THE EUROPEAN SOCIETY OF MEDICINE
Medical Research Archives, Volume 14 Issue 5

RESEARCH ARTICLE

Factors of the occurrence of Mpox in the Kokolo Military Health Zone, in Kinshasa, Democratic Republic of Congo, from January to December 2025

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OPEN ACCESS

PUBLISHED
31 May 2026

CITATION
Amisi, LK., Kiula, EN., et al., 2026. Factors of the occurrence of Mpox in the Kokolo Military Health Zone, in Kinshasa, Democratic Republic of Congo, from January to December 2025. Medical Research Archives, [online] 14(5).

ISSN
2375-1924

ABSTRACT

Introduction: Mpox constitutes a growing global public health concern, particularly in Central Africa. In the Democratic Republic of the Congo (DRC), the incidence has increased, with human-to-human and even sexual transmission. This study aimed to identify the factors associated with the occurrence of Mpox in Kinshasa, in a military Health Zone.

Methods: An unmatched case-control study was conducted from January to December 2025. The case was defined as any person with a positive Polymerase Chain Reaction (PCR); the controls were selected from the neighborhood of the case and had not been affected by Mpox. Data were collected from 192 cases and 576 controls using a questionnaire via KoboCollect. Statistical analyses were performed with Epi Info 7.2.6.0.

Results: The male sex was predominant (60.9%), young (major age group 15-29 years 76 or 39.6%, median age 19 years). The predominant symptoms were rash (99.5%), fever (95.3%), and physical asthenia (87.5%). The notion of mutation or recent travel (aOR=1.40; 95% CI: 1.13–2.09), physical contact with a patient (aOR=3.92; 95% CI: 2.84–4.96), having a pre-existing chronic pathology (aOR=1.95; 95% CI: 1.24-2.41), sleeping in the same bed as a patient (aOR=1.53; 95% CI: 1.14–2.29), washing the clothes of a Mpox patient (aOR=1.77; 95% CI: 1.32–2.98) or wearing them (aOR=2.27; 95% CI: 1.55–3.69), kissing the patient (aOR=2.65; 95% CI: 1.46–3.73), eating/drinking with a Mpox case (aOR=1.66; 95% CI: 1.19–2.28), helping the patient to eat (aOR=1.68; 95% CI: 1.13–2.60) or to urinate (aOR=2.11; 95% CI: 1.47–3.34), having sex with a casual partner (aOR=3.41; 95% CI: 2.85–4.22), and being in contact with sick or dead animals (aOR=1.54; 95% CI: 1.16–3.26) were factors associated with the occurrence of Mpox.

Conclusion: The transmission of Mpox in the Democratic Republic of Congo appears to be dominated by intrafamilial contacts, reinforcing the hypothesis of a now primarily human-to-human dynamic. The results highlight the need to strengthen community communication, surveillance, and access to care, particularly in rural areas.

Keywords: Risk factors, Mpox, Outbreak, Military environment, Democratic Républic of the Congo.

I. Introduction

Mpox is a viral infectious disease caused by the *monkeypox virus (MPXV)*, an Orthopoxvirus related to smallpox. It typically produces a painful skin rash, fever, and swollen lymph nodes, and spreads mainly through close physical contact[1].

The emergence of Mpox cases (formerly known as Monkeypox) has raised growing concern internationally, particularly in Central and West African countries where the disease is endemic. Since the early 2000s, there has been an increase in the number of reported cases, notably in the Democratic Republic of Congo (DRC)[1].

On August 13, 2024, the Africa Centers for Disease Control and Prevention (CDC), which brings together the African centers for disease control and prevention, provided its support to the DRC for the declaration of the current Mpox outbreak. However, a few days later, the World Health Organization (WHO) described this situation as an international public health emergency[2,3].

Data provided by the WHO have highlighted a worrying increase in the number of Mpox cases over the past three years. Between January 2022 and July 2023, more than 87,000 Mpox cases were reported in 110 countries worldwide, including over 1,000 deaths (with an average occurrence rate of 1.15%)[4,5]. Nearly half of these cases were reported in Africa, mainly in the DRC, Nigeria, and Cameroon. These numbers clearly stand out from previous years, when Mpox was mainly confined to remote rural areas and imported cases outside of Africa were rare[6]. The 2024 figures show a 15% increase in cases compared to the previous year[7,8].

Kinshasa ranks eighth among the most affected regions in the DRC. In the city-province of Kinshasa, the Kokolo health zone (HZ) ranks second in terms of impact, just after the Limeté zone. According to WHO information, in 2024, more than 50 cases were recorded in this health register (HZ), marking a 100% increase compared to the years 2019 and 2021[9-11]. According to data published by the Public Health Emergency Operations Center (PHEOC) in September 2024, the Mpox outbreak affects all provinces of DRC. From Epidemiological Week (EW) 1 to EW38, 26,568 suspected cases were noted, of which 5,611 were confirmed and 836 resulted in deaths, representing a mortality rate of 3.14%. According to the same source, the Kokolo Health Zone (HZ) accounts for 15% of the cases reported in the entire province[12].

Kokolo HZ is a Health Zone, with health areas (HA) scattered throughout the city-province of Kinshasa, shows a specificity that illustrates all the characteristics inherent to each health zone, including HAs located near the forests of Kwango and Kwilu. Potential animal sources for the virus, such as rodents and primates, are found in large forests where the regular cohabitation between humans and wild animals promotes zoonotic transmissions[1,2,13]. In Maluku, where the HAs of Maluku and Mabana are integrated into the Special Zone Kokolo, the armed forces take part in interventions in Kwamouth. The spread of the virus was favored by armed conflicts that led to large population movements, which resulted in overcrowding, deteriorated sanitary conditions, and limited access to health services[3-5].

It is essential to optimize epidemiological surveillance systems in order to quickly identify cases and control outbreaks through targeted actions on high-risk groups, including medical workers and those living near forests with the highest risk of zoonotic transmission[6]. According to the WHO, despite notable efforts to improve diagnosis and rapid response to outbreaks, logistical problems as well as ongoing conflicts in various regions hinder the effectiveness of interventions[7].

A study conducted in 2023 by Muyembe-Tamfum and his team on the causes of the resurgence of Mpox in the DRC between 2022 and 2023 highlighted several concerning elements. This includes an increase in contacts between humans and host animals, such as rodents and non-human primates, as well as a difficult socio-economic situation[14]. The researchers also noted a link between population movements due to conflicts and the spread of Mpox, emphasizing the importance of social stability in controlling the outbreak.

Local traditions, such as hunting and the consumption of wild meat, play a crucial role in the transmission of the virus to humans. Factors like deforestation and logging in the region have disrupted the natural habitats of animal reservoirs, thus increasing the risk of interspecies transmission[5,6].

Areas affected by conflicts show higher incidence rates, partly due to the disruption of hospital services and the increase in personal interactions in overcrowded situations, as is the case in refugee camps[7].
According to the World Food Programme (2023), the epidemic has intensified food insecurity in the affected regions, due to economic problems and the decrease in household incomes[3,10,14]. A report from the Ministry of Public Health in the DRC highlights the considerable expenses required for the purchase of medicines, vaccines, and protective equipment[11].

Several factors can influence the spread of Mpox, such as interactions with wild animals, living conditions, population movements, and cultural traditions[11,13]. However, most studies have not established a direct comparison between infected individuals and an unaffected control group in the same environment, nor in the Kokolo health region.

We will conduct a case-control study to better understand the factors that promote the occurrence of the infection. We will study, in particular, access to healthcare, dietary practices, personal hygiene, sexual behaviors, contact with wildlife, and the effects of internal displacement resulting from armed conflicts in the Kokolo area[11,15,16].

2. Methods

2.1. TYPE, FRAMEWORK, AND STUDY PERIOD

A case-control study was conducted in the Kokolo Health Zone, for the period from January to December 2025.

Data collection was carried out in December 2025. This study was conducted in all health areas of the Kokolo Health Zone that had at least one confirmed case or one probable case. The Kokolo military Health Zone is one of the 35 health zones of the city-province of Kinshasa with an estimated population of 521,742 inhabitants in 2025.

2.2. STUDY POPULATION

A "case" was considered any confirmed case of Mpox (according to the definition during the outbreak) recorded in the linear list of epidemiological surveillance of the Kokolo Health Zone during the outbreak in the period from January to December 2025. Or any suspected case in whom Mpox infection was confirmed by molecular biology (Polymerase Chain Reaction - PCR) in the laboratory at the National Biomedical Research Institute.

A "control" was a person in the neighborhood of the case's household who had not contracted Mpox during the said outbreak and selected according to the following sociodemographic criteria:

- Living in the vicinity of the case within a radius of less than 500 meters or being their close friend with a contact frequency of at least 2 times per week during the outbreak.
- Being aged within plus or minus 5 years of the case.
- Being of the same sex as the case.
- Having been in the neighborhood of the case during the outbreak.

2.3. INCLUSION CRITERIA

1° Exhaustively, every confirmed "case", living, residing in one of the HA of the Kokolo HZ, consenting and listed in the linear list of the Kokolo HZ during the said period.
2° Selectively, three witnesses, living, residing in the HA of the Kokolo HZ, consenting and whose household is near the confirmed case included in the study during the said period.

.4. EXCLUSION CRITERIA

1° Any confirmed "case", living and listed in the linear list of the Kokolo HZ but not consenting to participate in the study and/or not having lived in the HA of the Kokolo HZ during the said period or no longer having the mental capacity to respond.
2° Any witness, living, but not consenting to participate in the study and/or not having lived in the HA of the Kokolo HZ during the said period or no longer having the mental capacity to respond.
3° Any confirmed "case" deceased during the said epidemic or deceased before the data collection period or also deceased during the data collection period.
4° Any witness deceased during the said epidemic or deceased before the data collection period or also deceased during the data collection period.

2.5. SAMPLING

All confirmed cases, exhaustively, in view of several movements experienced by the military recently following the country's security situation, and based on the linear epidemiological surveillance list of the Kokolo Health Zone from January to December 2025, were retained. One case was planned for three witnesses. Once identified in the linear list, the case was located and physically seen by the investigator at the household where they live to collect data. The "witness" was identified by the investigator through a non-probabilistic convenience sampling following the investigation of the "case" in the household. If multiple people met the witness criteria, the investigator made a reasoned choice based on the witness's consent and availability.

2.6. VARIABLES OF INTEREST

The study variables will be determined and collected:

- ***Dependent variable:*** Mpox infection in the epidemic context of the Kokolo Health Zone, in Kinshasa, DRC, from January to December 2025. Case and witness are dependent variables.
- ***Independent variables:*** The following variables were considered independent:

  - Sociodemographic characteristics: Health Area, place of residence, residence status in the Health Area, sex, age, level of education, respondent's status, secondary occupation, marital status, respondent's religion or religious belief, household size.
  - Clinical characteristics of Mpox cases: delay in seeking consultation, hospitalization, duration of illness, clinical manifestations of the disease.
  - Risk sociocultural behaviors: travel to a risk area, travel of a family member to a risk area, a pre-existing chronic pathology, physical contact with a Mpox case, sleeping in the same room as a Mpox case, sleeping in the same bed as a Mpox case, kissing a Mpox case, washing the clothes of a Mpox case, wearing the clothes of a Mpox case, eating/drinking from the same container as a Mpox case, helping a Mpox case to eat/drink/walk, helping a Mpox case to urinate/defecate, sexual intercourse with a casual partner, contact with dead animals, consumption of bushmeat.

2.7. DATA COLLECTION, PRE-TEST, ANALYSIS AND ETHICAL CONSIDERATIONS

The survey questionnaire administered during the interview, the linear list of Mpox cases for the Kokolo Health Zone, and the counting form of the Kokolo Health Zone, of the health areas, of the villages/localities/ Community Animation Cells (CAC), the list of households in the localities/villages/CAC, medical records (consultation form), and the identity documents of respondents or the declaration of guardians for minors were the sources used to obtain the data for our study. The data were collected and entered through a phone using the KoboCollect application based on a previously designed and pretested questionnaire in the Police Health Zone. This virtual questionnaire was completed during the face-to-face interview between the investigator (the nurse in charge of the HA) and the respondents in the households. In the event of the absence of the selected respondent, a second visit was made to include them in the study. If the interviewee was a child who could not reasonably respond, their guardian or an adult well-informed about their situation answered on

their behalf. Only the data recorded during the interview with the respondent at the visit were entered. A case or a witness absent during the visit was replaced by the investigator according to the study's selection criteria. If the selected case was seen but the identified witness was absent at the visit, the latter was replaced by the investigator in the household where they reside. The investigators also used the review of medical records (consultations) of confirmed Mpox cases in healthcare facilities to clarify certain elements, particularly clinical signs or the identities and residences of the cases, in order to reach them and facilitate the selection of witnesses.

The database was stored on the principal investigator's computer secured with a password, without the collected data remaining on the investigators' phones. The database data were exported in Microsoft Excel format and then analyzed using Epi Info 7.2.6.0 and Microsoft Excel by the investigators. Regular checks for duplicates, missing data, and potential anomalies were carried out on the database by the investigators. Proportions and measures of central tendency (mean or median), dispersion (standard deviation, range) were calculated, and univariate analysis was conducted to extract relevant descriptive results. For bivariate analysis, the measure of association (odds ratio) and statistical tests (chi-square, confidence interval, p-value) were calculated for statistical interpretation. The significance threshold considered was 5%. The results were presented in the form of tables and graphs. The cases and controls surveyed were classified according to their sociodemographic characteristics.

Approval from the National Health Ethics Committee was obtained before the implementation of the study under No. 630/CNES/BN/PMMF/2025 on 16/02/2025. Before being carried out, the study had also received the endorsement of the military and health authorities of the Kokolo Health Zone to be conducted.

Verbal informed consent was obtained from each participant before proceeding with the administration of the questionnaire. In the case of a minor respondent, the team sought consent from a responsible adult parent. Participation in the study was free for respondents. No compensation in kind or cash was provided, except that respondents were informed about the factors associated with Mpox and the importance of knowledge. The confidentiality of the survey data and respect for the human person were preserved. Only the investigators had access to the survey data. The data collected on participants by the surveyor were automatically sent to the database. For the implementation of the survey, contacts with military, administrative, and health authorities of the province were previously made with a mission order duly established by Kokolo HZ. During these contacts, the interest and scope of the survey were presented to them. Their cooperation and requested support had facilitated the conduct of the survey.

3. Results

The study involved 768 respondents due to 192 cases and 576 controls.

3.1. SOCIODEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS IN THE STUDY

The sociodemographic characteristics are detailed in Tables 1 and 2.

Table 1. Distribution by Health Area of respondents to the Mpox study in the Kokolo Health Zone, Kinshasa, DRC, January to December 2025

Health Area	Case n (%)	Controls n (%)
Ndolo	32 (16,7)	96 (16,7)
Kokolo2	30 (15,6)	90 (15,6)
Kokolo1	24 (12,5)	72 (12,5)
Base logistique	18 (9,4)	54 (9,4)
Tshatshi	17 (8,9)	51 (8,9)
Bataillon PM	13 (6,8)	39 (6,8)
Anciens combattants	6 (3,1)	18 (3,1)
Ceta	5 (2,6)	15 (2,6)
Force Navale	5 (2,6)	15 (2,6)
Mbaki	5 (2,6)	15 (2,6)
Gesm	4 (2,1)	12 (2,1)
Transmission	4 (2,1)	12 (2,1)
Salongo	4 (5,3)	12 (5,3)
Kibomango	3 (1,6)	9 (1,6)
Maluku	3 (1,6)	9 (1,6)
Ci mikondo	3 (1,6)	9 (1,6)
Badiadingi	2 (1,0)	6 (1,0)
E-musique	2 (1,0)	6 (1,0)
Faé n'djili	2 (1,0)	6 (1,0)
Kinkole nsele	2 (1,0)	6 (1,0)
STP Makelele	2 (1,0)	6 (1,0)
Meteo	1 (0,5)	3 (0,5)
Loano	1 (0,5)	3 (0,5)
Matadi mayo	1 (0,5)	3 (0,5)

Health Area	Case n (%)	Controls n (%)
Mabana	1 (0,5)	3 (0,5)
Limete motel	1 (0,5)	3 (0,5)
Bia	1 (0,5)	3 (0,5)
Total	**192**	**576**

All 27 Health Areas of the Kokolo Health Zone had recorded at least one confirmed case of Mpox and were taken into account in the conduct of this study. Ndolo Prison Health Area enrolled many cases in this study (32 or 16.7%), followed by those from Kokolo2 (30 or 15.6%) and Kokolo1 (24 or 12.5%). The details are in Table 1.

Table 2. Sociodemographic characteristics of respondents to the Mpox study in the Kokolo Health Zone, Kinshasa, DRC, January to December 2025.

Variable	Case n (%)	Control n (%)	p
Sex			**0.031**
Male	117 (60.9)	351 (60.9)	
Female	75 (39.1)	225 (39.1)	
Age group			0.058
0–4 years	20 (10.4)	61 (10.6)	
5–14 years	35 (18.2)	106 (18,4)	
15–29 years	76 (39.6)	226 (39.2)	
30–44 years	34 (17.7)	103 (17,9)	
45–59 years	16 (8.3)	47 (8.2)	
> 60 years	11 (5.7)	33 (5.7)	
Age			
Q1, Median, Q3	7, 29, 47	8, 29, 48	
Extent	1 – 66	2 – 68	
Living environment			0.069
Urban	145 (75.5)	435 (75.5)	
Rural	47 (24.5)	141 (24.5)	
Respondent's residence status in the HZ			0.324
Resident	189 (98.4)	569 (98.8)	
Traveler	3 (1.6)	7 (1.2)	
Household size			
Q1, Median, Q3	3, 6, 9	4, 7, 11	
Extent	1 – 12	1 – 14	
Level of education			0.127
None	44 (22.9)	139 (24.1)	
Primary	67 (34.9)	180 (31.3)	
Secondary	62 (32.3)	204 (35.4)	
University	19 (9.9)	53 (9.2)	
***n** : Total*	*% : Percentage*		***Q** : Quartile*

The male sex was the most represented (117 or 60.9%) with a median age of 29 years (range: 1-66, Q1=7 and Q3=47) among the cases, with a predominance of cases in the 15-29 age group (76 or 39.6%). Several households of the cases were in the urban area (145 or 75.5%) with a median household size of 6. The majority of cases had not reached secondary school level (67 or 34.9%).

Table 3. Continuation of the sociodemographic characteristics of respondents to the Mpox study in the Kokolo Health Zone, Kinshasa, DRC, January to December 2025.

Variable	Case n (%)	Control n (%)	p
Respondent's status in relation to the army			**< 0.001**
Military Dependent	86 (44.8)	261 (45.3)	
Military	55 (28.6)	165 (28.7)	
Civilian defense personnel	51 (26.6)	150 (26.0)	
Secondary Occupation			**0.003**
Pupil/Student	77 (40.1)	231 (40.1)	
Merchant	43 (22.4)	128 (22.2)	
Farmer	18 (9.3)	55 (9.5)	
Hunter	13 (6.8)	39 (6.8)	
Teacher	11 (5.7)	33 (5.7)	
Healthcare professional	8 (4.2)	24 (4.2)	

Variable	Case n (%)	Control n (%)	p
Sex professional	5 (2.6)	15 (2.6)	
Without secondary occupation or Others occupation	17 (8.9)	51 (8.9)	
Marital status			**0.026**
Married	83 (43.2)	249 (43.2)	
Single	65 (33.9)	194 (33.7)	
Free union	33 (17.2)	100 (17.4)	
Divorced	8 (4.1)	23 (4.0)	
Widower	3 (1.6)	10 (1.7)	
Patient's situation regarding a chronic illness			**0.008**
HIV	11 (5.7)	1 (0.2)	
Diabetes	2 (1.0)	1 (0.2)	
AHT	3 (1.6)	1 (0.2)	
Tuberculosis	2 (1.0)	0 (0.0)	
Absence of chronic disease	174 (90.6)	573 (99.4)	
Religion			0.722
Christian	166 (86.5)	498 (86.5)	
Muslim	13 (6.8)	39 (6.8)	
Atheist	7 (3.6)	21 (3.6)	
Other	6 (3.1)	18 (3.1)	

***n** : Total* *% : Percentage* ***Q** : Quartile*

The majority were military dependents (86 or 44.8%), pupils/students (77 or 40.1%), and married (83 or 43.2%). The vast majority of cases were Christians (166 or 86.5%). There were no sex workers among the cases. Regarding the secondary activities of the 55 military personnel, 16 were farmers, 13 hunters, 6 students, 3 health professionals, and 17 had no secondary activity.

3.2. CLINICAL ELEMENTS RELATED TO MPOX CASES

The clinical elements related to Mpox cases are summarized in Table 3.

Table 4. Clinical elements related to Mpox cases in the Kokolo Health Zone, DRC, January to December 2025

Clinical elements	n (%)
Time before the consultation	
Q1, Median, Q3	*2, 5, 9*
Extent	*1 – 14*
Less than a day	*21 (10.9)*
1 - 3 days (Reference)	*29 (15.1)*
More than 3 days	*142 (74.0)*
Hospitalization	
Yes	*124 (64.6)*
No	*68 (35.4)*
Duration	
Less than 4 days	*36 (18.8)*
4 – 6 days	*41 (21.4)*
7 – 10 days	*52 (27.0)*
More than 10 days	*63 (32.8)*

***n** : Total* *% : Percentage* ***Q** : Quartile*

The majority of cases consulted the healthcare facility (HCF) more than 3 days after the onset of symptoms (142 or 74.0%) and had the illness last more than 10 days before recovery (63 or 32.8%). The majority were hospitalized (124 or 64.6%) during their illness. Cases of Mpox during the outbreak mainly presented the clinical manifestations in the proportions shown in Table 4.

Table 5. Clinical manifestations related to Mpox cases in the Kokolo HS, January to December 2025.

Clinical elements	Case n (%)	95% CI
Skin rash	191 (99.5)	98.7 – 99.8
Fever	183 (95.3)	92.9 – 97.0
Physical asthenia	168 (87.5)	82.7 – 89.2
Sore throat	155 (80.7)	76.4 – 87.7
Headaches	141 (73.4)	66.9 – 75.8

Clinical elements	Case n (%)	95% CI
Cough	127 (66.7)	61.6 – 75.3
Genital lesions	125 (65.1)	60.2 – 69.2
Cervical lymphadenopathy	122 (63.5)	58.7 – 67.8
Diarrhea	91 (21.21)	17.6 – 25.3
***n** : Total*	*% : Percentage*	***95% CI** : 95% confidence interval*

More than 99% of cases presented with skin rashes (191 or 99.5%), fever (183 or 95.3%), and physical weakness (168 or 87.5%) characteristic of the disease.

3.3. RISK FACTORS ASSOCIATED WITH THE EMERGENCE OF MPOX IN THE KOKOLO HEALTH ZONE

The risk factors associated with the occurrence of the Mpox outbreak in the Kokolo Health Zone are listed in Table 5.

Table 6. Factors of Mpox occurrence in the Kokolo Health Zone in multivariate analysis, January to December 2025

	Case		Control		OR (95% CI)	P	aOR (95% CI)	P
	n	%	n	%				
Sex								
Male	117	60.9	351	60.9	1.09 (0.57 - 1.41)	0.092	1.03 (0.68 - 1.39)	0.286
Female	75	39.1	225	39.1	1		1	
Respondent's status in relation to the army								
Military	55	28.6	135	23.4	1.85 (1.14 - 2.33)	0.007	1.02 (0.88 - 1.27)	0.131
Civilian	137	71.4	441	76.6	1		1	
Secondary Occupation								
With a secondary occupation	110	86.6	230	60.4	1.93 (1.19 - 2.47)	0.003	0.94 (0.73 - 1.19)	0.281
Without any secondary occupation	17	13.4	151	39.6	1		1	
Marital status								
In Union	116	60.4	349	60.6	1.05 (0.64 - 1.38)	0.081	1.01 (0.86 - 1.33)	0.968
Not in union	76	39.6	227	39.4	1		1	
Patient's situation regarding a pre-existing chronic disease								
With chronic disease	18	9.4	3	0.5	2.07 (1.54 - 3.61)	0.002	1.95 (1.24 - 2.41)	**0.018**
Absence of chronic disease	174	90.6	573	99.5	1		1	
Notion of mutation or recent travel for oneself								
Yes	60	31.2	67	11.6	1.58 (1.11 - 2.26)	0.013	1.40 (1.13 - 2.09)	**0.041**
No	132	68.8	509	88.4	1		1	
Notion of recent travel for a family member or neighbour								
No	149	77.6	390	67.7	1		1	
Yes	43	22.4	186	32.3	1.01 (0.58 - 1.15)	0.290	1.08 (0.92 - 1.80)	0.573
Physical contact with a case of Mpox								
Yes	124	64.6	92	16.0	4.11 (2.89 - 5.45)	0.000	3.92 (2.84 - 4.96)	**0.000**
No	68	35.4	484	84.0	1		1	
Sleeping in the same room as the Mpox patient								
No	61	31.8	284	49.3	1		1	
Yes	131	68.2	292	50.7	1.07 (0.68 – 1.37)	0.829	0.98 (0.56 – 1.24)	0.924
Sleeping in the same bed as the Mpox patient								
No	75	39.1	432	75.0	1		1	
Yes	117	60.9	144	25.0	1.62 (1.16 - 2.18)	0.006	1.53 (1.14 - 2.29)	**0.037**
Washing the clothes of a Mpox case								
No	88	45.8	475	82.5	1		1	
Yes	104	54.2	101	17.5	1.95 (1.27 - 2.81)	0.000	1.77 (1.32 - 2.98)	**0.002**
Wearing the clothes of a Mpox case								
No	83	43.2	481	83.5	1		1	
Yes	109	56.8	95	16.5	2.39 (1.66 - 3.72)	0.023	2.27 (1.55 - 3.69)	**0.044**

	Case		Control		OR (95% CI)	P	aOR (95% CI)	P
	n	%	n	%				
To give a kiss to a person sick with Mpox								
No	80	41.7	479	83.2	1		1	
Yes	112	58.3	97	16.8	2.73 (1.40 - 3.65)	0.0006	2.65 (1.46 - 3.73)	**0.009**
Eating/drinking from the same container with the case								
No	74	38.5	472	81.9	1		1	
Yes	118	61.5	104	18.1	1.68 (1.22 - 2.19)	0.000	1.66 (1.19 - 2.28)	**0.008**
Help the patient to eat								
No	75	39.1	477	82.8	1		1	
Yes	117	60.9	99	17.2	1.72 (1.10 - 2.58)	0.006	1.68 (1.13 - 2.60)	**0.009**
Help the patient to urinate/defecate								
No	73	38.0	478	83.0	1		1	
Yes	119	62.0	98	17.0	2.16 (1.33 - 3.46)	0.003	2.11 (1.47 - 3.34)	**0.008**
Sexual intercourse with a casual partner								
No	150	78.1	517	89.8	1		1	
Yes	42	21.9	59	10.2	3.90 (1.90 - 4.31)	0.004	3.41 (2.85 - 4.22)	**0.000**
Contact with sick or dead animals								
No	136	70.8	543	94.3	1		1	
Yes	56	29.2	33	5.7	1.63 (1.10 - 3.31)	0.022	1.54 (1.16 - 3.26)	**0.040**
Consumption of bushmeat								
No	93	48.4	274	47.6	1		1	
Yes	99	51.6	302	52.4	0.84 (0.74 - 1.35)	0.818	0.89 (0.68 - 1.37)	0.732

***OR** : Odds Ratio* ***aOR** : adjusted Odds Ratio* ***95% CI** : 95% Confidence Interval* ***p** : p-value*

The risk factors associated with the occurrence of the Mpox epidemic in the Kokolo Health Zone are the notion of mutation or recent travel for the respondent to an epidemic area (aOR=1.40; 95% CI: 1.13-2.09; p=0.041), the co-occurrence of Mpox with another chronic pathology (aOR=1.95; 95% CI: 1.24-2.41; p=0.018), physical contact with a case of Mpox (aOR=3.92; 95% CI: 2.84-4.96; p=0.000), sleeping in the same bed with the Mpox case (aOR=1.53; 95% CI: 1.14-2.29; p=0.037), washing the clothes of an Mpox case (aOR=1.77; 95% CI: 1.32-2.98; p=0.002), wearing the clothes of an Mpox case (aOR=2.27; 95% CI: 1.55-3.69; p=0.044), kissing the Mpox case (aOR=2.65; 95% CI: 1.46-3.73; p=0.009), eating/drinking from the same container as the Mpox case (aOR=1.66; 95% CI: 1.19-2.28; p=0.008), helping the patient to eat (aOR=1.68; 95% CI: 1.13-2.60; p=0.009), helping the patient to urinate/defecate (aOR=2.11; 95% CI: 1.47-3.34; p=0.008), having sexual intercourse with a casual partner (aOR=3.41; 95% CI: 2.85-4.22; p=0.000) and being in contact with sick or dead animals (aOR=1.54; 95% CI: 1.16-3.26; p=0.040).

4. Discussion

This study analyzed the factors of Mpox occurrence in the Kokolo Health Zone, by determining the sociodemographic characteristics, clinical manifestations, as well as the factors associated with the appearance of Mpox.

The results of this study show a male predominance among Mpox cases (60.9% compared to 39.1% women). This trend has been observed in several recent epidemic contexts, notably in Nigeria and previously in our country, the DRC, where it is attributed to a greater exposure of men, linked to sociocultural practices such as hunting and bush activities[16,17]. The high proportion of cases from urban areas (75.5%) contrasts with the studies of Ježek et al.[18] and Beer and Rao[19]. This can be explained by the fact that the city of Kinshasa, over which the Kokolo military health zone extends, is more urban than rural in terms of population presence.

The median age of 29 years observed among the cases indicates an increased impact on young people. This observation aligns with several recent previous studies where the cases mostly concerned children and young adults who were not beneficiaries of smallpox vaccination, which was discontinued in 1980, after the eradication of smallpox[18,20].

Clinically, the rash (99.5%), fever (95.3%), and physical fatigue (87.5%) were the most frequent symptoms, which is consistent with the literature describing the typical fever-rash sequence[21,22]. These results are also similar to those reported in previous outbreaks, where these signs were almost constant[18,23].

Regarding associations, several factors were significantly associated with Mpox transmission. The concept of recent mutation or travel appears as an important risk factor (aOR = 1.40; p = 0.041), suggesting that the mobility of military personnel and their dependents promote exposure to areas of active virus circulation. This observation aligns with the work of Besombes et al. (2019) in the Central African Republic, who had already demonstrated the role of inter-village movements in the spread of Mpox outbreaks[24].

Among interpersonal factors, direct physical contact proves to be the main determinant of transmission (aOR = 3.92; p < 0.001). This result is in line with those reported by Nakoune et al. (2017) in the CAR, by Muyembe et al. (2022) in the DRC, which confirm that the virus is mainly transmitted during close contact with a symptomatic patient[12,14,25]. There is also sexual intercourse with a casual partner, which proves to be a considerable risk factor for Mpox transmission (aOR = 3.41; p < 0.001), as well as having a pre-existing chronic condition (aOR = 1.95; p = 0.018). This result is similar to that of the study recently conducted in Kamituga (DRC), tracing sexual transmission of Mpox[26], also for the 2022 outbreak in Europe and North America, where sexual transmission was a key factor, and also to the study by Kengea et al. (2025) in the DRC mentioning cases of Mpox-HIV co-infection, also transmitted sexually for clades Ib and IIb[27-29]. Other close-contact practices such as sleeping in the same bed (aOR = 1.53; p = 0.037), giving a kiss (aOR = 2.65; p = 0.009), and sharing the same eating utensils (aOR = 1.66; p = 0.008) are also significant. These results reinforce the idea that close contacts, particularly within households, constitute privileged contexts of transmission, as shown by Hoff et al. (2022) in Nigeria[28,30].

Home care of patients also represents a major risk factor. Washing contaminated clothes (aOR = 1.77; p = 0.002) as well as wearing contaminated clothes (aOR = 2.27; p = 0.044), helping the patient to eat (aOR = 1.68; p = 0.009) or to urinate/defecate (aOR = 2.11; p = 0.008) are activities that expose one to infectious biological fluids. This observation aligns with the results of Vakaniaki et al. (2022) in the Kamituga health zone, where home care was identified as practices highly contributing to human-to-human transmission[26].

On the other hand, some variables do not show a statistically significant association, notably the concept of a recent trip by a family member or neighbor (aOR = 1.08; p = 0.573) or even sleeping in the same room as the Mpox patient (aOR = 0.98; p = 0.924). Finally, zoonotic transmission remains present, although less predominant. Contact with sick or dead animals (aOR = 1.54; p = 0.040) shows a statistically significant association, whereas the consumption of bushmeat (aOR = 0.89; p = 0.732) does not. These results corroborate those of Kalthan et al. (2018), who had shown that handling infected game constitutes a potential source of human contamination[30]. Cooking the meat could explain the absence of a link between consumption and infection, unlike prior handling of the carcasses. Although human-to-human transmission predominates, the study shows that contact with sick or dead animals remains a significant factor (aOR = 1.54). This confirms that Mpox maintains a dual dynamic, human-to-human, now predominant, and zoonotic, still active in certain areas. This duality complicates disease control, as it requires integrated One Health-type strategies.

Overall, our results confirm the predominance of domestic and sexual human-to-human transmission, while emphasizing that zoonotic transmission persists through contact with wild animals.

The results call for strengthening, community communication (raising awareness about transmission modes, the importance of isolation, early recognition of symptoms, epidemiological surveillance (rapid detection of family clusters, contact tracing), access to care (reducing consultation delays, early management) and targeted interventions in military settings, where close contact and mobility can amplify transmission.

LIMITS AND STRENGTHS

We acknowledge certain limitations, including memory bias regarding some information on risky practices (sleeping in the same bed, consuming bushmeat), which may have been underreported or misremembered, particularly among the controls, potentially influencing the association estimates. Also, selection bias with the inclusion of controls sometimes from the immediate households of the cases, which may not fully reflect the general population. In this study, we note several strengths, including the large sample size of 768 participants, with three controls per case, distributed across all HAs of the HZ, which increases statistical robustness and representativeness for these areas. The direct collection of data in the field by regular nurses as surveyors, well-known in the community and having physically located the cases and conducted face-to-face interviews, thus improving data quality. The biological confirmation of cases using PCR to confirm Mpox, reducing the risk of including false positives. The consideration of military contexts constrained to operations in areas with particular sociocultural practices and contact with wildlife, allowing a comprehensive approach to transmission. The rigorous survey methodology, including the pretesting of the questionnaire and follow-up of data using KoboCollect, the anonymization of data and quality control, enhancing the reliability of the information collected.

Conclusion

This case-control study conducted between January and December 2025 in the Kokolo military health zone made it possible to characterize the epidemiological profiles and the determinants of Mpox transmission in the context of an outbreak in the military setting in Kinshasa, Democratic Republic of the Congo. The analysis showed a predominance of young males. The most common clinical manifestations remained rash, fever, and physical asthenia, consistent with historical data of the disease. Epidemiologically, direct physical contact, having a pre-existing chronic condition, a history of mutation or recent travel, sleeping in the same bed, giving a kiss, sharing the same eating utensils, washing or wearing the clothes of a Mpox case, having sexual intercourse with a casual partner, helping a case of Mpox to urinate/defecate or to eat, as well as contact with sick animals or those found dead, were found to be the main factors associated with the occurrence of Mpox cases. Furthermore, the absence of a significant association was observed for the notion of recent travel by a family member or neighbor, sleeping in the same room as a person with Mpox, and consumption of bushmeat. These results lead to several operational implications. First, strengthening risk communication and community engagement to reduce close contact with patients. Next, improving access to care and community-based surveillance in urban areas. Finally, strengthening the capacity of healthcare personnel remains essential for early detection and adequate management of cases. From

a scientific standpoint, taking into account the One Health Approach, understanding the interactions between socio-economic determinants and environmental transmission within the framework of military operations will be crucial for designing effective control strategies, possibly including targeted vaccination options.

Contributors: AMISI KENGEA Levis and KIULA NTETE Eloi conceptualised the study. AMISI KENGEA Levis, MASAMBA BIKOKI Winnie and NDUMBI TEMUANGUDI Vallhy were responsible for literature and data acquisition. AMISI KENGEA Levis, KIULA NTETE Eloi and MASAMBA BIKOKI Winnie contributed to the literature review, analysis and data interpretation. AMISI KENGEA Levis, KIULA NTETE Eloi, MASAMBA BIKOKI Winnie and NDUMBI TEMUANGUDI Vallhy drafted the initial manuscript. AMISI KENGEA Levis, MASAMBA BIKOKI Winnie and KIULA NTETE Eloi developed the second draft. All authors contributed to the final version of the manuscript, approved the final draft, and agreed to be accountable for all aspects of the work.

Declaration of interests: No conflict of interest.

Acknowledgements: We sincerely thank participants, authorities and all those who provided guidance, feedback, and support during the preparation of this paper. Their contributions greatly helped to improve the quality of this work. Role of funding: No funding was received for this article.

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