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The possible effect of sociobehavioral factors and public health actions on the mpox epidemic slowdown

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ABSTRACT

Objectives: A pre-exposure vaccination campaign to prevent the spread of the mpox virus was initiated in Italy in August 2022. We explore the possible factors affecting the trend of mpox cases in an Italian region (Lazio) with a rapid roll-out of the vaccination campaign.
Methods: We estimated the impact of the communication and vaccination campaign by fitting a Poisson segmented regression model. Results By September 30, 2692, high-risk men who have sex with men had received at least one dose of vaccine, with a vaccination coverage of 37%. The analysis of surveillance data showed a significant decreasing trend in the number of mpox cases starting from the second week after vaccination (incidence rate ratio 0.452 [0.331-0.618]).
Conclusion: The reported trend in mpox cases is likely to result from a combination of multiple social and public health factors combined with a vaccination campaign.

As of January 16, 2022, more than 83,000 mpox (formerly known as monkeypox) cases have been confirmed worldwide in 102 nonendemic countries [1], involving predominantly (96%) young men who have sex with men (MSM) [2]. Public health measures and vaccination for high-risk groups were recommended by the World Health Organization to contain the outbreak. Herein, we explore the possible social/behavioral and public health factors that influenced the epidemiological trend of mpox cases from the beginning of the vaccination campaign (August 8), the second week of the vaccination campaign (August 22), until November 30 in one Italian region (Lazio). The target population for the recommended pre-exposure vaccination was defined as gay, bisexual, or other MSM; reporting multiple sexual partners; participation in group sex events; sexual encounters in clubs/cruises/saunas; recent sexually transmitted infections; or with sexual acts associated with the use of chemical drugs. The details on the vaccination campaign are given in the Supplements (S1).

Using interrupted time series analysis and visual inspection of the data [3], we compared data from the Regional Surveillance System of Infectious Diseases of the Lazio Region across three periods (i) prescale-up of media and public communication (May 9-June 12), (ii) postscale-up of media and public communication campaign (June 13-August 21), and (iii) postvaccination campaign (August 22-November 30), defined as 14 days after the administration of the first vaccine dose. We estimated the impact of the communication and vaccination campaign, the pre and postcommunication and vaccination trends, and the slope changes after the two campaigns by fitting a Poisson segmented regression model with Newey-West standard errors to account for autocorrelation and heteroskedasticity [3,4].

As of November 30, a total of 160 mpox cases have been reported to the Regional Surveillance System of Infectious Diseases of the Lazio Region. The epidemic curve is shown in Figure 1. The last date of symptom onset has been reported as October 27.

The Poisson segmented regression model showed a weekly increase of 66.1% before the scale-up of public and media communication (incidence rate ratio [IRR] 1.661 [95% confidence interval, 1.549-1.781]), followed by no evidence of immediate effect of the

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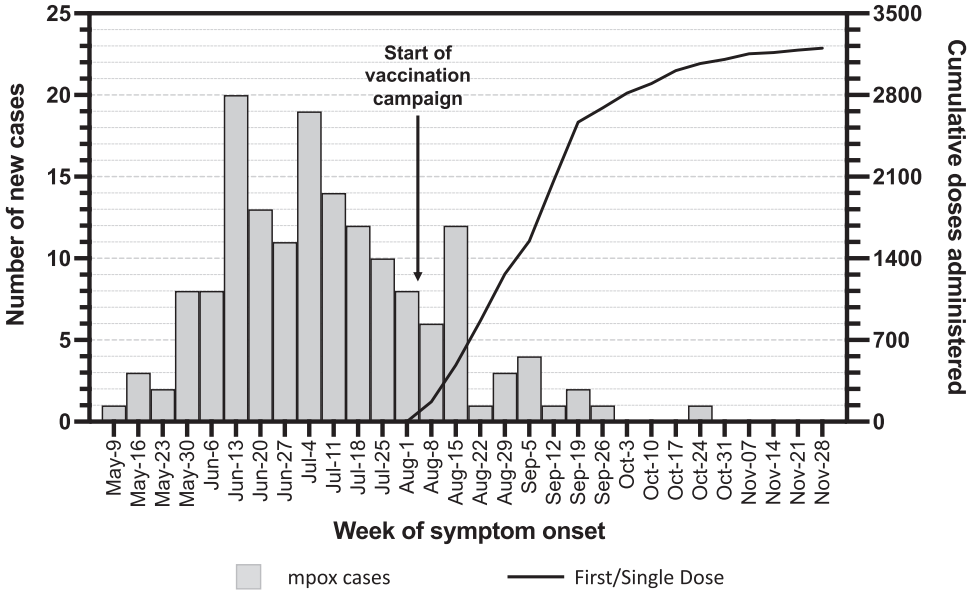

Figure 1. Epidemic curve of mpox confirmed cases in the Lazio region (May-November 2022) and daily cumulative number of administered mpox vaccination (schedule completed) from the start of the vaccination campaign (August 8, 2022 up to November 30, 2022).
Mpox, monkeypox.

Table 1
Poisson segmented regression model of the impact of communication and vaccination campaign on the weekly number of monkeypox cases in one Italian region (Lazio) from May 9, 2022 to November 30, 2022.

Time/period	Incidence rate ratio (95% confidence interval)
Scale-up of public and media communication (June 13-19)[a]	0.971 (0.800-1.179)
Prescale-up of communication trend	**1.661 (1.549-1.781)**
Postscale-up-of mass communication trend	**0.926 (0.899-0.952)**
Vaccination (August 22-28)[a]	**0.452 (0.331-0.618)**
Post- vaccination trend	**0.734 (0.673-0.801)**
End of study period[a]	**0.018 (0.007-0.047)**
Slope change following scale-up of communication	**0.557 (0.519-0.598)**
Slope change following vaccination	**0.793 (0.725-0.868)**

[a] Compared with counterfactual.

communication campaign (IRR, 0.971 [0.772-1.221]) and a 54.8% decrease in the second week of vaccination compared with the counterfactual value of postscale-up of media and public communication campaign (IRR, 0.452 [0.331-0.618]). Moreover, the number of mpox cases showed a decreasing trend of 7.4% (IRR, 0.926 [0.899-0.952]) and 26.6% (IRR, 0.734 [0.673-0.801]) per week in the postscale-up of media and public communication campaign and the postvaccination period, respectively. The reduction in case incidence is in line with the surveillance data reported worldwide [5] (Table 1).

The model shows how the combination of several factors, such as communication and vaccination, influenced the outbreak. In the United States, approximately half of MSM reduced high-risk sexual behaviors as information about the mpox epidemic increased [6]. Similarly, in the Lazio region, since the first mpox report in May 2022 [7], the community has been involved in reaching out to high-risk individuals through key messages on sexual health and prevention and a scale-up of media and public communication was observed in the second week of June. In our study, 88.4% of participants reported at least one higher risk sexual intercourse during the 21 days preceding the symptom onset in the period between May and July than 76.3% during the period between August and November 2022. Nevertheless, a study conducted in the United Kingdom showed that behavioral changes had the highest impact in symptomatic cases, and most high-risk sexual networks were infected early in the outbreak [8]. Moreover, most individuals with mpox reported participating in gathering events [2,8], which declined with the end of the summer, concomitant with mpox cases, suggesting their possible role in amplifying the transmission [9]. The data from contact tracing interviews showed that during the period May-July, 21% reported participation in an event/festival compared with 10.5% during the period August-November.

Thus, the indirect role of the vaccination campaign in implementing mpox exposure mitigation strategies adapted by MSM [10] was probably essential in reducing mpox cases, as observed.

However, in line with the UK Health Security Agency communication [11], which said that a single dose of the MVA-BN smallpox vaccine provides around 78% protection against mpox 14 days after vaccination [12]—a possible direct effect of vaccination in reducing cases could also be during the second week after the start of the vaccination campaign and is shown with the weekly decrease in the incidence rate—after the vaccination campaign of 26.6% in addition to the decreasing trend after communication campaign. The estimated Lazio vaccination coverage of 44% among high-risk people could partially explain the more pronounced decrease in the incidence rate at the end of the analysis period, with a decrease of over 90%. In a recent network-based model, the coverage of vaccination of high-risk MSM of 5%, 25%, and 50% resulted in a 56%, 91%, and 95% reduction in the number of cases, respectively [13], and US reports showed that mpox incidence was 14-times higher among unvaccinated than those vaccinated with at least one dose ≥14 days earlier [14]. Taking into account the limitation arising

from the estimation of the coverage and the partial quantification of the effect of the information campaign, we suggest that control strategies integrating vaccination with information and sensitization campaigns played a role in limiting the mpox spread outside the affected communities and avoiding exposure, as well as in the immediate postvaccination period.

Declaration of competing interest

The authors have no competing interests to declare.

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Ethical approval

The data were recorded as part of routine surveillance activities and from database of two observational studies approved by ethical committee (Monkey-Vac protocol: “Studio prospettico osservazionale per monitorare aspetti relativi alla sicurezza, all’efficacia, all’immunogenicità e all’accettabilità della vaccinazione anti Monkeypox con vaccino MVA-BN [JYNNEOS] in persone ad alto rischio”, approval number 41z, Register of Non-Covid Trials 2022; Monkey-Cohort protocol: “Studio di coorte osservazionale monocentrica su soggetti che afferiscono per sospetto clinico o epidemiologico di malattia del vaiolo delle scimmie [Monkeypox]”; approval number 40z, Register of Non-Covid Trials 2022). Data have been analyzed anonymously.

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Author contributions

FVairo, AA, EG, VM, and FVaia led the development of the manuscript and revised the content; SL and PP analyzed the data, SLa, RG, and GDC contributed to the writing, gathered data, and reviewed the manuscript. GR, AS, and AB provided national and regional public health support and advice; RM and EN provided input into the protocol and comments on the final article. All authors read and approved the manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2023.03.005.

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