		
Poor	85	60.7
Fair	29	20.7
Good	26	18.6

barrier to compliance with the routine immunization service for children (Figure S1).

A low proportion of respondents (7.1%) correctly identified the full eligibility period for the EPI as 0-23 months. Knowledge about MCV requirements was limited, with less than half (41.4%) correctly identifying the need for two doses. Regarding the timing of MCV2, 52.1% accurately recognized 15 months as the optimal window. Overall, 60.7% of caregivers demonstrated poor knowledge, while 18.6% exhibited good knowledge (scoring 100% correct).

### 3.4. Factors associated with the uptake of the MCV2

Univariate analysis revealed that the marital status (single/widow[er]), occupation (student), and the implementation of an advanced vaccination strategy were significantly associated with vaccine uptake. However, in the multivariate analysis, households reporting the absence of an advanced strategy were 7 times more likely not to have their children receive the MCV2 (aOR = 7.15; 95% CI: 3.19-17.2;  $p < 0.001$ ) (Table 3).

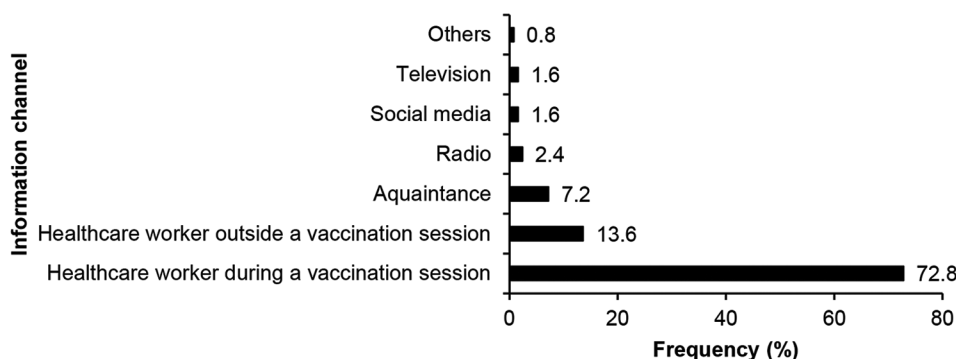


Figure 1. Reported information channel for the second dose of the measles-containing vaccine among household members in the Ngog-Mapubi Health District, Cameroon (n = 125)

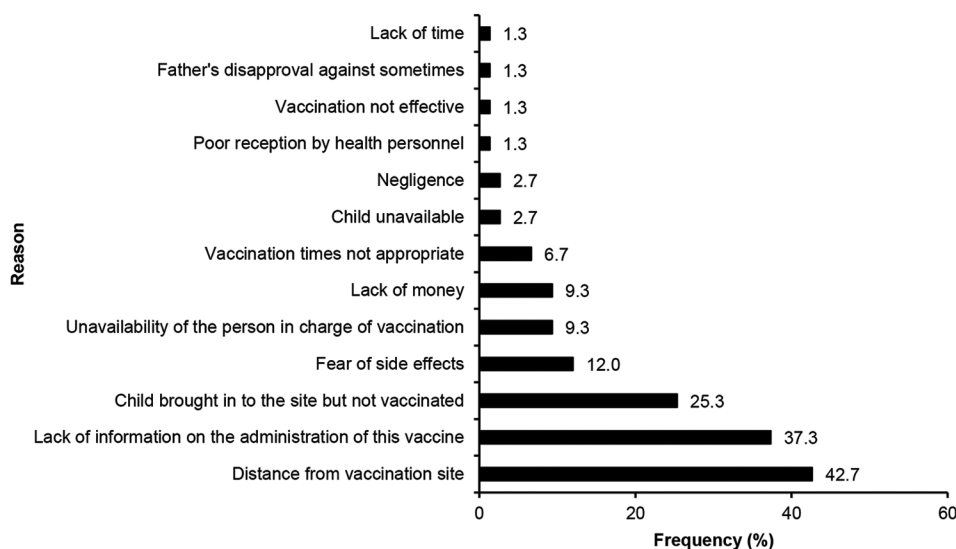


Figure 2. Reported barriers to the vaccination of the second dose of the measles-containing vaccine among eligible children in Ngog-Mapubi health district, Cameroon (n = 75)

#### 4. Discussion

The results revealed that 46.4% of the eligible children received MCV2, which is far below the expected vaccination coverage of 95% (Ewang *et al.*, 2020). This was mainly attributed to the absence of the implementation of an advanced vaccination strategy and other barriers raised by community members.

Despite high reported awareness of MCV2, with 89% of respondents having heard about the vaccine, 61% demonstrated poor knowledge regarding MCV2, particularly concerning vaccination schedules. This finding highlights a critical gap where initial communication efforts have successfully established vaccine recognition across sociodemographic groups, yet they have failed to translate into a comprehensive understanding. The pervasive poor knowledge, despite widespread awareness, suggests that

while the message is being received, its content or delivery may lack the depth necessary to empower caregivers with actionable information, indicating a need for more targeted and in-depth educational strategies to bridge this knowledge-action gap. This is critical as knowledge gaps among vaccination healthcare workers in Cameroon still exist, demonstrating significant deficiencies in their immunization understanding and problematic practices that contribute to missed vaccination opportunities. These shortcomings directly undermine vaccination coverage (Mukhtar *et al.*, 2022). These findings underscore the urgent need for robust capacity-building initiatives targeting vaccination staff, especially as the country's immunization program grows increasingly complex (Saidu *et al.*, 2023).

Awareness of MCV2, measured by having heard about the vaccine, was reported among all respondents who had vaccinated their children. Conversely, none of

**Table 3. Univariate and multivariate binary logistic regression of parameters associated with non-vaccination of the second dose of the measles-containing vaccine**

Factor	Vaccine uptake <i>n</i> (%)		cOR	<i>p</i> -value	aOR	95% CI limits		<i>p</i> -value
	Yes 65 (46)	No 75 (54)				Lower	Upper	
Marital status								
Married	15 (65.2)	8 (34.8)	1		-	-	-	-
Cohabitation	28 (48.3)	30 (51.7)	2.01	0.172				
Single/Widow (er)	22 (37.3)	37 (62.7)	3.15	0.025				
Educational level								
None	6 (37.5)	10 (62.5)	1	-	1	-	-	-
Primary	12 (37.5)	20 (62.5)	1.00	>0.999	1.36	0.34	5.43	0.660
Secondary	46 (52.9)	41 (47.1)	0.53	0.263	0.52	0.14	1.75	0.297
Tertiary	1 (20.0)	4 (80.0)	2.40	0.477	2.26	0.18	59.1	0.554
Occupation								
Civil servant	4 (66.7)	2 (33.3)	1	-	-	-	-	-
Farmer	16 (66.7)	8 (33.3)	1.00	>0.999				
Shopkeeper	8 (66.7)	4 (33.3)	1.00	>0.999				
Housekeeper	32 (41.6)	45 (58.4)	2.81	0.249				
Student	2 (16.7)	10 (83.3)	10.0	0.048				
Other	3 (33.3)	6 (66.7)	4.00	0.215				
Ethnic group								
Other tribes	11 (50.0)	11 (50.0)	1	-	1	-	-	-
Local tribe	54 (45.8)	64 (54.2)	1.19	0.715	0.89	0.31	2.48	0.820
Religion group								
Christian	64 (47.8)	70 (52.2)	1	-	-	-	-	-
Muslim	1 (33.3)	2 (66.7)	1.83	0.626				
Animist	0 (0.0)	3 (100.0)	NA	-				
Number of children								
0–3	24 (47.1)	27 (52.9)	1		1			
3–5	20 (37.7)	33 (62.3)	1.47	0.337	1.31	0.52	3.33	0.561
5–8	21 (58.3)	15 (41.7)	0.63	0.301	0.79	0.30	2.22	0.660
The household's monthly average income								
<50,000	54 (44.6)	67 (55.4)	1	-	-	-	-	-
50,000–150,000	10 (55.6)	8 (44.4)	0.64	0.388				
>150,000	1 (100.0)	0 (0.0)	NA	0.987				
Ever heard of MCV2								
Yes	65 (52.0)	60 (48.0)	1	-	-	-	-	-
No	0 (0.0)	15 (100.0)	NA					
Good knowledge of MCV2								
Yes	15 (57.7)	11 (42.3)	1	-	-	-	-	-
No	50 (43.9)	64 (56.1)	1.75	0.205				
Advanced strategy offered								
Yes	54 (63.5)	31 (36.5)	1	-	-	-	-	-
No	11 (20.0)	44 (80.0)	6.97	<0.001	7.15	3.19	17.2	<0.001

Abbreviations: aOR: Adjusted odds ratio; CI: Confidence interval; cOR: Crude odds ratio; MCV2: Second dose of the measles-containing vaccine; NA: Not applicable.

the 15 respondents who reported never having heard of MCV2 had vaccinated their children, highlighting the crucial importance of information in compliance with the vaccination program.

Vaccine hesitancy is one of the public health threats that hinder the effective implementation of vaccination services within communities (Amani *et al.*, 2022; Cheuyem *et al.*, 2025c; Nah *et al.*, 2023). This study identified three primary barriers that fuel vaccine hesitancy and reduce MCV2 vaccination uptake. These included geographical access (reported by 43% of respondents), health facility information gaps (37%), and service delivery failures where eligible children were left unvaccinated (25%). These findings align with observations from global reports which identified five key categories of vaccination barriers: (i) access barriers (e.g., time constraints, cost, and distance), disproportionately affecting vulnerable populations, (ii) clinic/system barriers (e.g., poor provider communication and low facility quality), (iii) concerns/beliefs (e.g., safety fears and distrust in vaccines or government), (iv) health perceptions (e.g., underestimating disease severity or past negative experiences), and (v) knowledge gaps (e.g., misinformation and schedule confusion). Social influences (e.g., family pressure and religious objections) also played a role, though with fewer distinct barriers. Altogether, these interconnected challenges highlight the need for multifaceted interventions that address the logistical, educational, and trust-related dimensions to improve vaccination uptake (Kaufman *et al.*, 2021; Singh *et al.*, 2019; Szalast *et al.*, 2025; WHO, 2025a).

In sub-Saharan Africa, the reported barriers to vaccination were identified at both the parent/caretaker and health system levels. Caregiver-reported obstacles primarily included insufficient immunization knowledge, geographical distance to access points, financial constraints, lack of partner support, and distrust in vaccines or immunization programs. Additional factors contributing to lower vaccination rates include household dynamics (such as the number of children and birth order), lifestyle choices, migration, parental forgetfulness, inconvenient clinic hours, and language barriers. From the perspective of healthcare providers, systemic impediments cited were limited human resources and inadequate infrastructure for maintaining the cold chain and ensuring a consistent vaccine supply (Bangura *et al.*, 2020).

The 25% reported that service delivery failures are particularly concerning, suggesting systemic issues in vaccine availability or staff practices that require immediate quality improvement interventions. Notably, distance emerged as a cross-cutting barrier affecting both MCV2-specific uptake and routine immunization compliance, reinforcing the need for decentralized service delivery models. These results underscore the importance of implementing multi-

pronged solutions: (i) expanding outreach vaccination services to address geographical barriers, (ii) strengthening health facility communication systems to inform caregivers, and (iii) conducting process evaluations to identify and rectify the causes of missed vaccinations during facility visits (Ekezie *et al.*, 2024; Gbeminiyi & Oyeneye, 2025; Jalloh *et al.*, 2022; Parsekar *et al.*, 2024). Despite high reported awareness (89%), the persistence of these barriers highlights that improving coverage will require addressing both demand-side (information) and supply-side (service access and quality) constraints simultaneously. To this regard, scientific evidences recommend health authorities to increase knowledge about the importance of vaccination for disease prevention, stay up-to-date on latest vaccination recommendations, become familiar with new vaccines, assure office staff are friendly and supportive of families, encourage vaccination at every opportunity, reminder/recall systems for patients, families and providers, and reduce out-of-pocket costs (Anderson, 2014).

The factor most strongly associated with non-vaccination remains the absence of an advanced vaccination strategy (aOR = 7.15; 95% CI: 3.19–17.2;  $p < 0.001$ ). This result is similar to those of Kamani *et al.* (2020) and Russo *et al.* (2015), who found distances of more than 5 km as a factor of non-adherence to children's vaccination schedules. This data underscores the operational importance of organizing vaccination services. In rural areas where geographical accessibility is a major obstacle, advanced vaccination strategies are essential to reach the most remote populations. The absence of geographical accessibility increases the risk of non-vaccination sevenfold, illustrating the determining role of structural healthcare provision.

The education level of the respondents, although not significantly associated with vaccination in our multivariate model, revealed a trend in which individuals with a secondary or higher education level showed higher vaccination rates than those with no education or only primary education. This observation corroborates data from the literature, which establishes a link between education level and the use of preventive health services, particularly concerning the understanding of awareness messages and adherence to the recommendations of the EPI (Ibrahim *et al.*, 2024; Woyessa *et al.*, 2024).

Regarding marital status, children with single or widowed caregivers had a significantly higher risk of non-vaccination compared to those living in households with married parents (cOR = 3.15;  $p = 0.025$ ). These findings corroborate the study of Yakum *et al.* (2023), which revealed that children whose mothers share the same home with their biological father are more likely to be compliant with the EPI schedule. This result suggests that marital

stability could promote better planning and improved access to vaccination services, particularly through shared parental responsibilities and increased social support. In other settings, the marital status has also been found to influence the uptake of vaccines like COVID-19. The reason is that divorced/separated older adults have limited health information and knowledge, and thus have worse vaccine awareness or greater vaccine hesitancy than their married counterparts (Cheuyem *et al.*, 2025d; Liu *et al.*, 2023).

Concerning the occupation of the respondents, we noted that parents who were still students were strongly associated with non-vaccination (crude OR = 10.0;  $p=0.048$ ). This result can be explained by the fact that students, generally young, may prioritize infant health obligations less. Conversely, homemakers, although available, did not have significantly better rates, suggesting that other factors, such as personal motivation, level of information, or decision-making autonomy, might play a role. These results differ from those of Legesse and Dechasa (2015), whose study showed that parents who were farmers were 1.7 times more likely to have their children fully vaccinated.

Nevertheless, this study has some limitations. First, the cross-sectional design does not allow the establishment of a causal relationship between the studied factors and non-vaccination. Second, the sample size was not large enough to detect the significance of some variables declared statistically non-significant. Third, the data relied on participants' declarations, which may result in recall bias or social desirability bias. Furthermore, the sample, though representative of the Ngog-Mapubi district, might limit the generalization of the results to other geographical or sociocultural contexts. Finally, several potentially influential factors, such as the quality of healthcare provision or the attitudes of healthcare professionals, were not explored.

## 5. Conclusion

Despite the high acceptance rate, the vaccination coverage for MCV2 remains low in this rural HD of Cameroon. The absence of an advanced vaccination strategy has emerged as the main barrier to vaccination, regardless of other sociodemographic factors. These results call for the strengthening of the implementation of advanced vaccination strategies, which should be considered an essential lever for health equity in rural areas.

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## Conflict of interest

The authors declare that they have no competing interests.

## Author contributions

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## Ethics approval and consent to participate

Ethical clearance for the present study was waived by the Regional Delegation of Public Health Ethical Board. Administrative approval was obtained from the Chief Medical Officer of Ngo-Mapubi HD. In addition, participants were required to provide signed informed consent. The confidentiality, anonymity, and autonomy of the research participants were respected throughout the study. All methods were performed in accordance with the relevant guidelines of the Helsinki Declaration.

## Consent for publication

All participants provided informed consent for the publication of the findings derived from this study.

## Availability of data

All data generated or analyzed during this study are provided in the manuscript.

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