Elsevier has created a Monkeypox Information Center in response to the declared public health emergency of international concern, with free information in English on the monkeypox virus. The Monkeypox Information Center is hosted on Elsevier Connect, the company's public news and information website.

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Possibility of vertical transmission of the human monkeypox virus

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Dear Editor,

The origin of the monkeypox virus (MPXV) can be traced as far back as 1958 when an outbreak of a pox-like disease occurred in colonies of monkeys kept for research in the Democratic Republic of the Congo (DRC) [1-3]. African rodents and non-human primates (including monkeys) were thought to be hosts to the virus, which gradually transmitted to humans and made them infectious. The spread was initially attributed to human contact with infected rodents, which then spread through skin-to-skin contact with an infected person. In 2003, more than 70 people in the United States of America (U.S.A.) contracted monkeypox after handling prairie dogs that were kept together with infected Gambian rats and hamsters imported from Ghana. This correspondence highlights the possibility of the vertical transmission of MPXV (see Fig. 1).

1. Transmission to humans

Human-to-human transmission (HHT) of MPXV occurs when an individual comes into contact with an infected animal, person, or contaminated material [4]. In addition to entering the body through broken skin (including wounds invisible to the naked eye), the virus can spread largely through fluid or droplets into the mouth, nose, or eyes. As these droplets are heavy and often unable to propagate more than a few feet, prolonged contact is required for person-to-person transmission. As a result, the ones at high risks are individuals who share a household with an infected individual, healthcare workers, and veterinarians who are likely to come into immediate and prolonged contact with infected humans or species of animals susceptible to the MPXV.

In the 2022 outbreak, monkeypox cases were detected frequently in men who have sex with men. To date, although evidence points in this direction, it is uncertain whether monkeypox can specifically be transmitted via sexual contact. Nevertheless, this mode of transmission, coupled with the spread of MPXV in non-endemic countries, have led many to question whether the virus, similar to acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has mutated to accommodate and to ease HHT [1]. Initially, it was thought that MPXV, a type of DNA virus that detected and corrected mutations better than RNA viruses such as SARS-CoV-2, should have been less likely to acquire rapid mutations. Yet, the virus has been circulating in European countries (the epicenter of the current epidemic) for longer than originally thought possible, suggesting that it is continually acquiring mutations that counteract human immune response [5]. More research is needed for a better understanding of the mechanisms by which the virus is responsible for the influx of cases.

2. Possibility of a vertical transmission

Due to the reopening of borders after the coronavirus disease 2019 (COVID-19) infections were more contained, international travel between nations have resumed. Pregnant women are at a high risk of contracting monkeypox while travelling.

Two of four pregnant women from the DRC who contracted monkeypox between 2007 and 2011 experienced spontaneous early miscarriages, and another experienced a second-trimester loss at 18 weeks of gestation after contracting the virus (likely from the central African clade of the virus) [6]. Two MPXV DNA were found in the placenta, umbilical cord, and fetal tissue of the stillborn fetus, demonstrating vertical transmission of the MPXV. The stillborn fetus also developed a generalized skin rash. Human infections with monkeypox and smallpox (a closely related orthopoxvirus) can carry a high risk of severe congenital infection, pregnancy loss, and maternal morbidity and mortality [7].

It is believed that the MPXV is shed in the amniotic fluid only once the fetal kidneys produce enough urine (i.e., after 18–21 weeks of gestation), in a manner similar to the cases of cytomegalovirus, toxoplasmosis, and Zika virus infections. It is advised for viral load in the placenta and umbilical cord blood to be measured and real-time PCR performed on the specimens taken from the newborn [8]. In another case report, a pregnant lady who contracted the infection at roughly 24 weeks' gestation gave birth to a preterm baby six weeks later. The infant, who had a broad skin rash resembling monkeypox, passed away from

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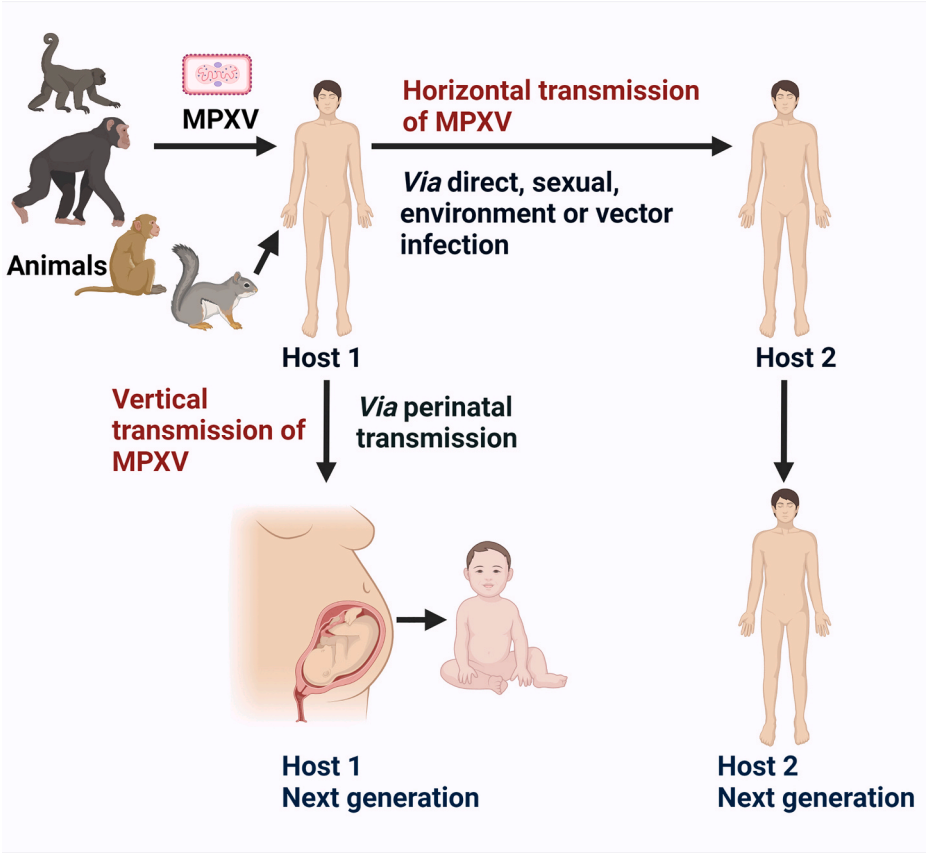

Fig. 1. The figure represents the horizontal and vertical routes of monkeypox virus (MPXV) transmission.

malnutrition.

Data on monkeypox in pregnancy are clearly limited and are subject to reporting biases. There is currently no evidence for a risk of viral transmission to the infant during breastfeeding, whether via breast milk, direct contact with maternal skin lesions, or via large droplet spread. Recently, on July 23, 2022, the Centers for Disease Control and Prevention (CDC), U.S.A. has confirmed its first case of monkeypox for this year in a pregnant woman. The woman and her child were reportedly healthy. However, the report failed to mention whether or not confirmatory tests were performed on the newborn.

In conclusion, there is little data to support the probability of vertical transmission of monkeypox disease in pregnant women. However, there is a high possibility given that the related orthopoxvirus, smallpox, was associated with an increased risk for maternal and perinatal comorbidities and mortality, including spontaneous miscarriage, fetal death, and premature birth.

Ethical approval

This article does not require any human/animal subjects to acquire such approval.

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Author contribution

Mathumalar Loganathan Fahrni: Conceptualization, Data Curation, Writing - Original Draft, Writing - review & editing. **Priyanka:** Conceptualization, Data Curation, Writing - Original Draft, Writing - review & editing. **Om Prakash Choudhary:** Conceptualization, Supervision, Writing - Original Draft, Writing - review & editing. All authors critically reviewed and approved the final version of the manuscript.

Conflicts of interest

All authors report no conflicts of interest relevant to this article.

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Om Prakash Choudhary, Assistant Professor (Senior Scale), Department of Veterinary Anatomy and Histology, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University (I), Selesih, Aizawl-796015, Mizoram, India. Tel: +91–9928099090; Email: dr.om.choudhary@gmail.com.

Data statement

The data in this correspondence article is not sensitive in nature and is accessible in the public domain. The data is therefore available and not of a confidential nature.

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Mathumalar Loganathan Fahrni
Faculty of Pharmacy, Universiti Teknologi MARA (UiTM) Puncak Alam Campus, Selangor Branch, 42300 Bandar Puncak Alam, Selangor Darul Ehsan, Malaysia

Priyanka[**]
Department of Veterinary Microbiology, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Rampura Phul, Bathinda, 151103, Punjab, India

Om Prakash Choudhary[*]
Department of Veterinary Anatomy and Histology, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University (I), Selesih, Aizawl, 796015, Mizoram, India

[**] Corresponding author.

[*] Corresponding author.
E-mail address: priyanka7malik@gmail.com (Priyanka).
E-mail address: dr.om.choudhary@gmail.com (O.P. Choudhary).