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Beyond African borders: Mpox's journey to the Americas

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ABSTRACT

The Mpox is characterized as a zoonotic disease, it is endemic at African continent and so in 2022 it has crossed the African borders which made ring the alarm all over the world due to the probability to cause a pandemic illness caused by the Mpox virus. Then, the infection is caused by a DNA virus that belongs to the *Poxviridae* family and *Orthopoxvirus* genus, so, it is far away relative to smallpox virus (VACV) that deeply observes the human's history with higher mortality before its vaccine was discovered through its variant that causes cowpox (CPXV). So, this research aims to describe the behavior of the infection despite its epidemiology, symptoms, treatment, prevention and the flight of the Mpox virus to American continent and also Brazil.

Keywords: Mpox, Smallpox, Monkeypox, Brazil.

INTRODUCTION

In the year 2022, still in the backdrop of the recurring news reports of the SARS-2 (Covid-19) pandemic around the world and the evolution of the virus that causes the disease (Câmara & Moreno, 2021), the World Health Organization (WHO), reported the risk of another possible pandemic due to the emergence of cases of the disease with an undefined name in different languages, but which in Portuguese-speaking countries became known as "monkey pox". In Brazil, to prevent stigma and protect the diversity of primates that inhabit the country's varied biomes, it was agreed to maintain the original name in English *Monkeypox.* Shortly afterwards, the ICTV (2022) standardized the abbreviation MPV to refer to the virus causing the infection and the WHO adopted the nomenclature "Mpox" to refer to the disease (OPAS, 2022).

However, it must be considered that the Mpox virus shares a degree of kinship, albeit distant, with the human smallpox virus, which decimated historical societies, including Aztec society following the Spanish invasion in the 16th century during the conquest of the Mexico (Franco-Paredes; Lammoglia; Santos-Preçado, 2004) . However, despite smallpox no longer being a contemporary health concern, Yang

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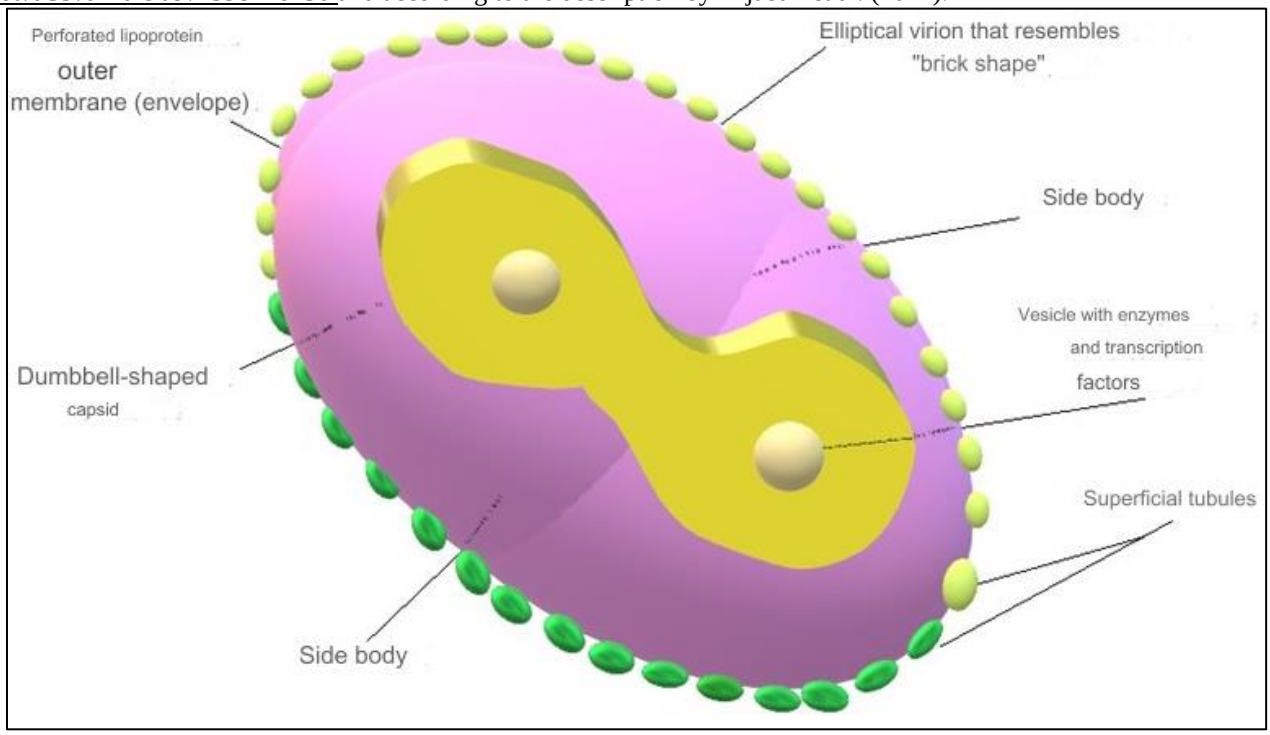
et al. (2022) and the CDC (2016), without alarming claims, agree about not underestimating the return of smallpox through unnoticed stocks of the virus.

However, Jacobs *et* al. (2009) emphasize that because MPV belongs to the same genus as VACV, they share the property of cross-immunization through smallpox vaccination. However, the WHO warned that the global population under the age of 45, not immunized for human smallpox, is more vulnerable to infection and, this, could trigger an epidemic or pandemic scenario due to MPV .

CLASSIFICATION AND MORPHOLOGY

The ICTV (2022) describes the Mpox virus (MPV) as another example of the *Orthopoxvirus genus* and the *Monkeypox virus species.* As such, MPV is a pleomorphic virus that can assume an elliptical, ovoid or parallelepiped shape, the latter characteristic being the most common, described as a "brick shape". The virus is enveloped with a lipoprotein surface membrane, sometimes in two layers, and exhibits globular or tubular projections on the envelope. The core takes on a cylindrical or dumbbell shape (biconcave) where the viral DNA and organized complex nucleoproteins are housed, exhibiting a typical characteristic of the *Poxviridae family*, the lateral bodies (Figure 1) (McInnes *et al.*, 2023).

Figure 1 Schematic image of the Mpox virus. Colored for illustration purposes only. Adapted from: https://www.gettyimages.pt/detail/fotografia-de-not%C3%ADcias/electron-microscope-image-of-various-virions-of-fotografia-de-not%C3%A d cias /1398416750 and according to the description by Aljabali et al. (2022).



EPIDEMIOLOGY AND INFECTION

The World Health Organization reported, as early as May 2022, the increase in *Monkeypox cases* outside the African continent and recommended urgent sanitary containment measures to prevent a possible new pandemic WHO (2023).

Since the alert, Brazil has adopted efforts to prevent infection and, through the Brazilian Ministry of Health, has issued communications to professionals and the population (MS, Brazil, 2024):

> As of January 30, 2024, 57,333 notifications for mpox were recorded. Of these, 11,212 (19.6%) cases were confirmed and 425 (0.7%) are classified as probable.
>
> From June 1, 2022 to January 30, 2024, the state of São Paulo appears as the state with the highest number of confirmed cases: 4,356 (37.4%), followed by Rio de Janeiro, with 1,610 (13.8%). %).
>
> Until the first month of this year, 16 deaths from mpox were reported in Brazil, 5 in Rio de Janeiro, 4 in Minas Gerais, 3 in São Paulo, 1 in Mato Grosso, 1 in Maranhão, 1 in Santa Catarina and 1 in Pará The average age of people infected with the virus is 31 years old, predominantly male.
>
> Although the regional scenario shows the need to maintain surveillance for new cases of Mpox in the country, the current scenario does not characterize an outbreak. The objective is to interrupt the transmission of the disease between people, with a priority focus on groups at high risk of exposure to the virus, with effective public health measures (CENTERS FOR DISEASE CONTROL AND PREVENTION, 2016)(Ministry of Health, 2024).

STREAMING

MPV infection is demonstrated by Tiecco *et al* . (2022) as zoonotic in nature , in which it can be transmitted through contact with bodily fluids from infected rodents, as well as the consumption of raw or poorly processed meat from these rodents, considered possible reservoirs of MPV, such as the Gambian pouched rat, the vole and follow the flow of infection to other species such as apes and humans . Despite this, De Sousa *et* al. (2022) add that it is not yet completely defined which animal species is a potential reservoir of the virus. Furthermore, the WHO (2023) emphasizes the accidental infection of the virus in humans and that transmission between humans, from the 2022 cases onwards, was perceived through close skin-to-skin contact and with body fluids such as: saliva, tract secretions upper respiratory tract (nose mucus) and direct intimate contact with oral, anal or vaginal sexual intercourse, touching the genitals of an infected person, kissing, hugging, massages and prolonged face-to-face contact.

SIGNS AND SYMPTOMS

The WHO (World Health Organization) clarifies that Mpox presents signs and symptoms between 1 and 21 days after exposure, but, on average, about a week . You Typical symptoms can last 2 to 4 weeks, but it emphasizes that in individuals with weak immunity, whether immunosuppressed by medication or a more serious medical condition (HIV co-infection), they can last longer, progress to severe conditions with secondary infections and culminate in death. However, the WHO reports that the

common symptoms of Mpox are: skin irritation, fever, sore throat, headache, myalgia, back pain, prostration and swollen lymph nodes. At first, symptoms vary, but skin irritation generally manifests as a flat lesion that evolves into vesicles with liquid inside that can be itchy or painful. Such lesions can appear on the palms of the hands or soles of the feet, face, mouth and throat, groin, genital area and anus, which may be painful in the affected areas of the body. As they heal, the lesions dry, crusts form and subsequently decay WHO (2023).

DIAGNOSIS

To date, the WHO highlights that the most efficient test is the real-time polymerase chain reaction (real-time PCR), which identifies more accurately from samples obtained from the fluids of skin vesicles. Furthermore, blood samples do not offer reliable results for a conclusive diagnosis for Mpox, since the best specimens for diagnosis are those that are directly obtained from *rash lesions* , even if inapparent on the skin, but which can be obtained from *swabs* in oropharyngeal, anal or rectal lesions. Therefore, we add the fact that Tiecco *et al* . (2022) report on obtaining the discrimination of MPV clades and the distinction of other *Orthopoxviruses* through PCR amplification of extracellular protein envelope markers, including the conserved regions of the B6R gene, E9L gene of DNA polymerase, POR18 gene of subunit 18 of DNA-dependent RNA polymerase , complement binding protein genes, C3L, F3L and N3R, as well as the enzyme-linked immunoassay test (ELISA) allows the detection of serum antibodies, IgM after 5 days and IgG after 8 days of infection, in patients with Mpox .

PREVENTION

Pre-exposure prophylaxis

Following the Advisory guidelines Committee on Immunization Practices (ACIP) – Immunization Practice Advisory Committee – Petterson ’s work *et al* (2016) report on the ACAM2000 vaccine with competent *vaccinia* virus replication , administered in a single dose, but intended for work situations with high risk of exposure to Mpox virus infection . But, due to the high-risk adverse effects of ACAM2000 such as: progressive vaccinia, vaccine eczema, myopericarditis and post-vaccine encephalitis, it later emerged as another alternative, reported in the study by Rao *et al* (2022), the JYNNEOS vaccine composed of attenuated virus, replicated incompetent vaccinia virus administered in two doses separated by an interval of 28 days.

Post-exposure prophylaxis

Tiecco *et al.* (2022) highlight that the United States CDC guide (2023), for post-exposure cases, non-specifically recommends that the vaccine it should be administered from 4 days after suspected

contact with infection, but warns about the fact that, in this situation, the intention of the vaccine administered between 4 and 14 days after exposure to the virus does not eliminate the chances of developing the disease, but it only alleviates the symptoms.

TREATMENT

From a thoughtful perspective, Rizk 's studies *et al.* (2022) reported that many cases of Mpox tended to be mild and self-limited infection and add that supportive treatment and symptom control are sufficient. These authors add that there is no specific medication that guarantees immediate cure, but the treatments available at the moment are the antivirals tecovirimat , brincidofovir , cidofovir and Vaccinia Immunoglobulin Intravenous (VIGIV), even so, their study warns that these antivirals should be considered for cases of severe disease, immunocompromised patients , pediatrics, pregnant and lactating women, patients with complicated lesions and when these appear close to the mouth, eyes and genitals. Given this, De Souza *et al.* (2022) agree with conservative treatment with analgesics to alleviate symptoms combined with VIGIV and monitoring of patients with severe Mpox and acute HIV co-infection , as these are the patients who cause the most problems.

GOAL

In order to seek to understand the human-disease relationship, the work aims to investigate the spread of the disease among countries that have manifested the disease outside the African continent, especially in North American countries (Canada, United States and Mexico), Central America (El Salvador and Guatemala) and South America (Argentina, Brazil, Chile, Colombia, Peru), whose populations manifested significant numbers of Mpox cases according to the population density of the countries. At the same time, it seeks to provide a literature review on Mpox with respect to epidemiology, infection, transmission, signs and symptoms, prophylaxis, treatment of a disease that is little known worldwide and has a neglected disease *status* . Furthermore, we seek to establish a relationship with the social aspects that contribute to the virus continuing to coexist with humans, causing damage to the health of infected populations, and to observe, through the sources consulted, whether the virus has pandemic potential.

METHODOLOGY

The research is a cross-sectional study that aims to investigate the prevalence of the disease in the main countries of the Americas and Brazil, which presented increasing cases of Mpox according to the population of these countries.

As it is a relatively new disease in areas outside the African continent, investigation of Mpox disease with respect to epidemiology, signs and symptoms, prevention and treatment was considered. Furthermore, the data is very limited, especially regarding the fact that it is a somewhat neglected disease, there are few reference laboratories with diagnostic capacity, as is the reality in Brazil, but even so, they express the national reality as stated in the work by Pascom *et al.* (2022). Measures to control and prevent the interests of social segments are still timid in most countries.

Therefore, regarding data from other countries, it was decided to investigate them based on publications from the websites of health bodies with international support and reach, such as the World Health Organization (WHO) and also the US body *Centers for Disease Control and Prevention* (CDC), as well as foreign publications in the biomedical field from the websites PubMed , National Center for Biotechnology Information , National Library of Medicine and other similar sites using the descriptors: "*Monkeypox* ", "*smallpox*", "*Monkeypox diagnosi* ", "*Monkeypox treatment*", "*Monkeypox outbreak*", "*Poxviridae"*, "*Orthopoxvirus"*.

Through these searches, data on populations affected by the disease were accessed, tables and graphs were created that provide a portrait of the epidemiological and social aspects involving Mpox infection. Therefore, given this scenario, below is the data presented by health surveillance and global health bodies, according to the populations of countries on the American continent that presented significant numbers of Mpox cases, obtained in February 2023. Furthermore, with respect to Brazil, data referring to cases determined up to July 14, 2023 was added and, in the epidemiology section, current data was inserted up to January 2024.

RESULTS

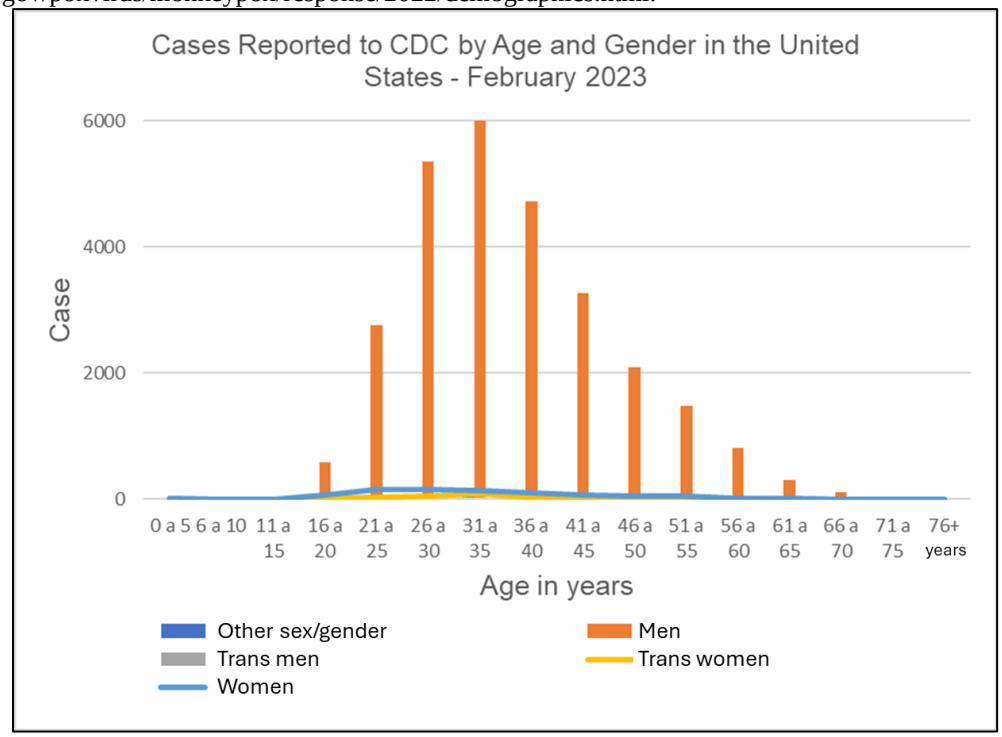
The data was grouped into tables and graphs, as follows:

Table 1: The table breaks down the numbers of cases according to the relationship between age groups and genders of individuals diagnosed with Mpox by February 19, 2023 in the United States. The data was obtained from the website: https://www.cdc.gov/poxvirus/monkeypox/response/2022/demographics.html. *Other sex/gender: the CDC used this term to refer to the other genders in the LGBTQIAPN+ acronym: Bisexual, Lesbian, Pansexual, Intersex , Queer and Non-binary.

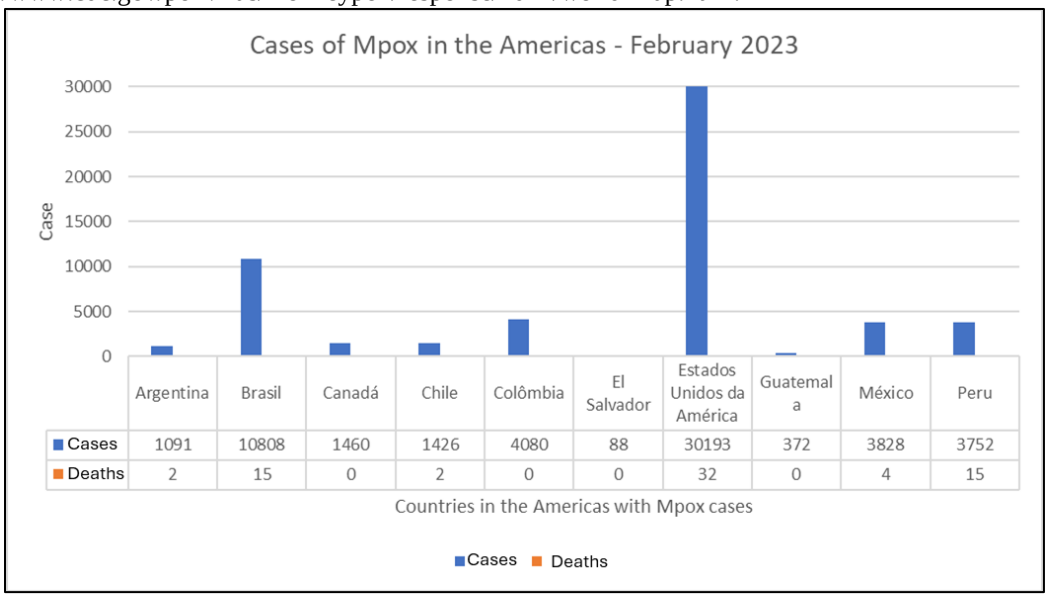
Age – groups	Other sex/gender*	Cis men	Trans men	Trans women	Cis women
0 to 5	0	24	0	0	11
6 to 10	1	5	0	0	5
11 to 15	0	10	0	0	5
16 to 20	9	583	7	9	63
21 to 25	36	2754	17	37	163
26 to 30	52	5356	17	51	161
31 to 35	52	6553	10	80	137
36 to 40	35	4721	9	35	103
41 to 45	26	3264	5	25	74
46 to 50	13	2091	5	17	55
51 to 55	9	1486	two	7	46
56 to 60	1	812	0	3	18

61 to 65	1	299	0	1	9
66 to 70	0	105	0	0	5
71 to 75	0	35	0	1	1
76+ years	0	5	0	0	4

Graphic 1: The graph breaks down the number of cases according to the relationship between age groups and genders of individuals diagnosed with Mpox in the United States until February 19, 2023. It is possible to observe that the orange bars represent the population of cis men with greater number of cases, especially among those aged 31 to 35 years. The other gender groups that accounted for fewer cases of the disease were represented in lines. The data was obtained from the website: https://www.cdc.gov/poxvirus/monkeypox/response/2022/demographics.html.



Graphic 2: Graph of Mpox cases in the countries of the Americas until February 2023 constructed from data obtained from the website: https://www.cdc.gov/poxvirus/monkeypox/response/2022/world-map.html.



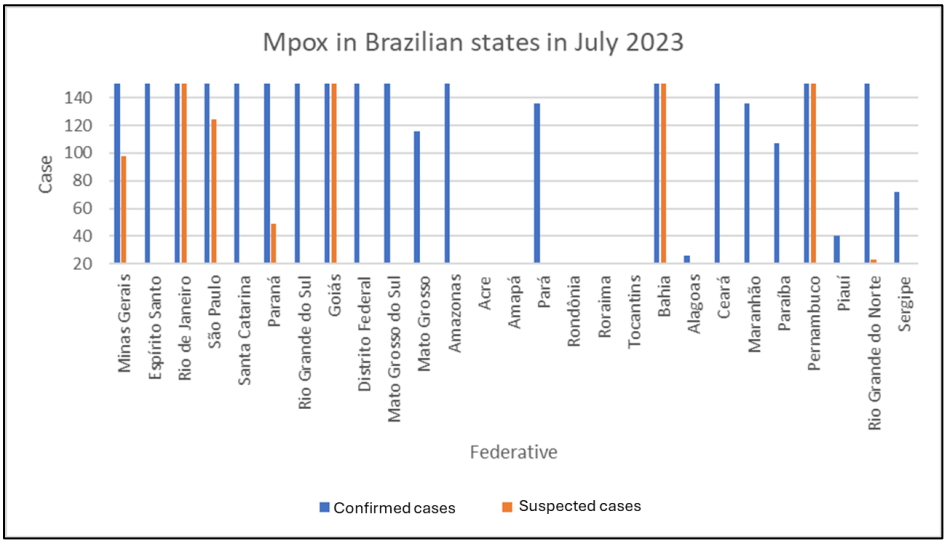
	Argentina	Brasil	Canadá	Chile	Colômbia	El Salvador	Estados Unidos da América	Guatemala	México	Peru
Cases	1091	10808	1460	1426	4080	88	30193	372	3828	3752
Deaths	2	15	0	2	0	0	32	0	4	15

MPOX - EPIDEMIOLOGICAL SITUATION IN BRAZIL ON JULY 14, 2023

Table 2: Table of absolute numbers of Mpox cases in Brazilian states until July 2023 constructed from data obtained from the website: https://www.gov.br/saude/pt-br/composicao/svsa/coes/monkeypox /atualizacao-dos-casos/card-situacao-epidemiologica-de-monkeypox-no-brasil-no184/view.

		Cases		
Regions	**Federation Units**	**Confirmed**	**Suspects**	**Deaths**
Southeast	Minas Gerais	617	98	4
	Espírito Santo	164	13	
	Rio de Janeiro	1395	244	5
	São Paulo	4350	124	3
South	Santa Catarina	469	20	1
	Paraná	299	49	
	Rio Grande do Sul	330	13	
Midwest	Goiás	566	314	1
	Distrito Federal	359	9	
	Mato Grosso do Sul	161	0	
	Mato Grosso	116	1	
North	Amazonas	352	18	1
	Acre	1	0	
	Amapá	4	3	
	Pará	136	0	
	Rondônia	9	1	
	Roraima	8	0	
	Tocantins	12	4	
Northeast	Bahia	160	398	1
	Alagoas	26	0	
	Ceará	583	two	
	Maranhão	136	1	
	Paraíba	107	0	
	Pernambuco	343	539	
	Piauí	40	0	
	Rio Grande do Norte	152	23	
	Sergipe	72	0	
Brazil		10,967	1,874	16

Graph 3: Graph of Mpox cases in Brazilian states constructed from data obtained from the website: https://www.gov.br/saude/pt-br/composicao/svsa/coes/monkeypox/atualizacao-dos-casos/ card-situacao-epidemiologica-de-monkeypox-no-brasil-no184/view.



DISCUSSION

Far from stigmatizing any population affected by the disease, it must be made clear that the virus does not choose which humans it will attack, this way the virus can affect any people who are in situations favorable to infection . The virus does not choose gender, social class, color, religion or any other social distinctions that make society and health institutions disregard health care for people affected by the infection.

Thus, through Table 1 and Graph 1, which display data reported by the CDC on the American population, expressed up to February 2023, infection by the Mpox virus affected several female and male people, but was very concentrated in people LGBTQIAPN+ and Men who have Sex with Men (MSM), therefore, it is known that the infection can be established through unprotected sexual intercourse, but the sexual route is not the only transmissible route , and does not require exclusively genital contact to effect the streaming.

Furthermore, using the same Table 1 and Graph 1, it is possible to observe the manifestation of infection among different age groups. In this way, it is observed that the virus has reached extreme ages , from the youngest to the oldest, however it is noticeable that male individuals (*cis men*) aged between 31 and 35 years old are notable for the skyrocketing numbers of cases compared between the other genders and ages that made up the research list of Mpox cases until February 2023.

Through Graph 2 it can be seen that the infection reached other countries in North America: Canada and Mexico. However, the skyrocketing number of cases is in the United States of America (USA), with the most significant numbers among the countries in the region. Further on, in Central America, despite the populations of these countries being smaller compared to other countries of continental dimensions in the North and South America region, one cannot underestimate the numbers, which are also expressive, such as those presented in Guatemala and El Savior. In South America, Brazil has the highest number of cases, followed by Colombia, Peru, Chile and Argentina.

Furthermore, data on Brazil in Table 2 and Graph 3 show a growing number across the country's states, especially those in the Southeast, with emphasis on São Paulo and Rio de Janeiro, but it is not a case of underestimating the numbers presented in the states of other regions of the country. It is worth mentioning that the WHO, considering the possibility of Mpox becoming a pandemic disease, reduced this risk for *Monkeypox* (PAHO, 2023).

However, it is still important to maintain supervision and monitoring of populations vulnerable to Mpox infection around the world, especially in those countries whose epidemiological data are poorly monitored, as, first and foremost, fighting and preventing viral diseases or any other etiological agent, It involves both individual and collective human actions that encompass the voluntary and supportive participation of various social segments, from the political field to individuals' homes. In this sense, to

achieve the preventive effect it is necessary to accurately understand the behavior of the etiological agent along with human lifestyle (JR, 2021).

FINAL CONSIDERATIONS

In view of this, the low risk of Mpox being a pandemic disease does not mean zero risk and it is not wise to underestimate it. Therefore, it is important to consider that the various social, governmental and non-governmental segments encourage scientific studies and research, encourage prevention and control measures with respect to the habits of different human cultures that favor the perpetuation of the Mpox virus and other pathological agents. The current interest in communicable diseases is not just a biomedical interest; This also implies a synergy with society through its sociais and political leaders together with the support of the population who must act in harmony on such issues.

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