

Spatial and Epidemiological Aspects of Monkeypox (MPX) in Rio Grande do Sul

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Keywords

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Abstract

This study analyzes the prevalence and spatial aspects of Monkeypox (MPX) in Rio Grande do Sul, considering the public health emergency declared by the World Health Organization in July 2022 and its relation to the high incidence of the disease in gay men and other men who have sex with men (MSM). Data were provided by the Rio Grande do Sul State Health Department via the Access to Information Law and revealed an incidence rate 53 times higher in MSM populations compared to heterosexual people and 48 times higher compared to bisexual people. In addition, MPX disproportionately affects Black and Brown people, with an incidence rate three times higher than the White population. Spatial analysis of the disease demonstrated its concentration in metropolitan areas. It is suggested that disseminating evidence-based information is essential to avoid stigmatization of these groups and that ring vaccination is crucial to prevent the endemic spread of the disease. It is concluded that Black and Brown gay men and MSM are at the highest risk for MPX, and preventive actions should be implemented to protect these vulnerable groups, avoid disease spread and ensure health equity.

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INTRODUCTION

The Monkeypox virus (MPX) belongs to the Poxviridae family and was identified in the 1960s circulating widely among rodents and non-human primates in Western and Central Africa (SHCHELKUNOV *et al.*, 2002). However, the scientific record of the first case in humans dates from the 1970s, when it was contracted by a nine-year-old girl from the Republic of Congo; it is considered a zoonosis with symptoms similar to smallpox (JEZEK *et al.*, 1983).

Since then, the spatial circulation of the virus in Africa has increased due to human interventions motivated by socioeconomic transformations and the resulting environmental degradation and urbanization processes in natural areas (MANDJA *et al.*, 2002; PARKER *et al.*, 2007). It should be noted that, during the nearly fifty-year period, despite the increase in cases—including human-to-human viral transmission—the international community showed limited scientific interest while the endemicity was restricted to African regions. This situation of structural racism was reinforced by failures that encompassed communication, research funding, vaccine production, and epidemiological surveillance strategies (ROTHENBURG *et al.*, 2022).

On the other hand, in 2003, the high number of MPX cases in Western countries drew the attention of the international scientific community. The investigation of the cases identified a high probability of human transmission related to a shipment of over eight hundred exotic animals brought to the United States from Ghana (LIGON, 2004).

Since then, the World Health Organization (WHO) has been monitoring the limited spread of cases among countries until July 23, 2022, when the total number of records reached 16,000 in 75 countries, mainly in high-income countries. That change and the uncertainty regarding how the disease is transmitted led to the MPX outbreak being declared a public health emergency and international concern (WHO, 2022). That was the seventh time the WHO issued such a declaration, joining the occurrences of H1N1 influenza (2009), polio (2014), Ebola (2014 and 2019), Zika (2016), and COVID-19 (2020).

The outbreak of the MPX epidemic caused a sense of *déjà vu* among the community of male individuals who are sexually attracted towards the same or both genders, as well as men who have sex with men (MSM). Similar to what happened during the HIV/AIDS epidemic, which emerged in the summer of 1981 in the Northern

Hemisphere, MPX directly impacted this population. Although the disease has been spreading in Africa, there is a tendency towards endemicity among gay, bisexual, and MSM men in Europe, the United States (GONSALVES *et al.*, 2022), and Brazil.

The arrival of cases in Europe in 2022 led to rapid scientific production. The initial articles published pointed out a similar epidemiological profile among affected individuals. In London, they referred to young adults who self-identified as gay or bisexual or whose sexual behavior fell into the MSM category (UKHSA, 2022; VIVANCOS *et al.*, 2022). In Spain, between April and June 2022, described as one of the most critical moments outside Africa, over 508 confirmed cases were reported predominantly among MSM individuals, and the suggestion of intimate and sexual contact was added as a relevant aspect in MPX transmission (MARTINEZ *et al.*, 2022).

Those recent events highlight that, in the Anthropocene period, outbreaks and the spread of diseases are no more than a plane ride away (WHITMEE *et al.*, 2015), underscoring the importance of understanding the conditions of this population and their spatial dynamics. Therefore, this text identifies and analyzes MPX cases recorded in the state of Rio Grande do Sul, aiming to describe the epidemiological and spatial profile of the disease. The objective is to shed light on the inequalities revealed by this outbreak, especially those related to racial and sexual orientation issues.

METHODOLOGY

This is a cross-sectional, ecological, and descriptive study of MPX cases reported from the 22nd to the last day of the 52nd epidemiological week, on December 31, 2022. The definition of a suspected MPX case is an individual of any age who, from March 15, 2022, presented a sudden onset of acute skin rash suggestive of MPX, single or multiple, in any part of the body (including the genital area), associated or not with lymphadenopathy or a history of fever (MINISTÉRIO DA SAÚDE, 2022). For this study, both confirmed and probable cases were considered, with the latter defined as suspected cases undergoing clinical and epidemiological investigation and presenting a clinical profile compatible with MPX but without laboratory confirmation through Real-Time PCR and/or sequencing (MINISTÉRIO DA SAÚDE, 2022).

According to information provided by the State Department of Health of Rio Grande do Sul through requisition number 203061/0168, the database that aggregated MPX notifications until November 7, 2022, was RedCap. After that period, the notifications were included in the Notification Disease Information System (SINAN).

The incidence per 100,000 inhabitants in the state of Rio Grande do Sul was calculated using the numerator composed of probable and confirmed cases, while the denominator corresponds to the total population classified by age group, race/ethnicity, and sex. Calculation of incidence by sexual orientation followed the criteria discussed in a previous investigation (POLIDORO *et al.*, 2021), which established an estimate of 3% for the homosexual population and 3% for the bisexual population, in accordance with other estimated procedures identified in previous research (LAUMANN *et al.*, 1994; BELOQUI, 2008). Although adopting this reference for calculating incidence by sexual orientation may be considered a methodological limitation, its application is essential in light of the national and global scenario of the disease, which has disproportionately affected gay, bisexual, and other MSM populations. It should be noted that calculating incidence based on gender identity was not possible due to a lack of empirical data that, contrary to what occurs in sexual orientation, would allow the configuration of the denominator of the scrutinized rate.

Population information was extracted from the 2010 Census Universe Results of the Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics - IBGE), available in the Sistema IBGE de Recuperação Automática (IBGE System of Automatic Data Recovery - SIDRA).

The variables explored in this study are: the user's municipality of residence (excluding cases of non-residents of Rio Grande do Sul), sex, age,

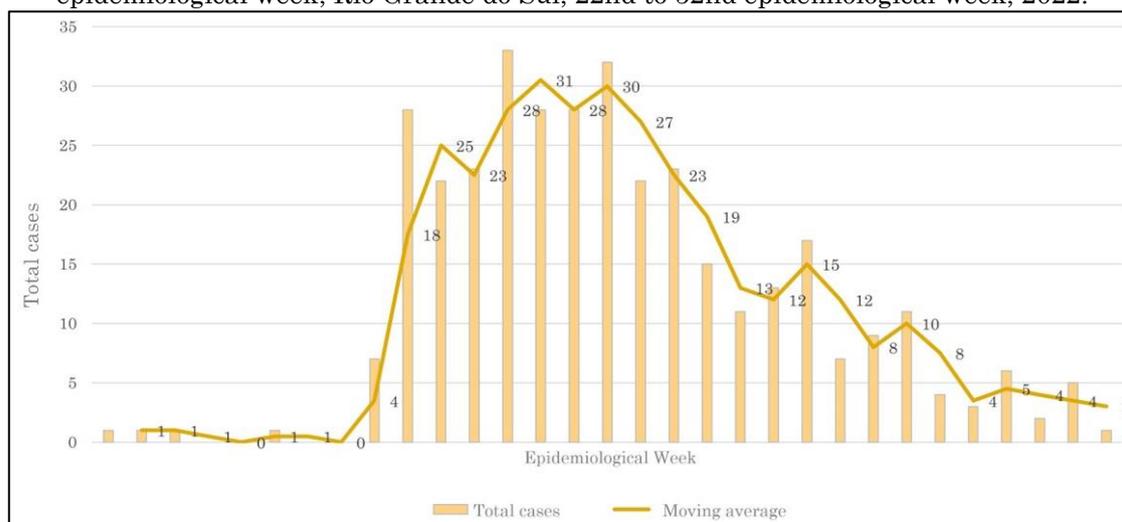
race/ethnicity, sexual orientation, gender identity, and HIV serology. The information was obtained through the Access to Information Act from the Central do Cidadão portal of Rio Grande do Sul, requisition number 203061/0168. Since these are secondary and anonymized data, submission to the Research Ethics Committee was not required, fulfilling the requirements of National Health Council Resolution (CNS) No. 466 from December 12, 2012.

All data were processed using Statistical Package for the Social Sciences (SPSS) version 26, and the maps were generated using ArcMap 10.3 software by georeferencing the data, specifically the total number of notification records and the notification rate per 100,000 residents.

RESULTS

A total of 2,587 cases were reported, of which 12.6% were confirmed, 81.1% were discarded, and 1% were classified as probable cases. The number of cases was higher in RedCap (80.1%) than in SINAN (19.9%). An increase in cases was observed from the 31st week onwards, peaking in the 34th week (Figure 1). Most confirmed and probable cases occurred in males (86.2%), and the most affected age group was 30 to 39 years (Table 1). White individuals accounted for 68.9% of the cases, although the rate was higher among Black individuals (herein encompassing Black and Brown as per the IBGE category), reaching 3.59. There were no reported cases of individuals of Asian and/or Indigenous descent. Many confirmed and probable cases occurred in homosexual individuals (49.7%), particularly gay men. The spatial distribution showed a concentration of cases in the metropolitan region of Porto Alegre and the Serra Gaúcha (Figure 2).

Figure 1 - Distribution of confirmed cases and probable cases of MPX and moving averages per epidemiological week, Rio Grande do Sul, 22nd to 52nd epidemiological week, 2022.



Source: Organized by the authors (2022).

Regarding the demographic characteristics of confirmed and probable MPX cases in Rio Grande do Sul, 86.2% (n=305) were male and 13.8% (n=49) were female (Table 1). The incidence rate per 100,000 population is higher in males (5.86).

Table 1 - Characteristics of confirmed and probable MPX cases, 22nd to 52nd epidemiological week, Rio Grande do Sul, 2022.

Characteristics	Total (n)	%	Incidence rate
Total	354	100	-
Sex			
Female	49	13,8	0,89
Male	305	86,2	5,86
Age group			
less than 1	2	0,6	1,56
1 to 4	5	1,4	0,97
5 to 9	4	1,1	0,55
10 to 14	3	0,8	0,35
15 to 17	5	1,4	0,94
18 to 29	91	25,7	4,31
30 to 39	136	38,4	8,75
40 to 49	82	23,2	5,35
50 to 59	17	4,8	1,33
60 or older	7	2	0,48
Invalid data (<i>missing</i>)	2	0,6	-
Race/color			
White	244	68,9	0,03
Black	62	8,2	3,59
Invalid data (<i>missing</i>)	37	17,5	-
Ignored	11	3,1	-
Sexual orientation			
Heterosexual	94	26,6	0,94
Bisexual	20	5,6	6,23
Homosexual	176	49,7	54,86
Pansexual	5	1,4	-
Other	3	0,8	-
Invalid data (<i>missing</i>)	1	0,3	-
Ignored	55	15,5	-

Source: Organized by the authors (2022).

In relation to gender identity, understood according to the Joint United Nations Programme on HIV/AIDS (UNAIDS, 2017) as

the internal and individual experience of gender by each person, which may or may not correspond to the sex assigned at birth, there is

a predominance of cisgender men (61.19%; n=219), cisgender women (11%; n=39), and transgender men (2.3%; n=8). The

incompleteness of the gender identity variable, indicated by the "unknown" or "invalid data" (missing) category, totaled 23.4% (n=83).

Table 2 - Gender identity of confirmed and probable MPX cases, 22nd to 52nd epidemiological week, Rio Grande do Sul, 2022.

Gender identity	Total (n)	%
Cisgender Man	219	61,9
Transgender Man	8	2,3
Cisgender Woman	39	11,0
Transgender Man	3	0,8
Non-binary	2	0,6
Invalid data (<i>missing</i>)	9	2,5
Ignored	74	20,9
Total	354	100

Source: Organized by the authors (2022).

The age profile of confirmed and probable MPX cases in Rio Grande do Sul reveals that the condition affects the young population. The highest prevalence is found in the 30 to 39 age group (38.4%; n=136, incidence rate of 8.75), followed by the 40 to 49 age group (23.2%; n=82, incidence rate of 5.35) and the 18 to 29 age group (25.7%; n=91, incidence rate of 4.31).

Regarding self-declared race/ethnicity, 68.9% (n=244) are White and 17.5% (n=62) are Black. There were no reported cases of confirmed and probable MPX in individuals of Asian and/or

Indigenous descent. As indicated by the data, the outbreak disproportionately affected Black individuals, with an incidence rate three times higher than the White population.

Regarding education, 28.2% (n=100) of the confirmed and probable MPX cases in Rio Grande do Sul had completed higher education, and 14.7% (n=52) had completed high school. The incompleteness of data in this variable, i.e., the sum of the fields for "unknown" and "missing" data, was 40.7% (n=144).

Table 3 - Education level of confirmed and probable MPX cases, 22nd to 52nd epidemiological week, Rio Grande do Sul, 2022.

Education level	Total (n)	%
1st to 4th grade incomplete	2	0,6
5th to 8th grade incomplete	8	2,3
Incomplete Elementary Education	1	0,3
Complete Elementary Education	7	2,0
Incomplete High School Education	13	3,7
Complete High School Education	52	14,7
Incomplete Higher Education	23	6,5
Complete Higher Education	100	28,2
Not applicable	4	1,1
Ignored	53	15,0
Invalid data (<i>missing</i>)	91	25,7
Total	354	100

Source: Organized by the authors (2022).

The majority of confirmed and probable cases of MPX in Rio Grande do Sul in 2022 were among homosexuals (49.7%; n=176). Out of this total, 2 cases were among lesbian women and the remaining cases were among gay men. Heterosexual individuals accounted for 26.6% (n=94), with 37 cases assigned female at birth and 57 cases assigned male at birth. The

incompleteness of the sexual orientation field was 15.8% (n=56). The incidence rate in the gay and other MSM populations is 53 times higher compared to the heterosexual population and 48 times higher compared to bisexuals. Regarding HIV serology, 60.2% (n=213) reported not living with the virus.

Table 4 - HIV serology of confirmed and probable MPX cases, 22nd to 52nd epidemiological week, 2022.

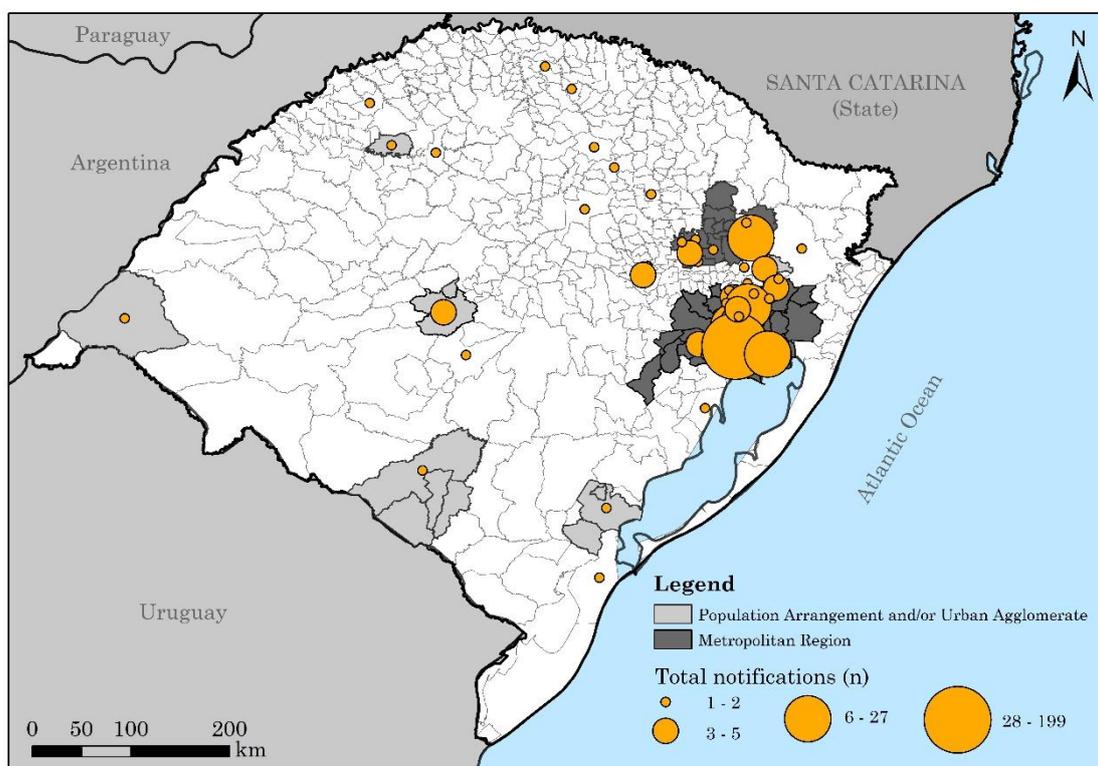
Is it HIV positive?	Total (n)	%
Yes	111	31,4
No	213	60,2
Ignored	30	8,5
Total	354	100

Source: Organized by the authors (2022).

The spatial distribution shows the concentration of confirmed and probable MPX cases in the metropolitan region of Porto Alegre, encompassing 16 out of the 34 municipalities within it (records from Canoas, Novo Hamburgo, Viamão, São Leopoldo, Alvorada, Campo Bom, Eldorado do Sul, Esteio, Igrejinha, Cachoeirinha, Guaíba, Portão, Sapiranga, Gravataí, Ivoti, Parobé). The same occurs in the Serra Gaúcha metropolitan region, comprising 7 out of the 14 municipalities (notified cases in Bento Gonçalves, Carlos Barbosa, Caxias do Sul, Farroupilha, Garibaldi, Monte Belo do Sul, São Marcos), as well as in the Gramado-Canela Population Cluster.

The municipalities with above-average numbers of cases (n=7) are Porto Alegre (n=199), Canoas (n=27), Novo Hamburgo (n=16), Viamão (n=16), and Caxias do Sul (n=12). Only 10 out of the 51 municipalities that had confirmed or probable MPX cases are not part of a metropolitan region, urban agglomeration, or population cluster. However, two out of these 10 municipalities are regionally significant, as indicated by REGIC (2018), namely Passo Fundo (206,103 inhabitants, Regional Capital) and Rio Grande (212,881 inhabitants, Sub-regional Center).

Figure 2 – Spatial distribution of confirmed and probable MPX cases, Rio Grande do Sul, 22nd to 52nd epidemiological week, 2022.



Source: Organized by the authors (2022).

DISCUSSION

On May 20, 2022, a gay sauna in Madrid, Spain, was closed after an MPX case was confirmed among one of its patrons. Subsequently, with the emergence of new cases throughout Europe, concerns about stigmatization and discrimination against homosexuals were expressed by the deputy director of UNAIDS, who stated that stigma "can quickly disable evidence-based responses, fuel cycles of fear, drive people away from health services, hinder efforts to identify cases, and encourage ineffective punitive measures" (UNITED NATIONS, 2022).

At that time, with the prospects of an increase in the number of cases and lingering uncertainties in Latin America, researchers questioned the possibility of achieving a better response based on the lessons learned from the COVID-19 pandemic and the region's particularities, such as prior knowledge of structural inequalities, overlapping epidemics of preventable diseases, and the impacts of declining vaccination coverage (CIMERMAN *et al.*, 2022).

In the Brazilian context, the inertia in developing plans and making decisions, as well as the absence of coordinated measures, raise questions about the lack of action in the face of the urgency imposed by the current health emergency (BOEING *et al.*, 2022). Furthermore, regarding the first MPX cases in the country, the initial publications in Brazil emphasized the importance of proper differential diagnosis with other sexually transmitted diseases, the prioritization of characterizing and clinically describing the disease, including its relationship with other conditions such as people living with HIV, children, and pregnant women, and the need to disseminate qualified information to support health actions (LIMA *et al.*, 2022; CLARO *et al.*, 2022).

In the United States, the racial/ethnic marker of individuals changed over the weeks in the morbidity and mortality reports published by the CDC. While in May 2022, 67% of the notifications were in White individuals and 33% in Black or African Americans, this percentage reversed to 26% in Whites and 48% in Black or African Americans by December 2022, reflecting the impact of ring vaccination on the most affected groups and, at the same time, the racial disparity in access to healthcare services for non-White individuals. Ring vaccination is a strategy that involves vaccinating individuals in proximity or direct contact with infected or suspected cases. The goal is to create a "ring" of

protection around the suspected cases, preventing the spread of the disease to others. This approach can be particularly useful in situations of infectious disease outbreaks, such as MPX, as it can help control the spread of the disease in specific population groups, including those at higher risk, such as men who have sex with men. It is important to note that ring vaccination is a complementary strategy to mass vaccination and other measures for preventing and controlling infectious diseases.

In Brazil, an analysis conducted by Pascom *et al.* (2022) revealed a certain balance in the racial/ethnic profile of confirmed and probable MPX cases: 43.7% (n=3,572) in White individuals and 40.8% (n=3,332) in Black individuals. However, both in Pascom's study and the findings of this text, the incompleteness of information in the race/ethnicity variable is striking. In the national survey results, 14.2% (n=1,163) of the notifications did not provide race/ethnicity information; in Rio Grande do Sul, this percentage was 3.1% (n=11).

It is worth noting that Ministry of Health Ordinance 344, dated February 1, 2017, emphasizes the relevance of including the race/ethnicity variable in health information systems to analyze the epidemiological profile of different population groups. Nsoesie and Vu (2023) advocate for maintaining the quality of race/ethnicity information in managing MPX in order to guide strategies that consider the economic and cultural particularities of communities.

Canavese *et al.* (2022) point out the importance of raising awareness about MPX without discrimination against groups, behaviors, or sexual orientation. The authors highlight the AIDS epidemic in 1980 when the disease was referred to as "gay plague" and "gay cancer." Scientific publications and the media initially disseminated misinformation by indicating that the epidemic was limited to a risk group known as the "4H": homosexuals, hemophiliacs, Haitians, and heroin users. Although the concept of risk group has been refuted and replaced by the notion of vulnerability (AYRES *et al.*, 1999) within the scientific community, stigma and discrimination still persist, particularly against the gay community.

In the state of Rio Grande do Sul, the HIV epidemic is widespread and affects all population groups, regardless of sexual orientation or behavior (PEREIRA *et al.*, 2018). According to the study, from 1980 to 2015, the HIV exposure category among homosexuals was 35.4% (n=372) from 1980 to 1990, and it decreased to 7.5% (n=6,241) in the 2001-2015

period, while among heterosexuals it increased from 12.9% (n=136) to 43.5% (n=36,260) in the same period. These data indicate the importance of a comprehensive and inclusive approach in combating HIV, thereby avoiding stigmatization and discrimination against specific groups.

According to the latest Epidemiological Bulletin on HIV/AIDS in Brazil (BRASIL, 2022), from 2007 to June 2022, among individuals aged 13 years and older, the main category of HIV exposure was heterosexual women in 86.6% of cases. Among individuals aged 40 years and older, 64.7% were men engaging in heterosexual sexual practices.

The stigma of HIV and AIDS is still present in the popular imagination. In a qualitative study conducted by Knauth et al. (2020) with heterosexual men in Rio Grande do Sul, it was revealed that positive diagnoses are still received with surprise. The media has played a key role in creating this stigma, and the disease is still associated with some homosexual celebrities, maintaining this association active. According to the authors, for heterosexual men, AIDS is seen as a disease distant from their sexual identity, as they do not consider themselves gay or "queer."

Regarding the global spatial pattern of confirmed cases of MPX until January 31, 2023, the United States was in the lead (30,112 cases and 27 deaths), followed by Brazil (10,739 cases and 15 deaths) and Spain (7,526 cases and 3 deaths). Although in the eighth global position with 3,723 confirmed cases, Peru recorded 15 deaths as of the aforementioned date (CDC, 2023b), highlighting the disease's lethality.

Until December 2022, the concentration of confirmed cases in the United States occurred in major metropolises such as New York, Chicago, and Los Angeles (CDC, 2023a). In Brazil, Pascom et al. (2022) demonstrated that São Paulo and Minas Gerais are the states with the highest number of cases, and the country does not yet provide information by municipality. This study highlighted a spatial concentration of cases in the metropolitan regions of Rio Grande do Sul, in urban agglomerations, and population clusters.

The spatial dimension of MPX outbreaks in Europe and the Americas differs significantly from those recorded in the scientific literature in Africa. Mandja et al. (2022) revealed that MPX cases in the Republic of Congo were concentrated in districts in the country's tropical forest. Another study conducted in West and Central Africa confirmed that MPX cases were associated with low altitudes and high precipitation levels (2007). An investigation in southern Nigeria identified the relationship

between bushmeat consumption and MPX transmission, exacerbated in unvaccinated children.

Limited attention has been given to the spatial aspect of MPX in scientific literature, except for studies conducted in Africa. According to Yinka-Ogunleye (2019), a publication on an MPX outbreak in an urban and peripheral area of Nigeria highlighted the difference in relation to the previously known dynamics of the disease. Furthermore, clinical and epidemiological studies have reported the high lethality of MPX in people living with HIV (PLHIV).

The difficulty in understanding the transmission routes and dynamics of the disease, which has taken on new transmission characteristics (urban-metropolitan, in regions of the world where it was eradicated and initially concentrated among gay men and MSM), and which gained worldwide attention starting from the gay sauna in Madrid and its link to intimate physical contact, has raised concerns by the WHO (WHO, 2022), leading some writers to argue for it to be considered a sexually transmitted infection (THRASHER, 2022), while others completely refute this possibility (KHATRI et al., 2022).

In this context, the proper use and dissemination of information that does not reinforce stigma and discrimination are urgently needed. A cross-sectional study conducted in England with the communities most affected by MPX demonstrated the relevance of disseminating information by engaging with the most vulnerable individuals, as well as the importance of the role of healthcare professionals in these actions (PAPARINI et al., 2022).

Unfortunately, scientific literature has shown that few lessons learned from the experiences with COVID-19 and MPX have been incorporated into healthcare practices, especially regarding vulnerable populations such as Black, Latinx, gay, and PLHIV individuals. Several factors contribute to this situation, including the lack of investment in collecting detailed data by social markers, the absence of stratified analyses, the slow adoption of prioritized measures for population groups, and the perpetuation of structural barriers to access and care.

According to Rodriguez-Diaz et al. (2022), the failure to define these populations as priorities demonstrates that the current scenario is not simply a matter of negligence but rather a deliberate choice. The reinforcement of inequalities and the perpetuation of vulnerabilities among these groups are evidence of this choice, which demands the adoption of

more effective and structural measures for health promotion and the reduction of disparities. Testing and vaccination, for example, are essential tools for disease prevention and control, but a more equitable and inclusive approach must guide their implementation.

The MPX epidemic, just like the HIV epidemic in its early stages, still poses many unanswered questions. However, as emphasized by Canavese et al. (2022), it is essential to recognize the accumulated knowledge and use it to guide practical actions in Brazil, aiming to eliminate health inequities and promote policies aligned with the principles of equity of the Sistema Único de Saúde (Unified Health System, SUS).

By reflecting on the lessons learned from the MPX epidemic, it is possible to identify opportunities to improve the healthcare system and make it more effective in meeting the population's needs. Additionally, it is essential to recognize that health inequities disproportionately affect vulnerable groups such as Black, Indigenous, LGBTQIA+, and impoverished individuals.

In this regard, it is necessary to establish effective strategies for promoting health equity, including collecting disaggregated data by social markers and adopting specific policies to address the needs of these groups. Implementing policies that consider the specificities of these populations can be an important step in reducing health inequities and promoting a more just and inclusive healthcare system.

CONCLUSION

The MPX outbreak "outside of Africa" that ravaged Europe and the Americas in 2022 within the context of the COVID-19 pandemic has primarily affected gay men and other MSM. Moreover, the persistence of the HIV/AIDS epidemic, despite advances in pharmaceutical and biomedical technologies, has been fueled by the perpetuation of stigma, discrimination, and misinformation.

The disproportionate burden on the Black population in Rio Grande do Sul, as well as on homosexuals and MSM, calls for effective measures aimed at disseminating evidence-based information devoid of prejudice and capable of empowering individuals in promoting their health. In the case of MPX, for which a vaccine is already available, the recent outbreak is concentrated in metropolitan areas and urban

clusters offers a window of opportunity for the implementation of strategic immunization actions, such as ring vaccination, where tracing close contacts of diagnosed individuals enables the interruption of virus transmission.

In summary, urgent and emergency measures to combat MPX are imperative. Health authorities and relevant organizations must implement effective and inclusive health policies that consider the particularities and needs of the most vulnerable groups while adhering to the highest scientific, ethical, and humanitarian standards.

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AUTHORS CONTRIBUTION

Maurício Polidoro conceived the study, collected and analyzed the data and wrote the text. Daniel Canavese de Olivera conceived the study and wrote the text. Paulo Ricardo Rocha Nogueira wrote the text.



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