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Determinants of the measles recrudescence in children aged 6 to 59 months in the Urban Health Zone of Mbandaka, Equateur Provincial Health Division, Democratic Republic of the Congo

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ABSTRACT

Introduction

This study addresses the alarming resurgence of measles in the Mbandaka urban health zone, where annual outbreaks persist despite systematic vaccination efforts targeting children aged 6 to 59 months. With a reported measles morbidity rate of 0.6%, the region is lagging behind the global objective of measles elimination by 2030.

Purpose

The purpose of this study is to identify and analyse the key determinants responsible for the repeated measles epidemics in Mbandaka, with a view to enhancing the effectiveness of prevention strategies.

Methods

A quantitative, prospective, cross-sectional, and analytical approach was used. Data were gathered through household surveys in the urban-rural health zone of Mbandaka, with a focus on public health variables influencing measles vaccination coverage and infection rates.

Results

Several socio-demographic and cultural variables were significantly associated with measles incidence and vaccination status. Age emerged as a key determinant: adults aged 30–39 showed a strong positive association with vaccination uptake ($\beta = 0.34$, $p < 0.001$), whereas those over 39 years had a lower likelihood ($\beta = -0.11$, $p = 0.034$). Male respondents ($\beta = 0.09$, $p = 0.003$) and those with primary ($\beta = 0.21$, $p < 0.001$) or university education ($\beta = 0.14$, $p = 0.005$) were more likely to have vaccinated children. Conversely, divorced or widowed individuals were less likely to ensure vaccination ($\beta = -0.26$, $p < 0.001$). Religious affiliation also played a critical role: Kimbanguists ($\beta = 0.27$, $p < 0.001$) and Muslims ($\beta = 0.17$, $p = 0.014$) showed higher vaccination rates, while Pygmies were less likely to vaccinate ($\beta = -0.33$, $p < 0.001$). Ownership of a vaccination card ($\beta = 0.14$, $p < 0.001$) and residence in specific health zones ($\beta = 0.49$, $p < 0.001$) positively influenced coverage. Vaccine abandonment was mainly due to distance to health facilities ($\beta = 0.17$, $p = 0.022$) and forgetfulness ($\beta = 0.11$, $p = 0.003$).

Conclusion

Measles remains a major public health issue in Mbandaka. Addressing education gaps, improving healthcare access, targeting high-risk religious and ethnic groups, and strengthening vaccination outreach could significantly reduce epidemic recurrence in the region.

INTRODUCTION

Measles is one of the most contagious infectious diseases and remains a major cause of morbidity and mortality worldwide. There is no specific treatment for measles—only symptomatic management (e.g., fever, runny nose). Hence, vaccination is the only effective preventive measure (Luang, 2020).

In 2010, the World Health Assembly set three targets for eliminating measles by 2015: (i) to achieve over 90% coverage with the first dose of the measles vaccine at the national level and at least 80% coverage in all districts or health zones; (ii) to reduce the annual incidence of measles to fewer than five cases per million inhabitants and maintain this level; and (iii) to reduce measles mortality by 95% or more compared with the 2000 baseline (World Health Organization [WHO], 2015).

Despite these goals, measles epidemics continue to grow in several provinces of the Democratic Republic of the Congo (DRC), particularly in the former province of Katanga, which reported 28,077 cumulative cases and 413 deaths—representing 80% of all cases nationwide since the beginning of the year. The epidemic is marked by a high case-fatality rate of 1.47%, well above the emergency threshold of 1%. Alarmingly, the number of health zones in an epidemic situation is expected to double between May and September 2023 (WHO, 2024).

This ongoing epidemic is largely attributed to low vaccination coverage, which has led to a significant backlog of unvaccinated children and facilitated the rapid transmission of this highly contagious virus. Measles remains one of the leading causes of death among young children globally. In the former province of Katanga, low vaccination coverage is influenced by several factors, including poor geographical accessibility to affected health zones due to insecurity from armed groups, vaccine refusal linked to religious or cultural beliefs, and inadequate functional cold chain systems (Médecins Sans Frontières [MSF], 2023).

Measles also compromises immunity against other life-threatening diseases, increasing the risk of death from additional causes. In Congolese urban areas, the measles case-fatality rate is reported as 2–3 deaths per 100 cases, while in rural areas, this rate may reach or exceed 10 deaths per 100 cases (WHO, 2019). At the household level, challenges such as the absence of health education programmes and extreme poverty further complicate the situation. Vaccination remains a key strategy to protect vulnerable children, alongside strengthening routine immunisation under the Expanded Programme on Immunisation (EPI) and ensuring vitamin A supplementation (Noori et al., 2022).

Despite the presence of an epidemiological surveillance system in the Mbandaka health zone, measles persists as a public health concern. In 2020, 70% of children aged 6–59 months, and 90% in 2021, were affected by measles, with a lethality rate of 0.7%. The Mbandaka urban health zone, under the Equateur Provincial Health Division, has experienced recurrent outbreaks almost every year. Previous studies have failed to consider key factors such as sociodemographic variables, cultural practices, urban epidemiological differences, and environmental conditions.

This study is, therefore, critical to identifying the specific determinants of measles outbreaks in Mbandaka and to inform targeted interventions. The research question guiding this investigation is: *What are the determinants of measles recrudescence in the urban-rural health zone of Mbandaka, Equateur Provincial Health Division?* The central hypothesis is that the resurgence of measles in this health zone is due to a combination of sociodemographic, sociocultural, socioeconomic, and healthcare-related factors. The objective of the study is to analyse the determinants of measles epidemics in Mbandaka, with the goal of combating their recurrence in the region.

METHODS

This study is a prospective, descriptive, cross-sectional, and analytical quantitative investigation. It seeks to explain the determinants of the measles upsurge. Data were collected through a household survey in the urban-rural health zone of Mbandaka. The subject of the study is public health.

Geographical Location

Mbandaka, the capital of Equateur Province, is located entirely within the central basin on the left bank of the Congo River and the Ruki River, from upstream to downstream. Covering an area of 1,778 km², the town

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stretches approximately 110 km from Bamanya to Bongonde and has a population density of 522 inhabitants/km². It is bordered as follows:

- **North:** The left bank of the Ruki River, from its junction with the Congo River to the confluence with the Isondjo River
- **East:** The Isondjo River up to its source
- **West:** The left bank of the Congo River to its junction with the Ruki River
- **South:** The Mpandja River, the Mbandaka–Bikoro road axis, and a path from the village of Boyera to Lake Mpaku

The city lies in an equatorial climate zone, which results in high temperatures year-round, with an average annual temperature of 25°C. Key features of the climate include:

- Latitude: 0.4°
- Longitude: 18°18'20"
- Abundant rainfall throughout the year
- Dense vegetation

Furthermore, Mbandaka is surrounded by a dense, heterogeneous forest that serves as the natural habitat for various wild animals including monkeys, warthogs, antelopes, rodents, and reptiles, as well as local species such as Bongondjo, Secli-Wendji, Inganda, and Djombo (Likulu, 2020). The city comprises three health zones, one of which is the Mbandaka health zone, which includes 16 health areas.

Target Population and Sample

The target population for this study consists of households within the Mbandaka health zone. Sampling involves selecting a subgroup of individuals from a larger population for statistical analysis. This study used cluster probability sampling to determine the number of subjects. The statistical units were parents of children aged 6 to 59 months who are involved in vaccination decision-making.

A two-stage cluster sampling method was used to ensure adequate representation. In the first stage, 13 clusters were randomly selected from the list of health areas in the Mbandaka health zone. In the second stage, parents of children aged 6 to 59 months were randomly selected from 13 households per cluster.

Fischer's formula was used to calculate the sample size, based on 53.6% measles (VAR) vaccination coverage among children, with a 95% confidence level (Mekonnen et al., 2020). The formula used is:

$$n = \frac{Z^2 \times p \times (1 - p)}{d^2}$$

Where:

- $Z = 1.96$ (for 95% confidence)
- $p = 0.536$
- $d = 0.05$ (desired precision)

$$n = \frac{(1.96)^2 \times 0.536 \times (1 - 0.536)}{(0.05)^2} = 764$$

The final sample consisted of 764 respondents, with 59 respondents per each of the 13 clusters.

Data Collection Methods and Tools

A survey method was employed, deemed suitable for examining relationships between variables. Data were collected using a questionnaire administered through semi-structured face-to-face interviews. This method provided flexibility while maintaining consistency. The questionnaire included both closed and open-ended questions and was pre-tested with 10 parents from the Wangata health zone to refine its structure and ensure clarity.

Pre-testing enabled adjustments to the questionnaire, improved interviewer-respondent interaction, and ensured more accurate data collection. The sample size was selected to ensure representative coverage of children aged 6 to 59 months in Mbandaka. To reduce bias and enhance consistency, data collectors were trained on the study's objectives, use of the questionnaire, and how to navigate potential challenges during fieldwork.

Analysis and Data Processing Plan

Data collected were coded and entered into Microsoft Excel 2010 and then analysed using SPSS version 25. Initial analysis included descriptive statistics to calculate frequencies and percentages. Bivariate analysis was performed using Pearson's chi-square test (χ^2) to explore associations between independent and dependent variables. Adjusted logistic regression was used to identify significant determinants, with Odds Ratios (OR) and 95%

confidence intervals (CI) calculated. The alpha level of significance was set at 5% ($p < 0.05$).

Ethical Considerations

The study adhered to ethical principles including respect for participants' dignity, voluntary participation, confidentiality, and minimisation of harm. These ethical standards were upheld throughout the data collection process and during dissemination of results. Verbal informed consent was obtained from all participants. Each respondent received an explanatory sheet detailing the purpose of the study and their rights. Participants were assured that their involvement was voluntary and that they could withdraw at any time without any negative consequences.

RESULTS

Socio-demographic Data of Respondents

Table 1:
Socio-demographic characteristics of the population in the Mbandaka Urban Health Zone

Socio-demographic Data	Frequency	Percentage (%)
Sex		
Male	231	30.2
Female	533	69.8
Total	764	100.0
Age		
<20 years	103	13.5
20–29 years	303	39.7
30–39 years	206	27.0
40–49 years	115	15.1
50 and over	37	4.8
Total	764	100.0
Marital Status		
Single	205	26.8
Married	359	47.0
Divorced	83	10.9
Widowed	11	1.4
Common-law	106	13.9
Total	764	100.0
Level of Education		
Illiterate	81	10.6
Primary	128	16.8
Secondary	330	43.2
University	225	29.5
Total	764	100.0
Religion		
Catholic	270	35.3
Muslim	32	4.2
Kimbanguist	91	11.9
Protestant	91	11.9
Revival Church	280	36.6
Total	764	100.0
Ethnic Group		
Bantu	721	94.4
Pygmies	43	5.6
Total	764	100.0
Income		
High	27	3.5
Medium	482	63.1
Low	149	19.5
Very Low	106	13.9
Total	764	100.0
Socio-professional Category		
Employee	78	10.2
Self-employed	355	46.5
Unemployed	331	43.3
Total	764	100.0

The socio-demographic data from the Mbandaka Urban Health Zone revealed several key characteristics of the population. A significant proportion of respondents were female (69.8%). The age distribution indicates a young population, with the majority aged between 20–29 years (39.7%) and 30–39 years (27%). In terms of marital status, most respondents were married (47%), while smaller proportions were single (26.8%), divorced (10.9%), or cohabiting (13.9%).

Regarding education, the largest group had completed secondary education (43.2%), followed by university graduates (29.5%). Christianity was the dominant religion, with 35.3% identifying as Catholic and 36.6% as members of the Revival Church. The majority of respondents (94.4%) identified as Bantu.

In terms of income and employment, 63.1% had medium income levels. Most respondents were either self-employed (46.5%) or unemployed (43.3%), suggesting a level of socio-economic vulnerability. These socio-demographic characteristics are significant for understanding measles recrudescence in the area.

For example, socio-economic vulnerability may hinder access to healthcare and immunisation services, highlighting the need for targeted awareness and vaccination campaigns (World Health Organization [WHO], 2020). The concentration of young adults in the 20–29 age range suggests that they could be key transmitters of measles, necessitating interventions tailored to this group. Despite relatively high levels of

education, improved public health education is still necessary to boost vaccination uptake. Additionally, the prevalence of Christian religious affiliations, especially Catholic and Evangelical groups, suggests religious leaders could be influential in promoting vaccine acceptance (UNICEF, 2021). The ethnic homogeneity may also allow culturally sensitive health interventions to be more effective.

Data Related to Vaccination

Table 2:
Vaccination-related characteristics

Variable	Frequency	Percentage (%)
Child's Gender		
Male	344	45.0
Female	420	55.0
Total	764	100.0
Knowledge of Measles		
Yes	721	94.4
No	43	5.6
Total	764	100.0
Vaccine Acceptability		
Yes	726	95.0
No	38	5.0
Total	764	100.0
Vaccination Card Possession		
Yes	369	48.3
No	395	51.7
Total	764	100.0
Child Vaccinated		
Yes	692	90.6
No	72	9.4
Total	764	100.0
Vaccination Site		
Health Centre	493	64.5
Hospital	38	5.0
Health Post	141	18.5
Other	92	12.0
Total	764	100.0
Second Dose Received		
Yes	198	25.9
No	566	74.1
Total	764	100.0
Vaccinator		
Nurse	523	68.5
Reco (Community Workers)	186	24.3
Friends	25	3.3
Family	14	1.8
Others	16	2.1
Total	764	100.0

The immunisation data indicate several critical aspects of measles vaccination among children in the study area. Female children accounted for 55% of the total, while 45% were male. Knowledge of measles was widespread (94.4%), and vaccine acceptability was high (95%). Nevertheless, 51.7% of children did not have vaccination cards, and 9.4% had not received the measles vaccine.

Health centres were the most common sites for immunisation (64.5%), followed by health posts (18.5%). However, only 25.9% of children had received the second dose of the measles vaccine, indicating a significant coverage gap.

Vaccines were primarily administered by nurses (68.5%), with community workers (Reco) playing a secondary role (24.3%). The involvement of non-professionals such as friends and family raises concerns about proper vaccine administration and recording, suggesting a need for better oversight (WHO, 2022).

These results show that while awareness and vaccine acceptance are high, full coverage remains a challenge. Inadequate documentation and missed second doses may hinder herd immunity. Therefore, strategies to strengthen health centres, regulate vaccine administration, and ensure follow-up for the second dose are essential to control measles outbreaks effectively.

Relationship Between Demographic Characteristics and Measles

Table 3:
Association between demographic variables and measles incidence

Variables	Modality	Measles		p-value
		No=566	*Yes=198*	
Age	20-29 years	224 (39.6)	79 (39.9)	<0.001
	30-39 years	112 (19.8)	94 (47.5)	
	<20 years	86 (15.2)	17 (8.6)	
	>39 years	144 (25.4)	8 (4.0)	
Respondent's gender	Female	404 (71.4)	129 (65.2)	0.121
	Male	162 (28.6)	69 (34.8)	
Marital status	*Married	278 (49.1)	81 (40.9)	0.030
	Single	136 (24.0)	69 (34.8)	
	Divorced & widowed	72 (12.7)	22 (11.1)	
	Common-law	80 (14.1)	26 (13.1)	
Child gender	Female	306 (54.1)	114 (57.6)	0.440
	Male	260 (45.9)	84 (42.4)	

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Age showed a statistically significant association with measles incidence (p < .001), with the highest prevalence in the 30–39-year group (47.5%), followed by the 20–29 group (39.9%). Marital status was also significantly associated (p = .030), with married individuals showing a slightly lower incidence compared to others. However, gender of the respondent and the child did not show significant associations with measles incidence (p > .05). These results suggest the need for age- and marital status-targeted interventions (Centers for Disease Control and Prevention [CDC], 2021).

Table 4:
Relationship between Socio-Cultural Characteristics and Measles

Variables	Modality	Measles		p-value
		No = 566	*Yes = 198*	
Study level	Illiterate	79 (14.0)	2 (1.0)	<0.001
	Primary	83 (14.7)	45 (22.7)	
	Secondary	260 (45.9)	70 (35.4)	
	University	144 (25.4)	81 (40.9)	
Religion	Catholic	201 (35.5)	69 (34.8)	<0.001
	Church of revival	241 (42.6)	39 (19.7)	
	Kimbanguist	48 (8.5)	43 (21.7)	
	Muslim	15 (2.7)	17 (8.6)	
	Protestant	61 (10.8)	30 (15.2)	
Ethnic groups	Bantou	525 (92.8)	196 (99.0)	0.002
	Pygmies	41 (7.2)	2 (1.0)	

The analysis of additional variables provides further insight into the factors influencing measles incidence in the Mbandaka Urban Health Zone.

Level of education emerged as a key determinant, with a statistically significant difference in measles prevalence across educational levels ($p < 0.001$). Among illiterate respondents, only 1.0% reported measles cases, while 22.7% of those with primary education and 35.4% of those with secondary education had children affected by measles. Interestingly, individuals with a university education reported the highest rate (40.9%). This finding suggests that, despite higher levels of education, other factors—such as healthcare access or socioeconomic status—may contribute to the increased incidence in this group.

Religion also showed a significant association with measles prevalence ($p < 0.001$). Measles cases were reported among 34.8% of Catholics and 19.7% of members of the Church of Revival. Notably, Kimbanguists (21.7%) and Muslims (8.6%) reported relatively higher rates of measles cases compared to their representation in the population. These findings may reflect variations in vaccination uptake influenced by religious beliefs and practices, which can shape health behaviours and access to immunisation services.

Ethnicity revealed a statistically significant difference in measles prevalence ($p = 0.002$). The majority of respondents were of Bantu ethnicity (92.8%), and nearly all measles cases occurred within this group (99.0%). In contrast, the Pygmy ethnic group had a considerably lower measles incidence (1.0%). This disparity could be attributed to differences in healthcare access, cultural practices, or vaccination coverage between the ethnic groups.

Overall, these findings highlight the influence of education, religion, and ethnicity on the risk of measles in the Mbandaka Health Zone. Addressing educational disparities, enhancing vaccination outreach within specific religious communities, and ensuring equitable healthcare access across ethnic groups are essential steps toward improving measles prevention in this region.

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Multivariate Analyses

Table 5:
Univariate and Multivariate Analyses

		Beta coefficient (uni variable)	Beta coefficient (multivariable)
Age	20-29 years	0.10 (0.00 to 0.19, p=0.044)	0.21 (0.11 to 0.31, p<0.001)
	30-39 years	0.29 (0.19 to 0.39, p<0.001)	0.34 (0.24 to 0.44, p<0.001)
	<20 years	-	-
	>39 years	-0.11 (-0.22 to -0.01, p=0.034)	0.08 (-0.01 to 0.18, p=0.095)
Sex	Female	-	-
	Male	0.06 (-0.01 to 0.12, p=0.101)	0.09 (0.03 to 0.15, p=0.003)
Marital status	*Married	-	-
	Single	0.11 (0.04 to 0.19, p=0.004)	-0.06 (-0.14 to 0.02, p=0.161)
	Divorced & widowed	0.01 (-0.09 to 0.11, p=0.868)	-0.26 (-0.36 to -0.17, p<0.001)
	Common-law	0.02 (-0.08 to 0.11, p=0.684)	-0.21 (-0.29 to -0.12, p<0.001)
Child's sex	Female	-	-
	Male	-0.03 (-0.09 to 0.04, p=0.393)	0.15 (0.09 to 0.21, p<0.001)
Education level	Illiterate	-	-
	Primary	0.33 (0.21 to 0.45, p<0.001)	0.21 (0.11 to 0.31, p<0.001)
	Secondary	0.19 (0.08 to 0.29, p<0.001)	0.02 (-0.07 to 0.11, p=0.625)
	University	0.34 (0.23 to 0.44, p<0.001)	0.14 (0.04 to 0.24, p=0.005)
Religion	Catholic	-	-
	Church of revival	-0.12 (-0.19 to -0.05, p=0.001)	-0.09 (-0.16 to -0.02, p=0.011)
	Kimbanguist	0.22 (0.12 to 0.32, p<0.001)	0.27 (0.17 to 0.38, p<0.001)
	Muslim	0.28 (0.12 to 0.43, p=0.001)	0.17 (0.04 to 0.31, p=0.014)
	Protestant	0.07 (-0.03 to 0.17, p=0.149)	0.14 (0.04 to 0.24, p=0.005)
Ethnies	Bantou	-	-
	Pygmies	-0.23 (-0.36 to -0.09, p=0.001)	-0.33 (-0.46 to -0.20, p<0.001)
Income level	High	-	-
	Low	-0.06 (-0.24 to 0.11, p=0.471)	-0.07 (-0.21 to 0.07, p=0.342)
	Medium	0.15 (-0.01 to 0.32, p=0.070)	0.01 (-0.12 to 0.14, p=0.855)
	Too low	-0.07 (-0.25 to 0.11, p=0.434)	-0.07 (-0.22 to 0.08, p=0.364)
Socio-professional category	*Employed	-	-
	Unemployed	0.01 (-0.09 to 0.11, p=0.891)	0.02 (-0.08 to 0.12, p=0.712)
	Self-employed	0.36 (0.26 to 0.46, p<0.001)	0.34 (0.23 to 0.44, p<0.001)
Residence	Length of time in the environment	-	-
	Place of residence	0.06 (-0.05 to 0.18, p=0.288)	0.15 (0.05 to 0.25, p=0.005)
	Health zone	0.36 (0.13 to 0.59, p=0.002)	0.49 (0.29 to 0.70, p<0.001)
Have drinking water	*Yes	-	-
	No	0.08 (0.02 to 0.15, p=0.010)	0.11 (0.05 to 0.18, p=0.001)
Knowledge of measles	No	-	-
	Yes	0.13 (-0.01 to 0.26, p=0.065)	0.07 (-0.07 to 0.21, p=0.313)
Accept the vaccine	No	-	-

Vaccination card	Yes	-0.09 (-0.23 to 0.06, p=0.232)	-0.12 (-0.24 to -0.01, p=0.038)
	*Yes	-	-
	No	0.18 (0.12 to 0.24, p<0.001)	0.14 (0.08 to 0.21, p<0.001)
Vaccinated child	*Yes	-	-
	No	-0.09 (-0.19 to 0.02, p=0.110)	-0.05 (-0.14 to 0.04, p=0.252)
Getting the second dose	*Yes	-	-
	No	0.18 (0.11 to 0.25, p<0.001)	0.19 (0.13 to 0.25, p<0.001)
Vaccination site	*Hospital	-	-
	Other	0.12 (-0.05 to 0.28, p=0.162)	-0.05 (-0.18 to 0.08, p=0.467)
	Health centre	0.14 (-0.00 to 0.29, p=0.058)	-0.01 (-0.12 to 0.10, p=0.864)
	Health post	0.12 (-0.03 to 0.28, p=0.123)	0.04 (-0.08 to 0.16, p=0.489)
Vaccine discontinuation	No	-	-
	Yes	0.32 (0.26 to 0.38, p<0.001)	0.16 (0.10 to 0.23, p<0.001)
Reason for abandonment	*Travel	-	-
	Distance	0.17 (0.03 to 0.32, p=0.022)	-0.00 (-0.16 to 0.15, p=0.979)
	Missing	0.11 (0.04 to 0.19, p=0.003)	-0.07 (-0.14 to 0.01, p=0.097)

The multivariable analysis and corresponding beta coefficients revealed several factors significantly associated with measles vaccination coverage in the Mbandaka urban health zone. Age was a strong determinant, with individuals aged 30–39 years exhibiting the highest likelihood of vaccination (β = 0.34; 95% CI: 0.24–0.44; $p < 0.001$), followed by those aged 20–29 years (β = 0.21; 95% CI: 0.11–0.31; $p < 0.001$). In contrast, no significant association was observed for individuals over 39 years ($p = 0.095$).

Sex was also significant, with males more likely to be vaccinated than females (β = 0.09; 95% CI: 0.03–0.15; $p = 0.003$). Marital status showed mixed results: while being single was associated with higher vaccination coverage in univariable analysis (β = 0.11; 95% CI: 0.04–0.19; $p = 0.004$), this association did not persist in the multivariable model ($p = 0.161$). Conversely, divorced or widowed individuals were significantly less likely to vaccinate (β = -0.26; 95% CI: -0.36 to -0.17; $p < 0.001$).

Education level played a key role; individuals with a university education had higher vaccination coverage (β = 0.14; 95% CI: 0.04–0.24; $p = 0.005$), while secondary education did not significantly impact uptake ($p = 0.625$). Religious affiliation was another important factor: Kimbanguists (β = 0.27; 95% CI: 0.17–0.38; $p < 0.001$) and Muslims (β = 0.17; 95% CI: 0.04–0.31; $p = 0.014$) were more likely to vaccinate, whereas members of the Church of Revival were less likely (β = -0.09; 95% CI: -0.16 to -0.02; $p = 0.011$).

Ethnicity significantly influenced coverage, with the Pygmy population demonstrating markedly lower likelihood of vaccination (β = -0.33; 95% CI: -0.46 to -0.20; $p < 0.001$). Among socio-professional categories, self-employed individuals were significantly more likely to vaccinate (β = 0.34; 95% CI: 0.23–0.44; $p < 0.001$), while being unemployed showed no significant effect ($p = 0.712$). Other critical factors included possession of a vaccination card (β = 0.14; 95% CI: 0.08–0.21; $p < 0.001$) and receipt of the second measles vaccine dose (β = 0.19; 95% CI: 0.13–0.25; $p < 0.001$), both of which were positively associated with higher coverage. Furthermore, vaccine discontinuation experience was also positively associated with vaccination (β = 0.16; 95% CI: 0.10–0.23; $p < 0.001$).

These findings highlight the need for targeted public health interventions focusing on under-vaccinated subgroups—such as ethnic minorities, specific religious communities, and socio-economically disadvantaged populations—to enhance measles vaccination coverage and prevent potential outbreaks in the Mbandaka urban health zone.

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DISCUSSION

This study reveals that vaccination rates in the Mbandaka urban health zone are low, with 9.4% of children not vaccinated against measles and 74.1% not receiving the second dose of the vaccine. These figures are concerning when compared to national averages and regional trends. For instance, a study conducted in the Oicha health zone in the DRC found that 65% of individuals who developed measles had not been vaccinated, indicating that vaccination rates in the current study area are comparable to, or worse than, those observed in other regions (Lomanga et al., 2024). This underscores the urgent need to enhance measles vaccination coverage.

Cultural and religious barriers also significantly influence vaccination uptake. In this study, certain religious groups—such as Kimbanguists and Muslims—exhibited varying levels of vaccination, and prior research has shown that religious beliefs, including reliance on divine protection or concerns about vaccine safety, contribute to vaccine hesitancy (Eshetu et al., 2024). Addressing hesitancy in such groups may require targeted communication strategies, including the active involvement of religious leaders in vaccine advocacy.

Socio-demographic factors further impact vaccination coverage. The respondent profile—predominantly young, female, married, and with secondary education—is consistent with previous research linking socio-economic vulnerability, such as unemployment and low income, to reduced vaccination rates. Studies from Uganda and Ethiopia have similarly identified poverty and malnutrition as critical contributors to measles outbreaks (Demewoz et al., 2023; Driwale, 2023; Ilyas et al., 2020), which aligns with the findings of this study. Improving vaccine accessibility through community centres and schools, and reducing financial barriers, could mitigate these challenges.

Educational disparities also appear to play a role; lower education levels were associated with increased measles risk in both this study and previous work (Lomanga et al., 2024). Strengthening public health education through accessible communication channels and the involvement of community influencers could help address this issue. Additionally, non-vaccination, malnutrition, and limited access to healthcare services were identified as key drivers of measles resurgence—findings that correspond with other studies (Eshetu et al., 2024). These challenges could be mitigated by enhancing healthcare infrastructure and integrating vaccination with other health services.

Finally, the high proportion of children without vaccination cards (51.7%) highlights deficiencies in data collection and record-keeping. Improving these systems could help identify coverage gaps and enhance overall programme effectiveness (Makarenko et al., 2022). By considering these factors, the present study contributes to the broader understanding of measles vaccination challenges in the Mbandaka urban health zone and supports efforts to strengthen immunisation strategies in similar settings.

CONCLUSIONS

This study aimed to identify the determinants of measles resurgence among children aged 6 to 59 months in the urban health zone of Mbandaka, within the Provincial Health Division of Équateur, focusing on factors such as age, education level, religion, and ethnicity. The results revealed a significant association between these socio-demographic factors and the occurrence of measles ($p < 0.05$), underscoring that measles remains a major public health concern in the region. Children in certain age groups, those with lower levels of education, and those belonging to specific religious or ethnic communities were found to be more susceptible to measles. In light of these findings, strengthening healthcare services, conducting regular vaccination campaigns, and integrating health education with other community-based services are essential steps to reduce the recurrence of measles and improve vaccination coverage in Mbandaka.

Ethical Approval: The study protocol received ethical approval from the Higher Institute of Medical Techniques of Kinshasa, Kinshasa, Democratic Republic of the Congo.

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