Nigerian Journal of Health Promotion
ISSN: 0995-3895
HEPRAN
Vol 18, No2, 2025

Temporal and Spatial Epidemiology of Monkey Pox (*Mpox*): A Case Study of Plateau State, Nigeria in 2022

Solomon Barnabas Butswat[1], James Iliya Kyamru[1*], Abubakar Sadiq Garba[2]

[1]College of Nursing Sciences, Abubakar Tafawa Balewa University Teaching Hospital, Bauchi
State, Nigeria

[2]College of Nursing Sciences, Abubakar Tafawa Balewa University Teaching Hospital, Bauchi
State, Nigeria
*Corresponding author: James Iliya Kyamru, PhD; E-mail: jamesiliye@yahoo.com

Abstract

The re-emergence of monkey pox virus has become a global public health concern, prompting the World Health Organization to declare it a public health emergency. This study investigated the cumulative incidence of monkey pox in Plateau State, Nigeria, examining transmission routes and enabling factors, thereby providing policy makers and public health professionals the necessary epidemiological data to prevent future incidence cases as well as mitigate the current prevalence of monkey pox virus. Surveillance data were obtained from the Plateau State Ministry of Health across all 17 Local Government Areas (LGAs) for the period January to December 2022. Using the Integrated Disease Surveillance and Response (IDSR) reporting system for immediate case notification, all monkey pox cases (both suspected and confirmed) were captured from reporting health facilities. Data collected included epidemiological case numbers, patient demographics (age and sex), reporting health facility details, geographic location (ward and LGA), dates of symptom onset and reporting, case classification status, clinical outcomes, and presenting symptoms. Descriptive statistics including frequencies and proportions were calculated, with results presented through tables, charts, and maps using the R version 4.5.2 software. Between January and December 2022, 118 suspected mpox cases were reported, of which 16 (13.6%) tested positive. The confirmed cases were distributed across six LGAs: Jos North (62.50%), Jos South (12.50%), Bassa (6.25%), Shendam (6.25%), Mangu (6.25%), and Pankshin (6.25%). The overall incidence rate was 2.6 per 100,000 population with a case fatality rate of 0%. The male-to-female ratio was 1.1:1, with the 0-19 years age group most affected. September recorded the highest number of cases. Monkey pox remains a public health concern in Plateau State. Enhanced surveillance systems and community engagement are crucial for early detection and containment. Access to vaccines and treatments may reduce morbidity and mortality in affected areas, particularly in Plateau State.

Keywords: Monkey pox (Mpox) virus, Epidemiology, Plateau State

Introduction

Monkey pox (Mpox) is an uncommon viral disease that primarily affects humans and animals' endemic in Western and Central Africa. However new observations have been made in other regions (WHO, 2023). It presented as a small pox-like disease with symptoms such as chills and fever together with rash (Ranjan & Biswal, 2022) while the first human case was in a 9-month child in September, 1970 in Democratic Republic of Congo (Mileto et al., 2022). The virus is spread from animals to Persons, and then from humans to humans, where

it manifests clinically as a vesiculopustular rash and fever that resembles other common infections. Mpox was detected for the first time in Equateur Province of Zaire (present-day the Democratic Republic of the Congo) in 1970, with numerous instances reported throughout Central and Western Africa (Center for Disease Control and Prevention [CDC], 2025). It was reported that since 2022 the continent hasrecorded 37,500-45,600 cases and 1,450-1,500 deaths, giving a case-fatality rate (CFR) of (3-4%) (African- CDC, 2024) . Furthermore, in the first half of 2024 (up to 28 July) there were 14, 250 cases (2,745confirmed) and 456 deaths (CFR=3.2%) across ten countries. This represents a (160%) increase in cases and a (19%) rise in heaths compared with the same period in 2023 (Africa-CDC, 2024). Data from the WHO African Region showed that (55%) of cases are male and (45%) female, with children under 5 years making up (29%) of cases (WHO, 2024). This means the disease affect all category of human being.

Monkey pox is a zoonotic orthopox virus with a similar illness presentation to human smallpox, with lymphadenopathy being the distinguishing sign. Following an initial febrile prodrome, a maculopapular rash with lesions on the palms of the hands and soles of the feet typically develops. The illness can last up to four weeks, until crusts fall off and a new skin layer form. Secondary bacterial infections, respiratory distress, bronchopneumonia, gastrointestinal involvement, dehydration, encephalitis, and ocular infections, which can cause irreversible corneal scarring, are among the complications. There is presently no specific treatment for Mpox infection, and patients are handled with supportive care and symptomatic medication. The case fatality rate for Persons who have not been vaccinated against smallpox, (which provides cross-protection) is (11%) (Liu et al., 2024). Transmission between humans happens via respiratory droplets and contact with lesions containing the virus (Christodoulidou & Mabbott, 2023). The World Health Organization (WHO) states that there does not appear to be any evidence of human-to-animal transmission at this time; however, this observation may be the result of chance rather than the dynamics of virus transmission. Unlike the human-only variola virus, mpox virus is promiscuous and can infect a variety of animals (Alakunle et al., 2020). The CDC recommends isolation in a negative-pressure chamber, standard contact tracing, and droplet precautions, and if possible, airborne precautions in healthcare settings.

Recent research has revealed that bodily fluids such as urine, saliva, sperm, and faeces, as well as in swabs taken from the oropharynx and rectum contain a high load of the causative organism.

Temporal epidemiology of monkey pox, otherwise referred to as T-patterns as the name implies relates to time as opposed to permanent. Temporal epidemiology on the other hand, is connected to things with the real physical world and or limited by time. These things could be physical challenges that could serve as impediments for healthy living that happens at a giving period and at a particular time. Temporal pattern provide significant advantages over traditional sequence analyses by incorporating time (Yuyu et al., 2017). Temporal epidemiology according to Yuyu, et al. (2017) relates to variables such as seasons, months, days-of-the week (Fridays, Saturdays) time of day (mornings; afternoons; evenings; day and night), public holidays (Easter, Christmas, Sallah), National day celebrations (October 1) and National general election days. In this work, the temporal epidemiology will mean epidemiology that focuses on the time-related dimensions of disease occurrence, including how diseases spread over time, the timing of exposures in relation to disease onset, and shifts in disease patterns across various time scales. It examines how the timing of an exposure influences the development of a disease, often relying on data collected over defined periods, such as tracking an Mpox outbreak over multiple years.

Kyamru and Nji (2015) posited that the epidemiology of Mpox varies across geographic regions, depending on whether a location is urban or rural within a particular country. They

further explained that spatial patterns of Mpox involve the co-variation of disease-related characteristics across geographic space, where nearby locations tend to exhibit either positive or negative correlations. In this work, therefore, the spatial pattern or variation refers to the Epidemiology of Mpox according to location (home, street, and public gathering based on age) around Plateau State in general.

Plateau State is home to both wild and domestic animals due to the geomorphic nature of its habitat. As an animal-transmitted virus, Mpox poses a danger of spread in the state. Therefore, surveillance of the geographical epidemiology of Mpox in the state of Plateau will go a long way to help improve control of this disease.

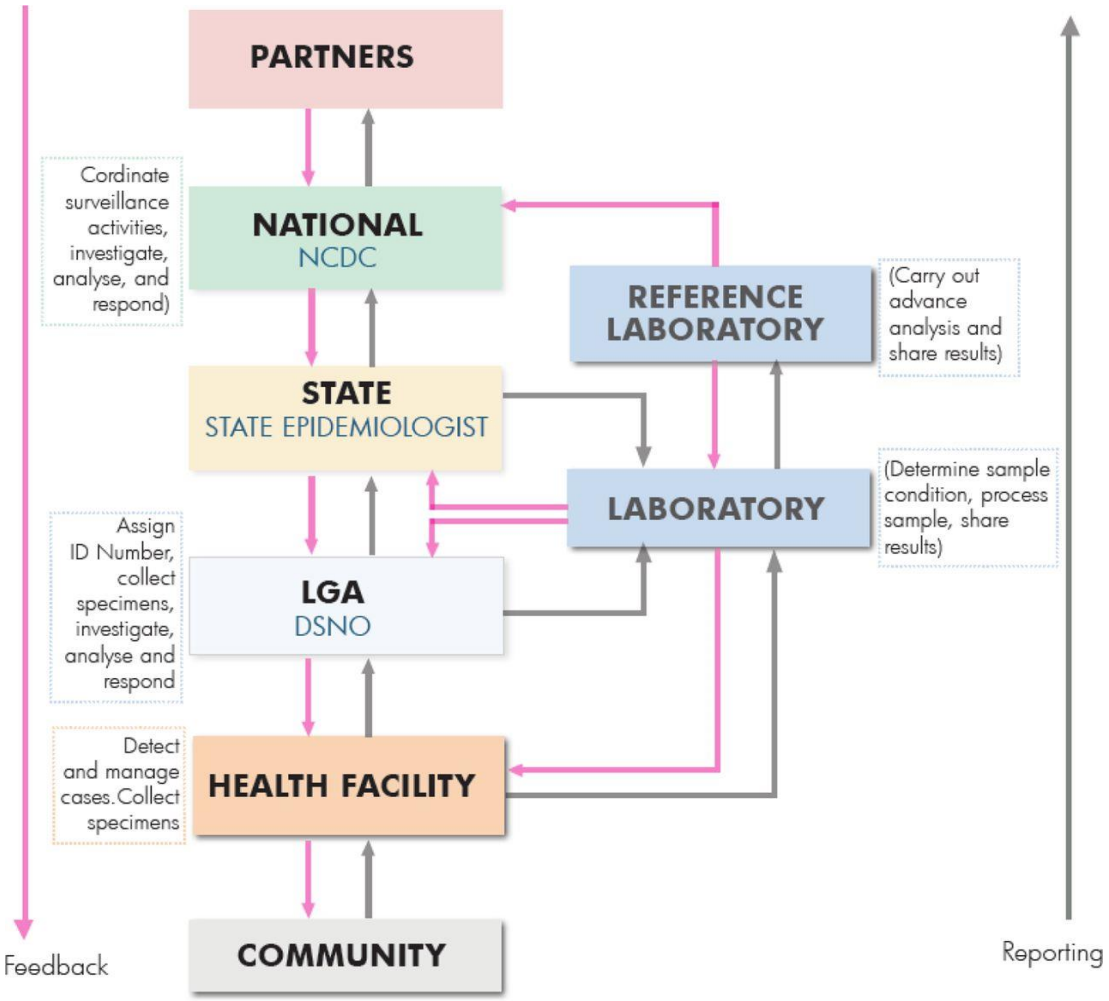
This study is aimed at understanding the epidemiological distribution of mpox in Plateau State and identifiy possible factors that can influence and prolong the sustenance of the mpox virus amongst humans. This is important so that elimination process can be initiated. Objectively, the study determined the incidence of Mpox in the 17 LGAs of Plateau State, described Mpox hot-spots in Plateau State, as well as ascertained the most affected gender and age group in Plateau State that are mostly affected by Mpox in 2022.

Methods

From January 2022 through December 2022, a secondary data analysis of mpox data from the Surveillance Outbreak Response Management and Analysis System (SORMAS) platform was conducted to assess the epidemiological characteristics and transmission dynamics of mpox cases in Plateau State.

The SORMAS is an electronic application adopted by the Nigeria Centre for Disease Control and Prevention (NCDC) for the digital implementation of the Integrated Disease Surveillance and Response. It is used for rapid collection, reporting and analysis of disease/events data in real-time for appropriate public health action.

Data flow/reporting system using IDSR



Area of the study

The study area is Plateau State, located in North central region of Nigeria.

Target Population

The study population for this secondary data analysis of mpox in Plateau State is all the reported cases from January 2022- December 2022. Variables analyzed include Epidemiological number, Age, Sex, LGA, Ward, health facility visited, Symptoms. All reported cases of mpox in the archive of the State Disease Surveillance and Notification Officer (DSNO) was used for this study. A total of 118 cases were extracted from the database.

Data Collection

Data was extracted from the Surveillance Outbreak Response Management and Analysis System (SORMAS) platform, which contains an archive of all reported cases that is in the

possession of the State Disease Surveillance and Notification Officer (DSNO). Using a standardized data extraction form, the variables extracted included age, sex, number of cases, reporting district, date of onset, vaccine doses received, the date the sample was collected and sent to the laboratory, laboratory results, and the result obtained.

Age was categorized into 0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69 and 70 and above. Sex was classified as male or female. The number of cases was defined as the number of suspected and confirmed mpox cases reported in each reporting LGA.

Data Visualization and Analysis

Data from SORMAS were extracted on Microsoft Excel sheet and then sorted and cleaned. Any errors or discrepancies were corrected by cross-checking with the original database. Epidemiologically related data analysis was done using the Epi Info version 7.0. Frequencies and proportions were calculated for each variable.

Risk factors for mpox was identified by calculating odds ratios (OR) and (95%) confidence intervals (CI) using logistic regression analysis. Variables with a p-value of less than 0.05 in univariate analysis were included in multivariate analysis to identify predictors for mpox infection. The geographical distribution of the cases was analyzed using QGIS. Descriptive statistics such as mean, standard deviation, median, and interquartile range was calculated for continuous variables such as age. The chi-square test was used to test for associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

All data was kept confidential and anonymous by excluding personal identifiable information from the analysis, such as name and address. Data were stored in a separate folder on a password-protected computer.

Results

A total of 118 cases were reported across 14 LGAs. There are 16 confirmed cases. Incidence rate is 2.6 per 100,000 population and the case fatality rate is (0%).

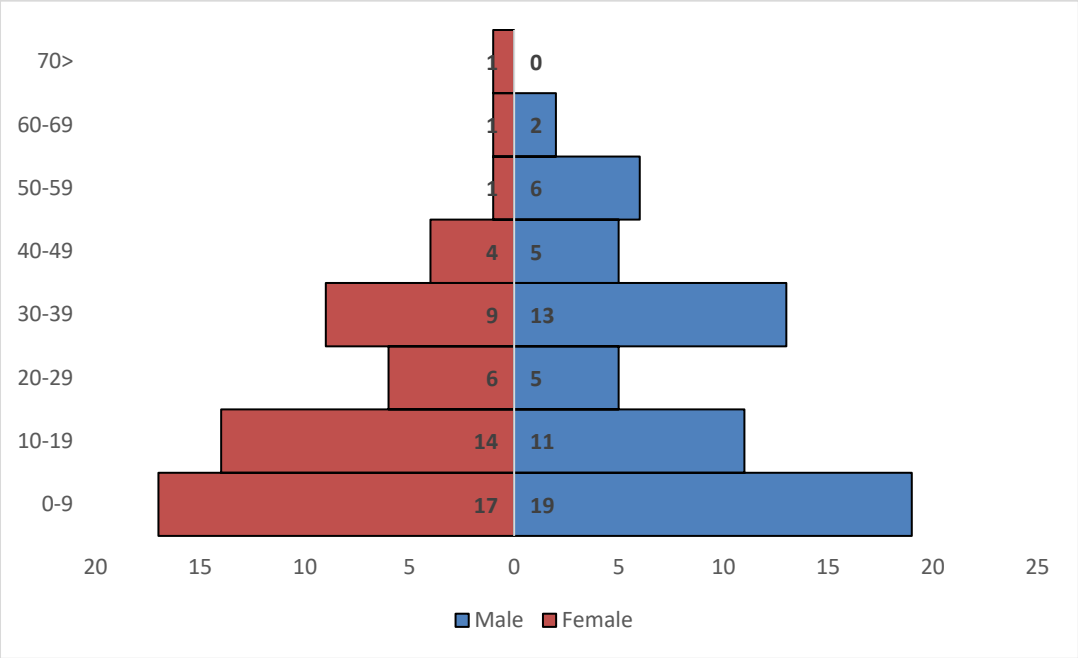
Table 1: **Socio-demographic Characteristics of Mpox cases in Plateau State**

Socio-demographic characteristics	**Frequency (N=118)**	**Percentage (%)**
Age		
0-9	36	30.5
10-19	25	21.2
20-29	11	9.3
30-39	22	18.6
40-49	9	7.6
50-59	7	5.9
60-69	3	2.5
70≥	1	0.8

Missing	4	3.4
Sex		
Male	63	53.4
Female	55	46.6

Above shows the age-sex distribution of Mpox cases in Plateau state among the 14 LGAs that have reported mpox cases (suspected and confirmed)

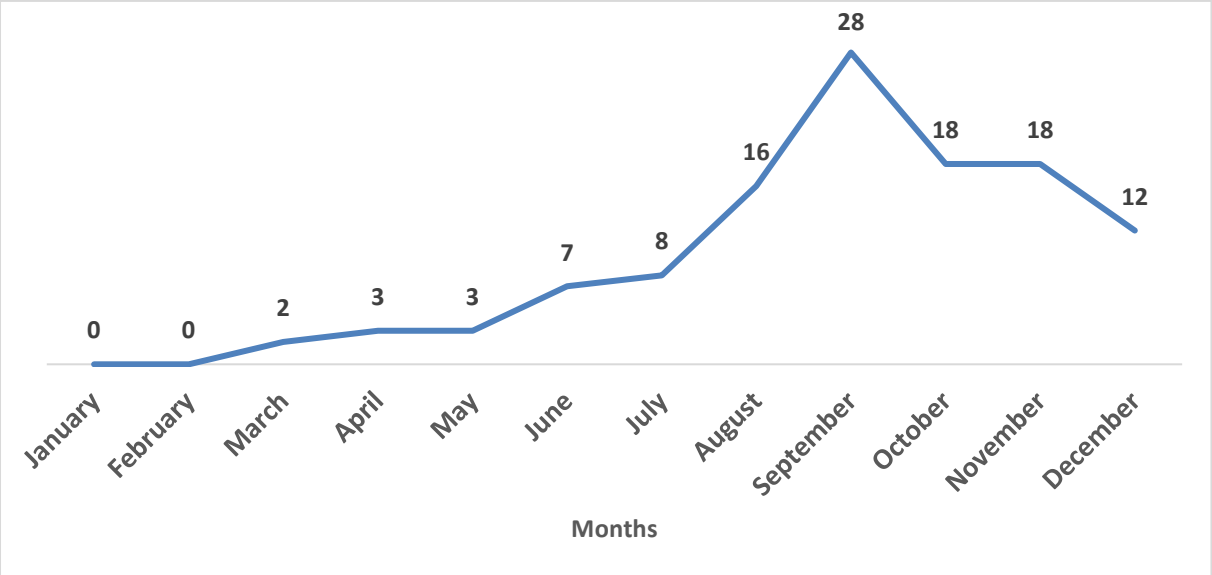
Figure 1: Distribution of Mpox cases across the affected LGAs in Plateau State. 2022



Source: R version 4.5.2

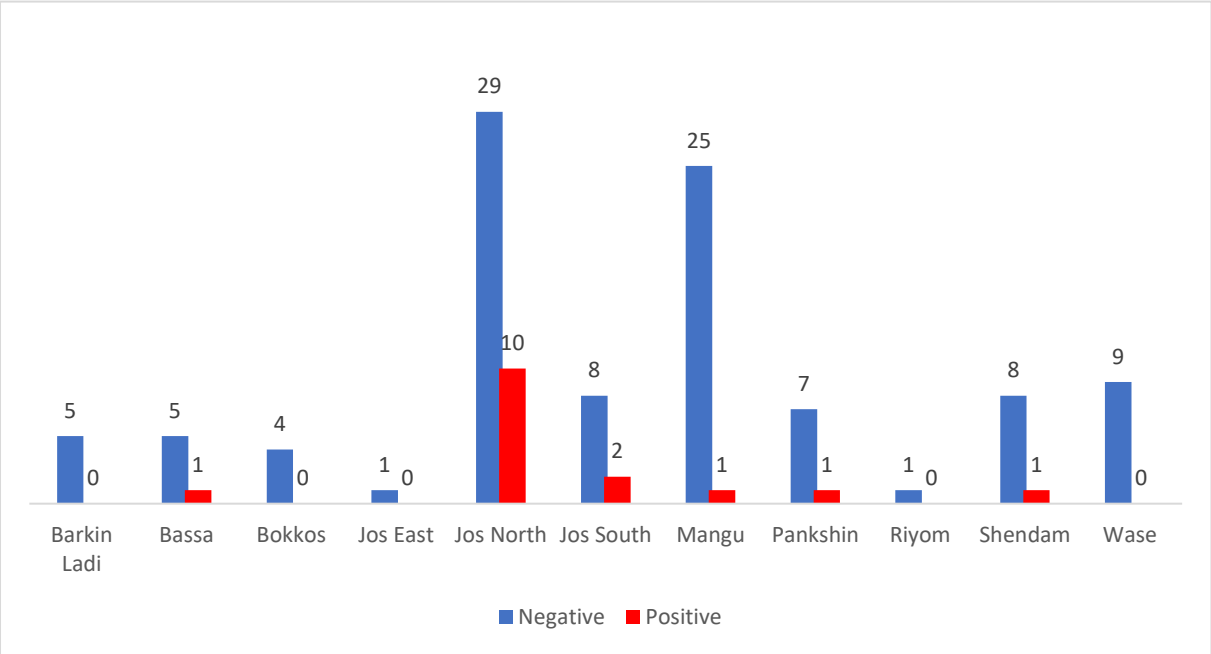
Mpox cases reported in all the LGAs with the highest reported in Jos North followed by Mangu then Jos South.

Figure 2: Trend of reported mpox cases across the months of the year 2022 in Plateau State Nigeria



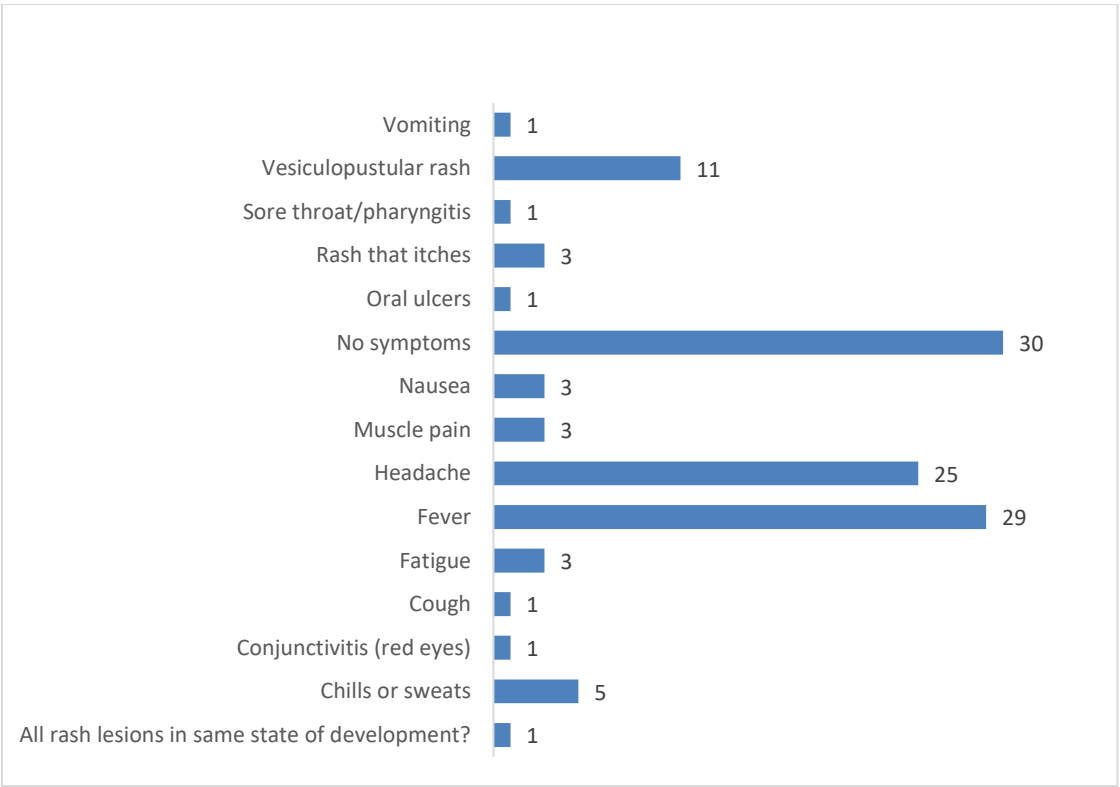
The trend of mpox cases based on the month of onset is displayed in figure above with 2 cases reported in the month of March and a spike in the month of September

Figure 3: Distribution of mpox cases across the affected LGAs in Plateau State by laboratory results. 2022



Above depicts the distribution of confirmed cases among the 118 suspected cases for which samples were collected and sent to the laboratory for each of the LGAs. A total of 16 positive samples were recorded. Positivity rate is 16/118 (13.6%).

Figure 4: Distribution of reported first symptoms among all the Mpox cases



The mpox cases reported first symptoms out of which (25%) (30/118) had no symptoms. Among those who reported symptoms, fever was the highest, followed by headache then vesiculopustular rash.

Discussion

The study examined the timing and geographical distribution of monkeypox cases in Plateau State, Nigeria, during the 2022 outbreak. The findings reveal important patterns that improve the understanding of disease transmission and inform public health strategies in the region.

A total of 118 suspected cases were documented, with 16 confirmed through laboratory testing, resulting in a positivity rate of (13.6%) and an overall incidence rate of 2.6 per 100,000 individuals. This incidence rate is relatively low compared to other areas affected during the 2022 global outbreak, possibly indicating effective early containment measures or underreporting due to surveillance challenges. Confirmed cases were spread across six local LGAs, with Jos North accounting for (62.50%) of the cases, suggesting significant spatial clustering. This urban concentration aligns with transmission patterns observed in major towns in the Democratic Republic (DRC) which reveals overwhelmingly driven (African-CDC, 2024) elsewhere, where high population density, increased human interaction, and mobility facilitate disease spread. The urban characteristics of Jos North, being the state capital and a commercial hub, likely contributed to higher transmission rates through increased interpersonal interactions in markets, religious gatherings, and healthcare settings. The lower case numbers in rural LGAs such as Bassa, Shendam, Mangu, and Pankshin might indicate either reduced transmission or limited surveillance in these regions.

The temporal pattern showed an increase in cases in September 2022, corresponding with the global rise in mpox cases in mid-2022, suggesting that community transmission was established by the third quarter of the year. The initial cases reported in March suggest early importation or zoonotic spillover, followed by human-to-human transmission chains. The absence of cases in several months may reflect either successful containment efforts or delays in case detection and reporting. The age distribution shows that the 0-19 years age group was most affected, with the 0-9 years category comprising (30.5%) of cases and the 10-19 years category making up (21.2%). This pattern differs from the 2022 global outbreak, where cases were mainly among adults aged 18-44 years. On age distribution, the study disagrees with work by Antinori et al. (2022) who also found that in the global outbreak, (98%) of infections occurred men with a median age of 38 years. This also disagrees with U.S. CDC data (2022) that showed (99%) of cases occurred in men with a median age reflecting adult populations. On the other hand, the work agrees with Bunge et al. (2022) documented that median age at presentation increased from 4 years in the 1970s to 21 years in 2010-2019.

The higher burden among children in Plateau State may suggest household transmission, close contact during play, or potential zoonotic exposure through animal contact. This finding warrants particular attention as children may be more susceptible to severe outcomes and complications from mpox infection.

The male-to-female ratio of 1.1:1 indicates a relatively equal distribution between sexes, contrasting with the male predominance observed in many other settings (include; Jos North, Jos south, Bassa, Mangu and Pankshin) during the 2022 outbreak. This near-equal distribution suggests that transmission patterns in Plateau State may involve household and community spread rather than being concentrated in specific risk groups. Clinical presentation data revealed that (25%) of reported cases were asymptomatic or had no documented symptoms at the time of reporting. Among symptomatic cases, fever was the most common presenting symptom, followed by headache and vesiculopustular rash. This symptom profile is consistent with classical mpox presentation, though the proportion of

asymptomatic or mildly symptomatic cases highlights challenges in case detection and the potential for unrecognized transmission chains.

The study findings underscore several challenges in mpox surveillance and control in Plateau State. The 13.6% laboratory confirmation rate among suspected cases indicates potential over reporting based on clinical suspicion alone, emphasizing the need for improved case definitions and diagnostic capacity. Additionally, the geographic clustering of cases suggests opportunities for targeted interventions in high-burden areas while strengthening surveillance in underrepresented local LGAs.

Conclusion

Monkey pox remains a public health concern in Plateau State, with distinct temporal and spatial patterns observed during 2022. The concentration of cases in urban areas, particularly Jos North, the predominance of cases among children and adolescents, and the seasonal spike in September highlights the need for tailored prevention and control strategies for this disease. The low overall incidence and zero case fatality rates are encouraging; however, the identification of transmission hotspots and the substantial proportion of laboratory-unconfirmed cases reveal gaps in surveillance and diagnostic capacity.

The study provides baseline epidemiological data essential for evidence-based public health planning and resource allocation. Understanding these patterns enables health authorities to implement targeted interventions in high-risk areas and among high-risk populations. The findings demonstrate that although Plateau State experienced a relatively contained outbreak compared to global trends, vigilance and strengthened surveillance systems remain critical for preventing future resurgences.

The near-equal sex distribution and high burden among younger age groups suggest community-wide transmission dynamics that differ from those observed in other regions, necessitating context-specific public health responses. Enhanced community engagement, improved laboratory diagnostic capacity, and sustained surveillance efforts are fundamental for controlling mpox transmission in Plateau State.

In respect to the public health response to Mpox, it is recommended that enhancing early case detection by communicating risks to those at higher risk and disseminating effective public health messaging. Delivering information to the general public and the majority of at-risk individuals, including mass-gathering event organizers, requires the implementation of effective risk communication and community engagement initiatives.

Providing and strengthening the diagnostic capacity of Nigeria will help to curb and identify newer mpox strains. Finally, preventing the spread of the infection by isolating cases and timely tracking of identified contact

References

African- Centre for disease Control. (2024). *Outbreak Reports*. Africacdc.org

Alakunle, E., Moens, U., Nchinda, G., & Okeke, M. I. (2020). Monkeypox Virus in Nigeria: *Infection Biology, Epidemiology, and Evolution. Viruses, 12*(11). https://doi.org/10.3390/V12111257

Antinori, A., John, P. T., Saph,a B., Sharon, W., Juergen R., , Luke B. H., & Romain, P. (2022). Monkeypox Virus Infection in Humans across 16 Countries. *The New England Journal of Medicine*: *387,* 679-691. doi:10.1056/NEJMoa2207323

Bunge, E. M., Hoet, B., Chen, L., Lienert, F., Weidenthaler, H., Baer, L. R., & Steffen, R. (2022). The changing epidemiology of human monkeypox-A potential threat? A systematic review. *PLoS Neglected Tropical Diseases*, *16*(2), e0010141. https://doi.org/10.1371/journal.pntd.0010141

Christodoulidou, M. M., & Mabbott, N. A. (2023). Efficacy of smallpox vaccines against Mpox infections in humans. *Immunotherapy Advances*, *3*(1), ltad020. https://doi.org/10.1093/immadv/ltad020

Centre for Disease Control and Prevention. (2025). *About Monkeypox*. https://www.cdc.gov/monkeypox/about/index.html#:~:text=Discovery%20and%20history,regions%20where%20monkeypox%20is%20endemic.

Costello, V., Sowash, M., Gaur, A., Cardis, M., Pasieka, H., Wortmann, G., & Ramdeen, S. (2022). Imported Monkeypox from International Traveler, Maryland, USA, 2021. Emerging Infectious Diseases, *28*(5), 1002. https://doi.org/10.3201/EID2805.220292

Du, M., Sun, H., Zhang, S., Yuan, J., Yan, W., Liu, Q., Qin, C., Liu, M., & Liu, J. (2023). Global Epidemiological Features of Human Monkeypox Cases and Their Associations With Social-Economic Level and International Travel Arrivals: A Systematic Review and Ecological Study. *International Journal of Public Health, 68*. https://doi.org/10.3389/ijph.2023.1605426

El Eid, R., Allaw, F., Haddad, S. F., & Kanj, S. S. (2022). Human monkeypox: A review of the literature. PLOS Pathogens, *18*(9), e1010768. https://doi.org/10.1371/JOURNAL.PPAT.1010768

Islam, M. R., Nowshin, D. T., Khan, M. R., Shahriar, M., & Bhuiyan, M. A. (2023). Monkeypox and sex: Sexual orientations and encounters are key factors to consider. *Health Science Reports, 6*(1). https://doi.org/10.1002/HSR2.1069

Kyamru, J. I , & Nji, G. C. (2015). Spatial Pattern of Elder Abuse of Retired Army Officers and Men in Bauchi South Senatorial District, Bauchi State, Nigeria: Implication for Teacher Education. *Review of Education Institute of Education Journal, University of Nigeria, Nsukka*

Li, H., Zhang, H., Ding, K., Wang, X. H., Sun, G. Y., Liu, Z. X., & Luo, Y. (2022). The evolving epidemiology of monkeypox virus. *Cytokine & Growth Factor Reviews, 68*, 1. https://doi.org/10.1016/J.CYTOGFR.2022.10.002

Lum, F. M., Torres-Ruesta, A., Tay, M. Z., Lin, R. T. P., Lye, D. C., Rénia, L., & Ng, L. F. P. (2022). Monkeypox: disease epidemiology, host immunity and clinical interventions. *Nature Reviews Immunology, 22*(10), 597–613. https://doi.org/10.1038/s41577-022-00775-4

Mileto, D., Riva, A., Cutrera, M., Moschese, D., Mancon, A., Meroni, L., Giacomelli, A., Bestetti, G., Rizzardini, G., Gismondo, M. R., & Antinori, S. (2022). New challenges in human monkeypox outside Africa: A review and case report from Italy. *Travel Medicine and Infectious Disease, 49*, 102386. https://doi.org/10.1016/J.TMAID.2022.102386

Ranjan, R., & Biswal, J. K. (2022). Monkeypox: Re-Emerging Zoonotic Threat. *Zoonotic Diseases, 2*(4), 234–246. https://doi.org/10.3390/zoonoticdis2040019

Rao, A. K., Schulte, J., Chen, T.-H., Hughes, C. M., Davidson, W., Neff, J. M., Markarian, M., Delea, K. C., Wada, S., Liddell, A., Alexander, S., Sunshine, B., Huang, P., Honza, H. T., Rey, A., Monroe, B., Doty, J., Christensen, B., Delaney, L., … Nolen, L. D. (2022). Monkeypox in a Traveler Returning from Nigeria — Dallas, Texas, July 2021. *MMWR. Morbidity and Mortality Weekly Report, 71*(14), 509–516. https://doi.org/10.15585/MMWR.MM7114A1

Stephen, R., Alele, F., Olumoh, J., Tyndall, J., Okeke, M. I., & Adegboye, O. (2022). The epidemiological trend of monkeypox and monkeypox-varicella zoster viruses co-infection in North-Eastern Nigeria. *Frontiers in Public Health, 10*, 1066589. https://doi.org/10.3389/FPUBH.2022.1066589/BIBTEX

Suárez Rodríguez, B., Guzmán Herrador, B. R., Díaz Franco, A., Sánchez-Seco Fariñas, M. P., Del Amo Valero, J., Aginagalde Llorente, A. H., de Agreda, J. P. A. P., Malonda, R. C., Castrillejo, D., Chirlaque López, M. D., Chong Chong, E. J., Balbuena, S. F., García, V. G., García-Cenoz, M., Hernández, L. G., Montalbán, E. G., Carril, F. G., Cortijo, T. G., Bueno, S. J., & Sierra Moros, M. J. (2022). Epidemiologic Features and control measures during Monkeypox Outbreak, Spain, June 2022. *Emerging Infectious Diseases, 28*(9), 1847–1851. https://doi.org/10.3201/EID2809.221051

Liu, H., Wang, W., Zhang, Y., Wang, F., Duan, J., Huang, T., & Zhang, T. (2024). Global perspectives on smallpox vaccine against monkeypox: a comprehensive meta-analysis and systematic review of effectiveness, protection, safety and cross-immunogenicity. *Emerging Microbes & Infections*, *13*(1). https://doi.org/10.1080/22221751.2024.2387442

WHO. (2023). *Mpox (monkeypox)*. https://www.who.int/news-room/questions-and-answers/item/monkeypox?gclid=CjwKCAjwloynBhBbEiwAGY25dKlk5dRiCagtZ5a-0lRo2mradr1QLfaDOliBDM2sDv7Suku96XkYUhoCmzwQAvD_BwE

WHO. (2024). *WHO African Regional Situation updates*. who.int

Yuyu, B. M; Kyamru, J. I., & Ezedum, C. E. (2017). Temporal Pattern of Emotional Abuse Among Retired Officers And Men in Bauchi South Senatorial District, Bauchi State. *International Journal of Health And Pharmaceutical Research* . 3(3) 47-56.