

Review

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Review

# Monkeypox Outbreak in Peru: Reflections after the COVID-19 Pandemic

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**Abstract:** Monkeypox is a zoonotic illness caused by the *Orthopoxvirus* monkeypox virus (MPXV). Since 1970, outbreaks of MPXV have occurred in several Sub-Saharan African countries. However, from May 2022 to April 2023, recent outbreaks of MPXV occurred in several countries outside of Africa, and these cases quickly spread to over 100 non-endemic countries on all continents. Because of this, in July 2022, World Health Organization declared monkeypox a Public Health Emergency of International. MPXV disproportionately affects men who have sex with men and members of the HIV-infected population. The current strategy for control and pre-exposure prophylaxis or post-exposure prophylaxis for people at high risk is vaccination. In this context, Peru has the fourth-highest number of MPXV cases in Latin America. Because of this, in this review, we describe public health indicators in Peru and reflect on the COVID-19 pandemic so that health authorities can join forces to identify and control MPXV transmission routes.

**Keywords:** monkeypox outbreak; public health; emergency; Peru

## 1. Introduction

Monkeypox virus (MPXV) of the genus *Orthopoxviruses* in the *Poxviridae* family, a sylvatic zoonotic virus transmitted via droplet exposure and direct contact or with contagious materials [1,2]. Since 1970, outbreaks of MPXV in humans have occurred in several Sub-Saharan African countries, primarily in the Democratic Republic of Congo, the Central African Republic, Cameroon, the Republic of Congo, Liberia, and Nigeria. Since then, MPXV has been restricted to these countries [3,4]. However, recent outbreaks of MPXV have occurred in several countries outside of Africa, and a high number of cases have quickly spread to almost every continent [2,5,6]. Most cases occur in young men, many of whom have sex with men (MSM), with lesions suggesting that transmission most likely occurs through close human-to-human contact [7,8]. In this review, we discuss the epidemiology, transmission and population at risk, public health indicators, and prevention of monkeypox in 2022 Peru outbreak.

## 2. COVID-19 pandemic in Peru

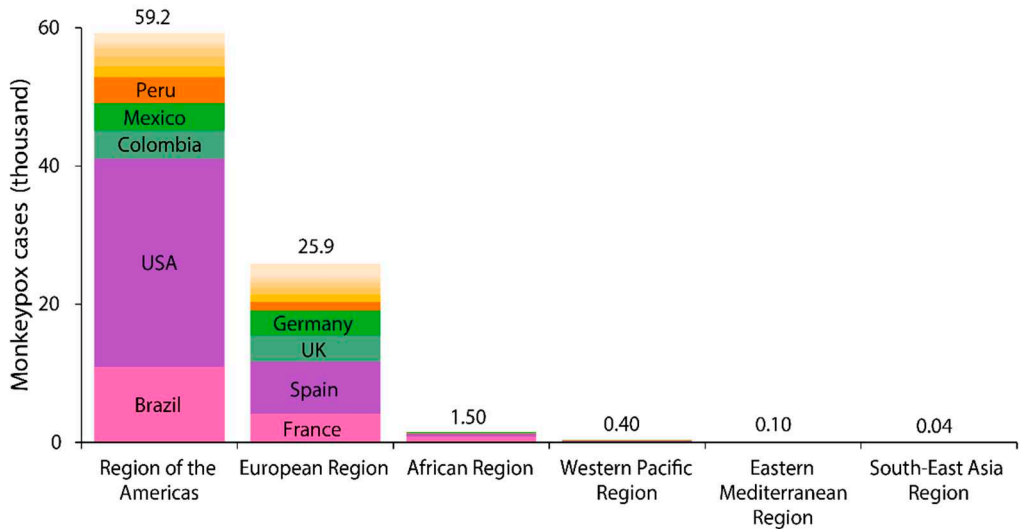
Despite the early implementation of a national lockdown and other restrictions to prevent COVID-19 transmission, Peru has been severely impacted by the COVID-19 pandemic, resulting in a high death rate and COVID-19 incidence, excess COVID-19 deaths, and excess death from all causes [9–11]. Possible explanations for the poor outcomes following the first and second waves of COVID-19 are a fragmented healthcare system, gaps in infrastructure, a lack of specialized human resources to tackle the pandemic, a lack of molecular tests (first wave), a lack of intensive care unit beds, a lack of essential drugs, the use of medications without evidence of their efficacy, a lack of leadership from health authorities, and a pandemic response that was directed toward hospitals and not primary healthcare [12,13]. These factors contributed to exacerbating the problem. The Peruvian health system was severely affected, and its health facilities were overfilled with COVID-19 patients. In addition,

an urgent need for improvement became evident since non-COVID-19 patients could not access regular healthcare services, which had an indirect impact on the population’s health [13]. Peru is still being affected by the COVID-19 pandemic, with more than 4.5 million cases and more than 220,000 deaths reported as of April 21, 2023 [14]. However, after the implementation of a vaccination program to combat COVID-19, the burden of disease and death has decreased considerably.

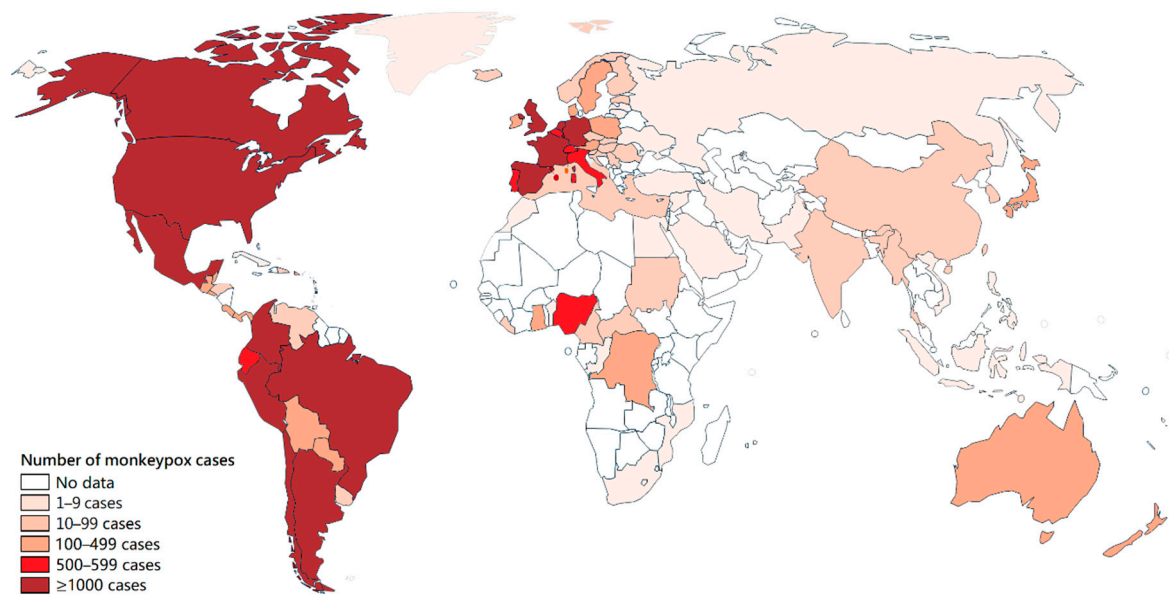
3. Epidemiology

Since human monkeypox was diagnosed in 1970 in the Democratic Republic of the Congo, it has spread to West and Central Africa [15–17]. Since the number of human monkeypox cases has been on the rise. From 2000 to 2015, there were outbreaks of human monkeypox in the Democratic Republic of the Congo, and Nigeria [3]. In these outbreaks, the overall case fatality rate was 8.7%, and 10.6% in Central African vs. 3.6% in West African 3.6% [3]. Since 2003, spread outside of Africa has been import- and travel-related to endemic countries occasionally resulted in outbreaks [18–20]. According to the WHO in 2022, monkeypox was considered endemic in several African countries [21]. In the 2022 global outbreak, the first cases were reported to in May [22]. Since then, the number of cases has continued to increase worldwide. Therefore, on July 23, 2022, the WHO declared MPXV a public health emergency of international concern [6].

In terms of cumulative number, from January 1, 2022, to April 25, 2023, 87,113 cases of MPXV have been reported in 111 countries worldwide, including a total of 130 deaths [22]. Most of these cases have been reported in the region of the Americas (59,220 cases) and Europe region (25,881 cases) (Figure 1). In Latin America, Peru is the country with the fourth-highest number of MPXV cases, after Brazil, Colombia y Mexico. In Europe, Spain and France are the countries with the most reported cases (Figure 2) [22].



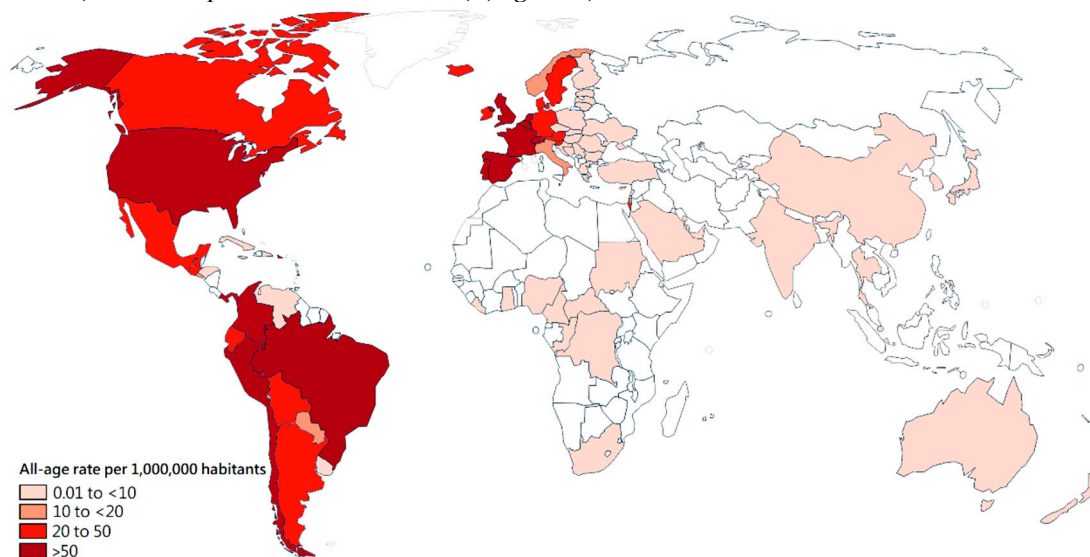
**Figure 1.** Stacked bar chart of regional distribution of monkeypox cases for 2022–2023 (Source: Monkeypox, WHO) [22].



**Figure 2.** Global distribution of monkeypox cases for the period 2022–2023 (Source: Monkeypox outbreak: WHO, April 25, 2023) [22].

To date (April 27, 2023), seventeen countries had all-age cumulative rate of monkeypox cases >50 cases per millions-habitants: Gibraltar, Spain, Peru, Portugal, United States of America, Luxembourg, Colombia, Chile, Netherlands, Belgium, Malta, Puerto Rico, Switzerland, France, The United Kingdom, Brazil and Panama.

In Latin America, the highest all-age monkeypox rates were in Peru (113.9 cases per millions-habitants), Colombia (79.8 cases per millions-habitants), Chile (74.9 cases per millions-habitants) and Brazil (50.9 cases per millions-habitants) (Figure 3).



**Figure 3.** Global distribution of estimated monkeypox rate for the cumulative period 2022–2023. Calculated rate by the number of cases reported for the cumulative period 2022–2023 ( $\geq 5$  cases) in a certain country [22] divided through the total population of that country of that same year as reported by <https://data.worldbank.org/indicator/SP.POP.TOTL>.

#### 4. Transmission and population at risk

Although the animal reservoir of the MPXV is still unknown, transmission can occur of animal-to-human and human-to-human [2,4,21]. During the 2022 outbreak has been reported human-to-

human transmission of MPXV can occur by respiratory secretions, direct contact, percutaneous transmission, or indirect contact through fomites [7,8,22].

Historical risk factors for acquiring the infection include high-risk sexual behavior (multiple or anonymous sexual partners) in Americas and European countries and living in forested areas in African countries [7,8,18,21,23]. Concomitant sexually transmitted infections (STIs) have been reported in persons with monkeypox. High rates of HIV infection [22] and other STIs in monkeypox persons have been reported in the current global outbreak [7,8,22]. This outbreak has affected primarily gay, bisexual, and other men who have sex with men (MSM) [7,8,22]. In previous monkeypox outbreaks in Nigeria, also there was concurrent HIV infection [24,25]. Among monkeypox persons from eight USA jurisdictions, HIV prevalence was 38%, and 41% had received a diagnosis of one or more other reportable STIs. These STIs included *N. gonorrhoeae*, *C. trachomatis*, and syphilis in the monkeypox patients with and without a diagnosis of HIV infection [26]. In Spain, herpes simplex virus (HSV-I/II), *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, Syphilis and *Mycoplasma genitalium* were detected in monkeypox patients [27]. In Italy, *M. genitalium* and *N. gonorrhoeae* were frequent STIs [28]. In Germany, *N. gonorrhoeae*, *C. trachomatis*, syphilis and *Mycoplasma* were reported [29]. In Mexico, HIV, syphilis and some cases of chronic hepatitis C have also been identified in patients with monkeypox [30]. In Latin America, HIV, Syphilis, Genital herpes, Chlamydia and Gonorrhea have been reported in Brazil [31], while in Peru only HIV and syphilis were reported in patients with monkeypox infection [32,33]. Finally, although women infected represent a very small part of the overall infected population in 2022 outbreak, a global case series found that 61% of 74 cis women and non-binary individuals and 89% of 62 trans women with monkeypox acquired it through sexual contact [34].

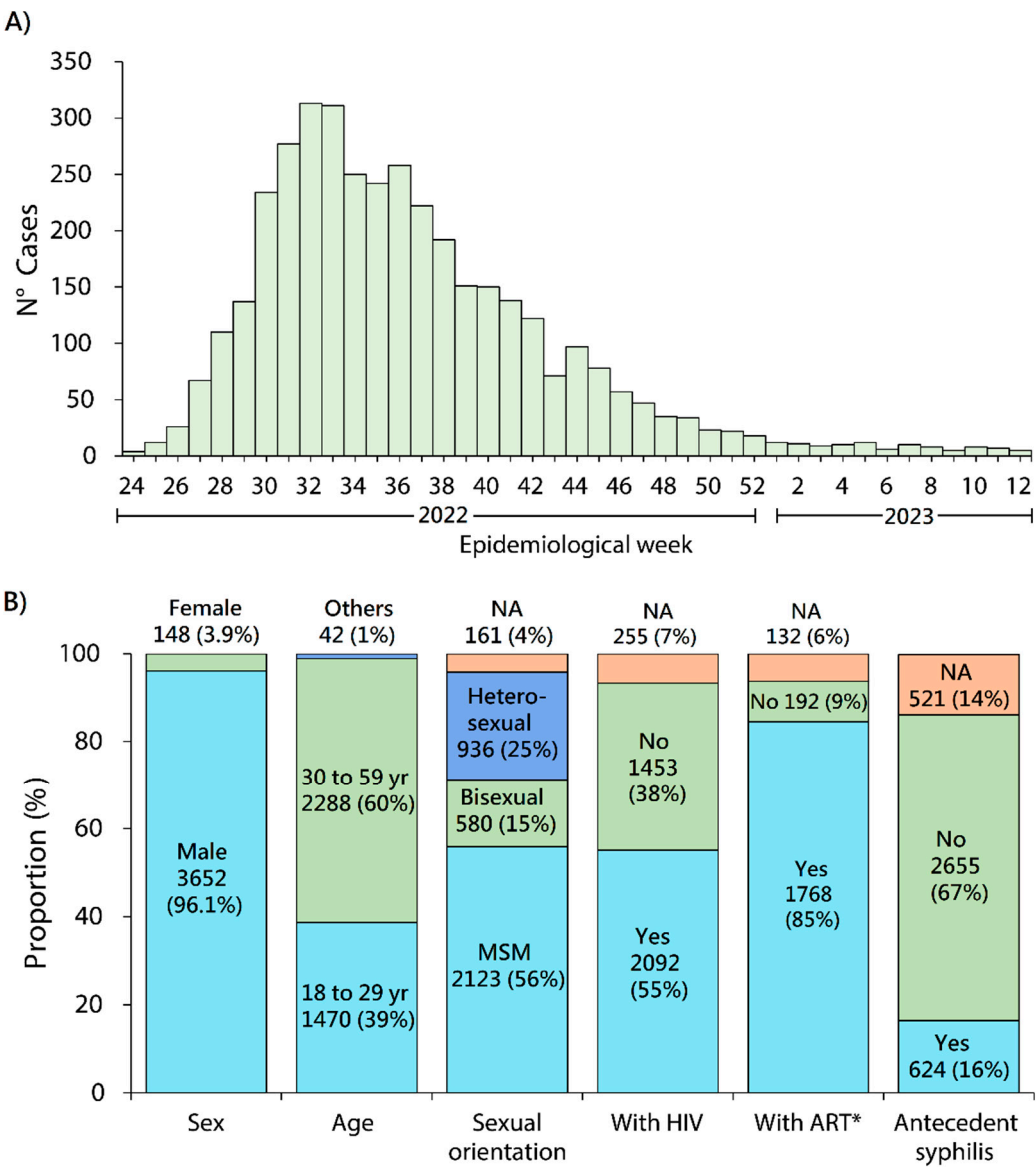
## 5. MPXV outbreak in Peru

Soon after the first descriptions of MPXV outbreaks in several countries around the world—and still in the context of the COVID-19 pandemic—on May 26, 2022, the Center for Disease Control of Peru (CDC-Peru) issued a health alert to health establishments about the risk of imported monkeypox cases in the national territory [35]. Subsequently, the government began implementing its control plan for the MPXV outbreak on 07 June, which included health establishments preparing and responding to possible cases [36]. Despite the implementation of a control plan for the MPXV outbreak, we knew that the introduction of monkeypox was imminent because of the large numbers of national and international travelers, combined with problems in the Peruvian health system.

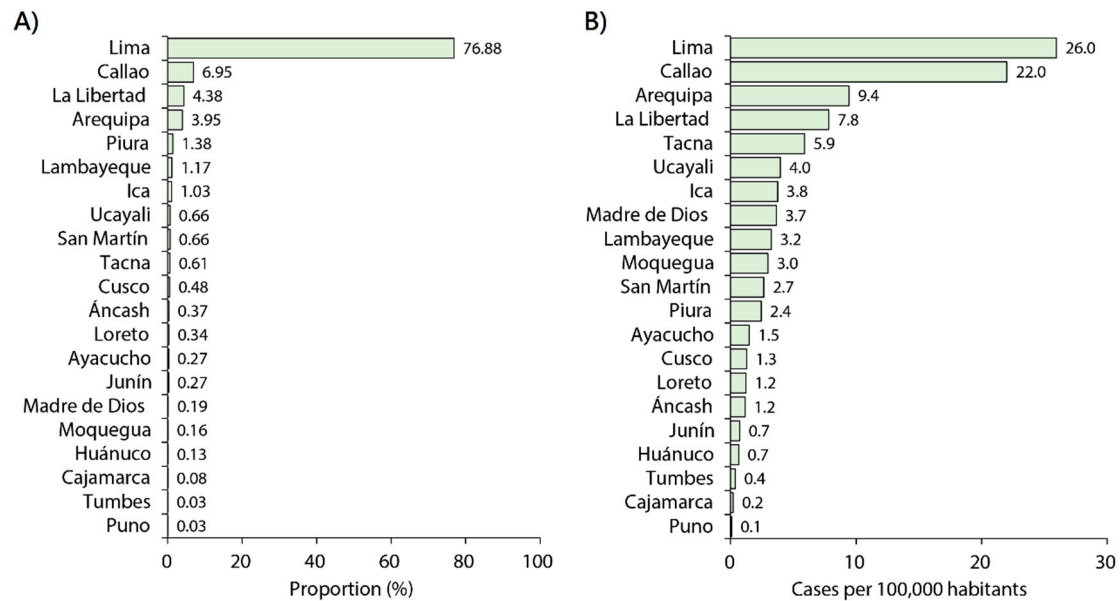
Peru's first MPXV case was diagnosed on June 15 in the Department of Lima. By mid-July, community transmission was occurring, and the country had neither a sufficient response nor the contact-tracing capacity to contain MPXV. Because of this, on September 30, 2022, the Peruvian Ministry of Health approved an updated version of the technical health standard for the prevention and management of patients affected by MPXV. This rule aims to protect the health of the population at risk of or affected by MPXV (probable or confirmed cases), including guidelines for community preventive measures and care in health facilities. Despite the implementation of a control plan against monkeypox, the disease was almost certain to become a public health emergency in Peru because of the same factors that influenced poor outcomes during the first and second waves of the COVID-19 pandemic.

Since the first case of monkeypox was reported in Peru (June 15, 2022), community transmission was occurring. Beginning week 36, 2022, the cases have decreased to week 12, 2023 (Figure 4A). Up to April 25, 3800 human MPXV cases and ten deaths have been reported by CDC-Peru [33]. As in other countries [7,8,26,31], most of these cases occurred in young men (96.1%) and men who have sex with men (56%). The most-affected population has been people living with HIV (55%) and those who receive antiretroviral therapy (85%) (Figure 4B) [33]. Most cases and the highest rates were recorded in large cities, such as Lima, Callao, La Libertad, and Arequipa (Figure 5A,B) [33].





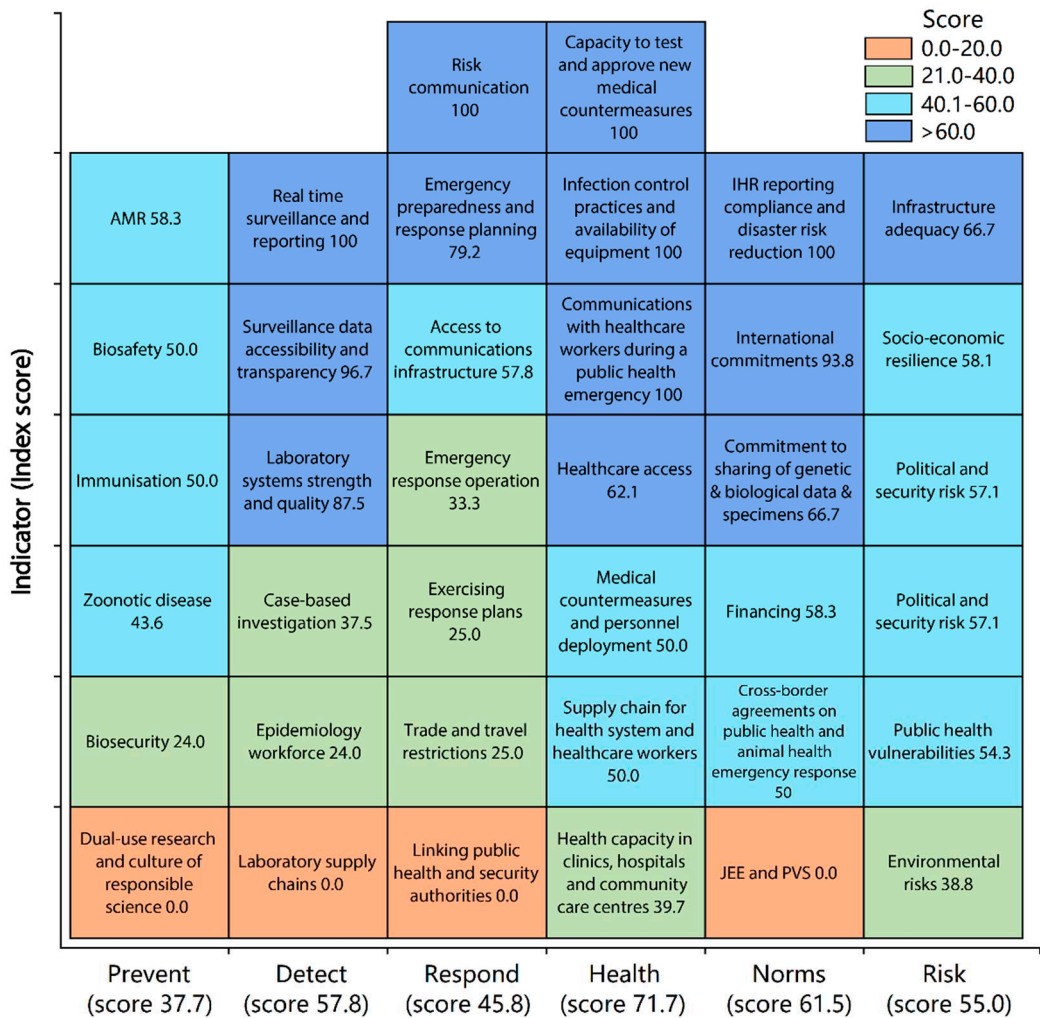
**Figure 4.** Human monkeypox cases registered in Peru from June 15 to April 24, 2022 (Source: Center of Control Disease, Ministry of Health, Peru) [33]. A) Weekly distribution of human monkeypox cases. B) Features of human monkeypox cases. MSM: men who have sex with men; NA: not available.



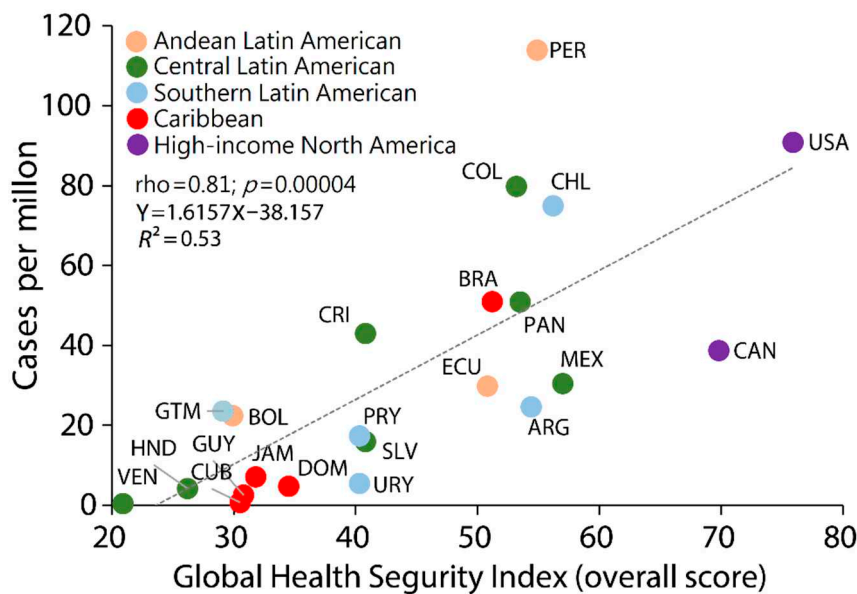
**Figure 5. Distribution of monkeypox cases in Peru from June 15, 2022, to April 23, 2023 [33].** A) Proportion of cases and B) monkeypox rate. Monkeypox rate was calculated dividing the number of monkeypox cases for the cumulative period 2022–2023 in a certain region [33] divided through the total population of that region per 100,000 habitants.

In the late-1970s, smallpox was eradicated through vaccination, and in Peru, as in other countries, the resurgence of MPXV is likely due to smallpox vaccines being phased out over the last four decades, as well as population growth and densely overpopulated areas, which facilitate virus spread [6]. Because of this, numerous individuals are now susceptible to MPXV. The current outbreak of MPXV in Peru also might be driven by changes in human behavior, such as the relaxation of COVID-19 prevention measures, including the resumption of national and international travel. Sexual interactions are also associated with large gatherings. In this context, we are currently bearing witness to an MPXV outbreak in Peru, with the fourth-highest number of cases in Latin America [22].

Apart from these factors, global health indicators may also help explain the current outbreak in Peru. According to the 2021 Global Health Security (GHS) Index report, which measures the capacity of 195 countries to prepare for epidemics and pandemics, all countries, including Peru, remain dangerously unprepared for future epidemic and pandemic threats: 38.9 is the average overall score in the 2021 GHS Index [37]. The United States is the country with the highest score in the 2021 GHS Index (75.9), and Somalia is the country with the lowest score (16.0) [37]. Peru has a 54.9 index score (32/195 rank), with low indicators for prevention, detection, response, health, norms, and risks (Figure 6) [37]. Therefore, Peru remains vulnerable to future outbreaks due to failures in quarantine and isolation policies and disease control. During the COVID-19 pandemic, some studies showed that the overall GHS Index was positively correlated with COVID-19 cases and deaths [38,39]. In the same vein, countries in the Americas region with different GHS Index scores have different rates of MPXV cases. For example, Peru, the United States, Colombia, Chile and Brazil are the countries with the highest GHS indicators, and they have the highest case rates of MPXV cases in the region (Figure 7). Although improved GHS indicators regarding the capability to prevent and mitigate epidemics do not guarantee success in controlling the MPXV outbreak, they can help contextualize the MPXV outbreak in Latin America and Peru.



**Figure 6.** Global Health Security Index in Peru, 2021 [15]. This figure was built with the Global Health Security Index data.



**Figure 7.** Relationship between Global Health Security (GHS) index score and MPXV cases in Americas region (Data updated to 25 April 2023). Spearman's analysis shows countries with higher GHS index had higher monkeypox cases rates per million of inhabitants.



According to the WHO (to October 19, 2022) among MPXV cases, 25,718 cases have been reported in MSM [22]. This shows that the current spread of MPXV has disproportionately affected MSM, suggesting the amplification of transmission through sexual networks. Although the MPXV outbreak has predominately affected gay men, monkeypox is not a “gay disease” [40]. Likewise, the WHO reports that among MKPV cases, approximately 50% of cases are HIV-positive people [22]. As in Peru, several reports in the United States, Europe, and Brazil describe a high rate of HIV infection among monkeypox cases [7,26–32,41,42]. Given the transmission route, MPXV could still find other transmission networks, and it could also start to spread among sex workers, their clients, and other population groups [40].

## 6. MPXV vaccination in Peru

Unlike the first year of the COVID-19 pandemic, when there was no efficacious vaccine, we currently have vaccines that offer protection against MPXV, but their availability is limited in some countries [43]. Currently, mass vaccination is not recommended for monkeypox. WHO provides many interim recommendations on vaccination and immunization against monkeypox for prevent onward spread human-to-human of MPXV, with a priority focus on groups at high risk of exposure [44]. Primary preventive (pre-exposure) vaccination is recommended for individuals at high-risk of exposure (gay, bisexual, MSM, and other with multiple causal sexual partners, sex workers, health workers at risk of repeated exposure, and laboratory personnel working with *orthopoxviruses*) [44]. Post-exposure preventive vaccination also is recommended for contacts of monkeypox cases within four days of first exposure, and up to 14 days in the absence of symptoms [44]. In the United States and the United Kingdom, the JYNNEOS vaccine (also known as IMVAMUNE) produced by Bavarian Nordic is used in high-risk groups to prevent MPXV disease [43,45], but this vaccine was not available in Peru. This vaccine is administered subcutaneously in two doses, 4 weeks apart to individuals 18 years of age. It can be used pre-exposure to prevent infection in population at high risk, or post-exposure (ideally within 4 days of exposure) [46,47].

Vaccination programmes against monkeypox in newly affected countries have focused primarily on MSM, who are at the highest risk of acquiring monkeypox. Globally, vaccines are being administered primarily in North America, Europe, whereas African countries remain without access to vaccines [21]. The Peruvian government announced that the first batch of a monkeypox vaccine was expected to arrive in the country on Wednesday, October 19, 2022. These were 5,600 of a total of 9,800 doses acquired by the country. In the second delivery, 4,200 doses arrived in November 2022 [48]. The monkeypox vaccination process initiated two phases. The first phase in people with HIV, and the second phase in vulnerable populations as MSM, transgender women, and workers and sex workers [49]. In that sense, the government should work to ensure timely access to vaccines for high-risk groups, including vulnerable populations such as MSM, bisexual men, and HIV-positive people in areas with a high number of MPXV cases and a high amount of risk contact.

## 7. Reflections and recommendations

There are several lessons to be learned from the COVID-19 pandemic in response to the MPXV outbreak. First, the COVID-19 pandemic made it clear that investment in healthcare capacity and science is essential to building robust and timely responses [6,50]. Second, now that the Peruvian population is recovering from the COVID-19 pandemic, the implementation of screening policies, contact tracing, and increased awareness of MPXV in the general population can help in the early detection of cases and disease control. Third, preparedness for new public health threats should be built upon planning and long-term investments in public health and science. Therefore, health authorities should join forces to properly contain the MPXV outbreak. Finally, findings in Peru suggest some risk groups are disproportionately affected. Thus, to contain the outbreak, special attention should be placed on MSM, people with HIV, and other groups at elevated risk levels, and MPXV vaccination programs should target these high-risk groups. Even if more vaccines do arrive in Peru, behavioral changes will be needed in the population to control the MPXV outbreak.

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