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Predictors of Mpox vaccine uptake among sexual and gender minority young adults living in Illinois: Unvaccinated vs. double vs. single dose vaccine recipients

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ABSTRACT

Introduction: The 2022 global outbreak of Monkeypox virus (Mpox), which has primarily spread through the sexual networks of sexual and gender minority (SGM) individuals, has introduced new public health challenges. While an efficacious Mpox vaccine is in active circulation, few Mpox vaccine studies have examined its uptake among SGM groups. The aims of this study were to investigate (a) the prevalence of Mpox vaccine uptake among SGM and (b) the contextual, Mpox-disease specific, and Mpox-vaccine specific factors associated with Mpox vaccine among SGM.

Methods: We conducted a cross-sectional survey in Illinois, USA in September 2022; 320 young SGM completed self-administered questionnaires. Multinomial logistic regression was used to assess the contextual, Mpox-disease specific, and Mpox-vaccine specific factors associated with Mpox vaccine uptake. Adjusted Odds Ratios (aORs) and 95 % Confidence Intervals (CI) are reported.

Results: Approximately 50 % of the SGM participants included in this study had received at least their first dose of the Mpox vaccine. Multinomial regression analysis showed that individuals who had recently experienced food insecurity, had higher degrees of fear of social rejection due to Mpox acquisition, and were more Mpox-vaccine hesitant were more likely to be unvaccinated. Conversely, knowing people who have contracted Mpox, having higher formal educational attainment, having higher degrees of Mpox-related internalized heterosexism, and being more concerned about one's safety regarding Mpox morbidity were more likely to be double-dosers.

Conclusion: Approximately 50 % of the SGMs included in this study received at least their first dose of the Mpox vaccine; however, only one-quarter of participants completed the recommended 2-dose Mpox regimen. Our findings indicate that socioeconomic stability, fear of social rejection due to disease acquisition, and Mpox-specific vaccine hesitancy may be important structural targets to consider when developing vaccine-uptake prevention and intervention strategies tailored to the needs of sexual and gender minorities.

1. Introduction

The 2022 global outbreak of Monkeypox virus (Mpox), a rare zoonotic disease caused by an orthopoxvirus, is of significant public health concern [1]. Between January 1, 2022, and September 30, 2022, the ongoing Mpox outbreak resulted in a total of 68,428 confirmed cases and 8 deaths; most cases were from countries where Mpox is not endemic [2]. Due to the rapid increase in global Mpox cases, the World Health Organization (WHO) declared the global Mpox outbreak a Public Health Emergency of International Concern on July 23, 2022 [3]. It should be noted that at the present stage of the 2022–23 global Mpox outbreak, where reported cases are low, frequency of reporting of cases has decreased substantially [4].

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During the outbreak, close physical contact, particularly prolonged close contact, was the main route of human-to-human Mpox transmission [5]. Transmission may have occurred through contact with skin lesions of infected patients, contaminated objects, and respiratory droplets [6,7]. Although direct skin-to-skin contact during sexual activities could spread the virus, there is contradictory evidence as to whether Mpox could be spread through sexual contact, specifically through semen or vaginal fluids [5,8]. Recent research suggest that there is a high prevalence of positive MPXV DNA in semen and vaginal fluid specimens; however, the infectivity of these specimens is yet to be determined due to current insufficient evidence regarding viral replication competence [9]. Despite these unknowns, public health response efforts generally focused on sexual transmission routes and identified sexual minorities (SM), particularly young men who have sex with men (MSM) and those living in densely populated metropolitan areas, among the most at-risk for infection [10–12]. As such, there have been concerted efforts to address this escalating outbreak through targeted early-epidemic vaccination programming within MSM and broader sexual and gender minority (SGM) communities [13]. This type of messaging reinforces pervasive narratives concerning SGM communities being vectors of STIs. The perpetuation of these harmful narratives is particularly distressing as, while reports have provided initial evidence for sexual transmission, but this route is likely implicated in a minority of infections [10,14].

Unlike the rapid vaccine development that was required to curtail the COVID-19 pandemic, the smallpox vaccine Jynneos (also known as MVA) is the only one licensed for Mpox and is valid in the US, Canada, the European Union, and the United Kingdom [15]. Because Jynneos is normally an emergency stockpile drug against smallpox, the US had a supply of the vaccine available in its Strategic National Stockpile, as well as two other antivirals that could be used as treatment [16]. While not specifically developed to vaccinate participants against Mpox, Jynneos has consistently been found to provide protection against Mpox infection [17–19]. Regardless, the potential effectiveness of an Mpox vaccine in addressing the current outbreak is dependent upon its uptake [20].

Prior infectious disease research suggests that there are a variety of multilevel factors that enable vaccination [21]. For instance, on the individual-level, the health belief model (HBM) suggests that a person's belief in a personal threat of an illness or disease (in this case, Mpox) together with a person's belief in the effectiveness of the recommended health behavior (in this case, vaccination) will predict the likelihood of uptake [22]. The HBM consists of five constructs proposed to influence the likelihood of vaccine uptake: perceived susceptibility (perceptions of the likelihood that one will experience the outcome), perceived severity (perceptions of the seriousness of the consequences associated with the outcome), perceived benefits (potential advantages of engaging in the health behavior, including the behavior's perceived efficacy in preventing the undesired outcome), perceived barriers (perceived obstacles to engaging in the health behavior), and cues to action (factors that signal or remind an individual to engage in the health behavior) [21]. While the HBM is one of the most widely used models for understanding health behaviors, it has several limitations particularly related to its lack of attention to economic and environmental factors (e. g. food insecurity) social power processes (e. g. identity-related stigmas) that also have a profound influence on health behavior [23,24]. Dahie et al. demonstrated how social characteristics such as sex, age, and formal educational attainment were associated with early uptake of the COVID-19 vaccine, while vaccine accessibility and vaccine hesitancy were associated with late uptake of the vaccine [25,26]. Further research has noted that structural factors, such as segregationist city planning and distribution of healthcare centers, as well as identity-related stigmas, have prevented equitable uptake of effective preventive treatments, such as Gardasil, a vaccine, for human papillomavirus (HPV) prevention [27,28]. Differential speeds in the uptake of vaccines among populations who are at higher risk of becoming infected is of public health concern because unvaccinated individuals remain highly susceptible to disease acquisition for longer periods of time, which contributes to the perpetuation of an infectious disease outbreak [29]. To date, this line of research has yet to be translated to the recent Mpox outbreak context.

1.1. The current study

Informed by prior investigations of vaccine uptake for infectious diseases [30–33], we conducted an cross-sectional study examining Mpox vaccine uptake among a sample of SGM individuals in Illinois, USA. Additionally, we sought to examine exploratory hypotheses regarding the contextual, Mpox-disease specific, and Mpox-vaccine specific factors associated with Mpox vaccine uptake among SGM individuals.

2. Methods

2.1. Parent study

Keeping it LITE examined HIV risk factors in young adults from December 2017 through December 2019 (n = 3444) [34]. Baseline eligibility requirements include living in the United States; identifying as a cis- or transgender man, transgender woman, or non-binary person who has sex with persons assigned male at birth; being between the ages of 13 and 34; and reporting an HIV-negative test or receiving an HIV diagnosis in the last year. In addition, participants 18 and older were required to report at least one of the following in the last 6 months: 1) condomless anal sex; 2) sex with a partner living with HIV; or 3) a bacterial sexually transmitted infection (STI). Participants ages 13–17 were eligible if they reported the above behaviors or engaging in unprotected oral sex with a person assigned male at birth. Recruitment methods include word of mouth, digital advertising, social media messaging, text messaging, and social apps with an LGBT focus.

2.2. Monkeypox (Mpox) substudy

All Keeping it LITE participants living in Illinois, USA who continued to actively participate through December 2021 (n = 469) were offered the opportunity to participate in a substudy focused on the Mpox outbreak. Invitations to a REDCap survey were sent out to the 469 participants; 5 invitations to each individual were sent between 09/10/22 and 09/20/22. A total of 322 individuals (68.7 %) completed the survey and were compensated with a $20 gift card for their time and attention. Substudy participants completed written informed consent forms before participating. Study activities were approved and overseen by Cook County Health's (CCH) Institutional Review Board (IRB #17–555-CORE).

Limited quantities of Mpox vaccine first became available in Illinois, USA in July 2022 [35]. The vaccine then became more widely available in mid-August 2022 when the local governor declared Mpox a public health emergency [35]. Our study's proximity to the wide-spread availability of the Mpox vaccine provided us with a unique opportunity to examine the contextual and structural factors associated with SGM individual's Mpox vaccine uptake. We limited the number of participants included in this analysis to those who had no missingness on any of the study variables of interest, which resulted in an analytic sample of 320.

2.3. Measures

2.3.1. Mpox vaccine uptake

Vaccine uptake was determined by asking "Have you received the Mpox vaccine?" Response options included (0) no, (1) yes, 1 dose, and (2) yes, 2 doses. Respondents who had not begun a vaccine regimen were categorized as *unvaccinated*. For the purposes of this study, individuals who had received both doses of the vaccine were categorized as *double-dosers*. Individuals who had received one dose of the vaccine were categorized as *single-dosers*. According to the CDC, the recommended dosing interval between dose 1 and dose 2 is approximately 28 days (4 weeks); however, available clinical study data suggests that the dose can be given up to 7 days later than the minimum interval of 28 days (i.e., up to 35 days after the first dose) and remain effective. Data was collected 2 months after the Mpox vaccine was first limitedly distributed.

2.3.2. Identity-based discrimination

Experiences of identity-based discrimination were assessed using the 10-item version of the Intersectional Day-to-day Discrimination Index [36]. Participants are asked how often a variety of experiences have happened to them in their "day-to-day life" in the past year. Items were rated for frequency on a 4-point Likert-type scale from 0 (*never*) to 3 (*yes, many times in the past year*). Items were summed to produce an identity-based discrimination sum score where higher scores correspond to a higher frequency of identity-based discrimination. Cronbach's alpha was 0.92.

2.3.3. Food insecurity

Participants were asked to describe whether the statement, "The food that we bought just didn't last, and we didn't have money to get more" was true for them and the other members of their household in the last 12 months. A 3-point Likert scale ranging from 0 (*never true*) to 2 (*often true*) was used to document participant responses.

2.3.4. Mpox vicarious exposure

Participants were asked if they were secondarily exposed to Mpox via any of their family members, friends, serious partner/spouse, sexual partners, or coworkers having tested positive for Mpox. These dichotomized items (no = 0; yes = 1) were summed to produce a total Mpox vicarious exposure score.

2.3.5. Mpox-related internalized heterosexism

Participants were asked to report their belief in certain Mpox-related anti-LGBTQ+ rhetoric statements. Captured by asking participants to rate their agreement on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) to the following three items: 1) Monkeypox infection means you are promiscuous, 2) A person with Mpox has engaged in same-sex sexual behavior, and 3) It is safe to assume that a person with Mpox is gay. Items were summed to produce a sum score where higher scores were indicative of higher levels of Mpox-related internalized heterosexism. Cronbach's alpha was 0.83.

2.3.6. Mpox morbidity stigma

Captured using a four-item scale. Participants were asked to rate their agreement using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) to the following statements: 1) I would avoid people who have Mpox, 2) People with Mpox have participated in immoral activities, 3) People with Mpox engaged in irresponsible behavior, and 4) It's one's own fault for contracting Mpox. Items were summed to produce a sum score where higher scores were indicative of higher levels of Mpox morbidity stigma. Cronbach's alpha was 0.74.

2.3.7. Fear of social rejection due to Mpox acquisition

Three items were used to develop the scale of Mpox related fear of social rejection. Using the abovementioned 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), participants were asked to rate their agreements with the following statements: 1) Those with Mpox will face social rejection, 2) I will not share my Mpox history even after recovery, out of the fear of rejection, and 3) If I contract Mpox, people will think I am gay. Items were summed to produce a sum score where higher scores were indicative of higher levels of fear of social rejection due to Mpox acquisition. Cronbach's alpha was 0.78.

2.3.8. Mpox concealment

Mpox concealment was measured using two items: 1) If I contract Mpox, I will not tell anyone. 2) I will not share my Mpox history even after recovery, out of the fear of rejection. Participants responded to these items on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Items were summed to produce a sum score where higher scores were indicative of higher levels of fear of social rejection due to Mpox concealment. These items have Cronbach's alpha of 0.76.

2.3.9. Mpox-related cues to action

Respondents reported either no (0) or yes (1) to a series of questions that asked them to identify external factors that they considered when deciding if they wanted to pursue getting the Mpox vaccine. Factors included: 1) A reason related to my immigration status, 2) Pressure from my household/community, 3) A reason related to my health insurance, and 4) A reason related to my HIV status. Items were summed to produce a manifest count score where higher scores were indicative of greater Mpox-related cues to action regarding Mpox vaccine. Cronbach's alpha was 0.69.

2.3.10. Mpox morbidity safety concerns

Respondents reported either no (0) or yes (1) to a series of questions that asked them to identify safety factors that they considered regarding getting the Mpox vaccine. Factors included: 1) I don't want to get really sick from Mpox, 2) I want to feel safe around other people, 3) I want to keep my community safe, 4) I want to keep my family safe, and 5) I want to keep myself safe. Items were summed to produce a manifest count score where higher scores were indicative of higher degrees of Mpox morbidity safety concerns. Cronbach's alpha was 0.80.

2.3.11. Mpox-related psychological distress

Mpox-related psychological distress was measured using an adapted 8-item version of the Pandemic Stress Index, which measures the impact of infectious disease outbreaks on participant wellbeing [37]. Participants were asked to indicate to what degree they were impacted by negative events related to Mpox, rating responses on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Responses are summed to get an Mpox-related psychological distress score. Items were summed to produce a manifest sum score where higher scores were indicative of higher levels of Mpox-related psychological distress. Cronbach's alpha was 0.98.

2.3.12. Mpox-related traumatic stress

An adapted 6-item version of the PTSD Checklist-5 (PCL-5) was used to assess secondary traumatic stress symptoms [38]. Participants were asked to indicate how much each of the items bothered them related to Mpox, rating responses on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*extremely*). Items were summed to produce a manifest sum score where higher scores were indicative of higher degrees of Mpox-related traumatic stress. Cronbach's alpha was 0.95.

2.3.13. Vaccination attempts

Participants responded either no (0) or yes (1) if they ever tried to get vaccinated but were unable.

2.3.14. Mpox-specific vaccine hesitancy

Respondents reported either no (0) or yes (1) to a series of questions that asked them to identify Mpox-specific vaccine hesitancy factors that they considered regarding getting the Mpox vaccine. Factors included: 1) I don't know enough about how well a Mpox vaccine works, 2) I'm concerned about side effects from the Mpox vaccine, 3) I don't trust that the Mpox vaccine will be safe, and 4) I don't like needles. Items were summed to produce a manifest count score where higher scores were indicative of higher degrees of Mpox- specific vaccine hesitancy.

2.3.15. Demographics

Demographic data, including age, educational attainment, racial/ethnic identity, and gender identity, were also collected.

2.4. Analytic approach

After the questions and variables were evaluated for completeness, consistency, and accuracy, the data were cleaned, coded, entered, and analyzed using SPSS 28.8. For qualitative variables, descriptive statistics such as relative (percentage) and absolute frequencies were calculated, while quantitative variables were reported using mean and standard deviation. The reliability of the scales used was established through Cronbach's alpha index. Bivariate analyses were performed to compare participants' demographic characteristics, Mpox-disease-specific factors, and Mpox-vaccine-specific factors by vaccine uptake status, using Chi-square tests for categorical measures and ANOVA for continuous measures. An adjusted odds ratio (aOR) analysis using a multinomial regression analysis model was also employed to investigate the independent contributions of each factor to the variance in Mpox vaccine uptake among SGM individuals. All potential determinants were included as independent variables.

3. Results

3.1. Participant characteristics

Demographic information for the sample is presented in Table 1. The sample was primarily comprised of individuals who identified their gender as man/boy (81.3 %), while 14.7 % of all participants identified as being transgender (questions about gender identity and transgender status were not mutually exclusive). The remainder of the sample identified as non-binary (9.4 %), woman/girl (3.1 %), Two-Spirit (1.3 %), and questioning their gender identity (0.9 %). Nearly three-quarters of the sample identified as gay (70.3 %), with 10.9 % identifying as bisexual. Substantially fewer individuals identified as heterosexual, lesbian, pansexual, or questioning. The sample was a mean age of 29.9 years (SD = 4.76). Most participants identified as White American (48.1 %). The remainder of the sample identified as Black American (15.3 %), Asian American (6.3 %), Multiracial (9.7 %), and Latinx American (19.7 %). We found that 24.1 % of participants had completed the full 2-dose Mpox vaccination regimen, while 27.5 % had received one-dose of the recommended Mpox regimen. 47.5 % of respondents had not received any Mpox vaccination.

3.2. Bivariate results

Presented in Table 1, our results communicate many significant bivariate relationships between vaccination uptake and crisis factors, Mpox vaccine specific factors, contextual factors, and demographics. More specifically, single-dosers had the highest proportion of man/boy identified participants and the highest levels of educational attainment ($p < .001$), Mpox vicarious exposure ($p < .001$), Mpox-related internalized heterosexism ($p < .05$), and Mpox morbidity safety concerns ($p < .001$) in comparison to double-dosers and the unvaccinated. Unvaccinated participants had the highest levels of Mpox- specific vaccine hesitancy ($p < .001$), identity-based discrimination ($p < .01$). Double-dosers tended to be older than single-dosers and the unvaccinated ($p < .001$). Despite double-dosers having the highest percentage of participants reporting having recently experienced food insecurity, the highest number of participants who had recently experienced food insecurity reported being unvaccinated ($p < .001$). Significant differences by gender identity also emerged; however, our sample was heavily skewed male and cisgender, which prevent us from drawing clear descriptive conclusions.

3.3. Multinomial results

Results of our multinomial regression are shown in Table 2. First, we describe which psychosocial factors were associated with respondents having received one or two doses of the Mpox vaccine compared to those that were unvaccinated as the reference group. Second, we describe the factors that were associated with being a double-doser compared to those that were single-dosers. Educational attainment emerged as a significant factor differentiating unvaccinated individuals from double- and single- dosers. Highly educated respondents were more likely to be double-dosers than unvaccinated or a single-dosers. Educational attainment did not differentiate double-dosers from single-dosers. Furthermore, those who had more exposure to Mpox via their interpersonal relationships were more likely to be a double-doser than unvaccinated or a single-dosers suggesting that secondary exposure to Mpox may have expedited vaccine uptake. Participants with higher levels of Mpox-related internalized heterosexism were more likely to be a double-doser than unvaccinated or a single-dosers. In contrast, respondents with higher degrees of fear of social rejection due to Mpox acquisition were more likely to be unvaccinated or a single-doser than a double-doser. Participants with higher degrees of Mpox-related morbidity safety concerns were more likely to be double- or single-doser than unvaccinated. Finally, participants with high levels of Mpox-vaccine hesitancy were more likely to be unvaccinated or a single-doser than a double-doser.

4. Discussion

Vaccines are one of the most effective and important steps in combating many viral outbreaks. However, despite their crucial role, Mpox vaccine uptake, especially among vulnerable populations, has been less than ideal. Understanding this slow uptake, particularly at the time of an ongoing Mpox outbreak, was one of the key aims of this study. More specifically, using a cross-sectional survey, this study aimed to investigate (a) the prevalence of Mpox vaccine uptake among a sample of SGM individuals across Illinois, USA and (b) examine the contextual, Mpox-disease specific, and Mpox-vaccine specific factors associated with the Mpox vaccine update among SGM individuals.

Consistent with broader infectious disease literature, our findings add to the robustness of already established relationships between educational attainment [39,40], fear of social rejection due to disease acquisition [41,42], and vaccine hesitancy [43] with lower levels of vaccine uptake. In detail, our study found that individuals who had higher degrees of fear of social rejection due to Mpox acquisition and were more Mpox-vaccine hesitant were more likely

Table 1
Participant Demographics & Univariate Association Tests.

Characteristic	Unvaccinated (n = 152)				Double-Dosers (n = 88)				Single-Dosers (n = 77)				F/χ^2	p-value
	M	SD	*n*	%	M	SD	*n*	%	M	SD	*n*	%		
Crisis Factors														
Mpox Vicarious Exposure	0.19	0.44			0.36	0.65			0.65	0.60			18.11	<0.001
Mpox-Related Internalized Heterosexism	7.22	4.42			6.08	3.67			7.76	4.24			3.22	<0.05
Mpox Morbidity Stigma	8.48	5.14			7.27	3.98			6.97	3.92			2.93	0.06
Fear of Social Rejection Due to MPX Acquisition	11.46	5.09			10.30	4.96			10.34	5.34			1.58	0.21
Mpox Concealment	5.25	3.35			4.18	3.05			4.54	2.73			2.92	0.06
Mpox-Related Cues to Action	1.16	1.67			1.10	1.65			0.71	1.16			2.25	0.11
Mpox Morbidity Safety Concerns	8.29	2.55			9.22	1.46			9.47	1.39			10.62	<0.001
Mpox-Related Psychological Distress	21.06	18.77			16.36	14.88			17.73	16.36			1.86	0.16
Mpox-Related Traumatic Stress	1.50	4.10			1.72	4.00			1.49	4.22			0.08	0.92
Mpox Vaccine-Specific														
Unsuccessful Vaccination Attempt													4.18	0.12
No			128	84 %			65	74 %			59	77 %		
Yes			24	16 %			23	26 %			18	23 %		
Mpox-Vaccine Hesitancy	2.71	2.17			1.76	1.90			0.69	1.17			29.74	<0.001
Contextual Factors														
Age	28.58	4.90			31.06	4.61			31.01	4.12			11.10	<0.001
Educational Attainment													26.46	<0.001
6th to 8th grade			0	0 %			0	0 %			1	1 %		
9th to 12th grade, no diploma			2	1 %			0	0 %			0	0 %		
High school graduate or GED completed			34	22 %			9	10 %			1	1 %		
College level/Technical/Vocational degree			31	20 %			8	9 %			4	5 %		
Bachelor's degree			57	38 %			38	43 %			34	44 %		
Advanced degree (Masters, Doctoral degree)			28	18 %			33	38 %			37	48 %		
Identity-Based Discrimination	12.25	8.29			10.08	7.53			8.65	6.49			5.14	<0.01
Food Insecurity													36.24	<0.001
No			128	84 %			65	74 %			59	77 %		
Yes			24	16 %			23	26 %			18	23 %		
Racial/Ethnic Identity													17.82	0.12
American Indian or Alaska Native American			1	1 %			0	0 %			0	0 %		
White American			65	43 %			45	51 %			43	56 %		
Black American			34	22 %			10	11 %			4	5 %		
Asian American			9	6 %			5	6 %			6	8 %		
Multiracial American			14	9 %			8	9 %			9	12 %		
Latinx American			27	18 %			20	23 %			15	19 %		
Not Specified			2	1 %			0	0 %			0	0 %		
Gender Identity													24.54	<0.05
Questioning my gender identity			0	0 %			3	3 %			0	0 %		
Woman/Girl			8	5 %			1	1 %			1	1 %		
Man/Boy			121	80 %			70	80 %			66	86 %		
Two-Spirit			2	1 %			2	2 %			0	0 %		
Non-Binary			18	12 %			5	6 %			7	9 %		
Agender			1	1 %			0	0 %			1	1 %		
Genderqueer			2	1 %			7	8 %			2	3 %		
Identified as Transgender													15.14	<0.01
No			112	74 %			77	88 %			71	92 %		
I'm not sure			6	4 %			3	3 %			1	1 %		
Yes			34	22 %			8	9 %			5	6 %		
Sexual Identity													23.48	0.10
Questioning my sexual orientation			2	1 %			0	0 %			1	1 %		
Asexual			2	1 %			0	0 %			0	0 %		
Asexual Spectrum			2	1 %			1	1 %			0	0 %		
Bisexual			24	16 %			5	6 %			6	8 %		
Pansexual			6	4 %			2	2 %			0	0 %		
Gay			91	60 %			69	78 %			62	81 %		
Lesbian			4	3 %			0	0 %			0	0 %		
Straight (Heterosexual)			2	1 %			1	1 %			0	0 %		
Queer			19	13 %			10	11 %			8	10 %		

to be unvaccinated. Conversely, participants who knew people who have contracted Mpox [44], had higher formal educational attainment [45], had higher degrees of Mpox-related internalized heterosexism, and were more concerned about their safety regarding Mpox morbidity [46] were more likely to have completed the recommended 2-dose Mpox vaccine regimen. Due to the quantitative and exploratory nature of this study, we are unable to decern the exact reasoning why individuals delayed or did not complete the recommend 2-dose Mpox vaccine regimen. Such information could be attained from future qualitative inquiries, which is warranted.

Our findings highlight key structural and psychosocial processes that may have influenced the SGM individuals living in Illinois, USA' ability to pursue and acquire the recommended 2-dose Mpox vaccine regimen. When the Mpox vaccine first became widely available in Illinois, USA, distributors were instructed to prioritize high exposure risk communities such as gay, bisexual, and other men who have sex with men or those who had been in known contact with someone with Mpox [35]. Additionally, due to low vaccine supplies, distributors often required individuals' interested in receiving the vaccine to complete screeners, which were used to verify their high-risk statuses (i.e., having recently had same-gender male sexual intercourse) [47]. This screening process has been critiqued for the use of outdated public health & healthcare infrastructure, which required participants to provide

Table 2
Determinants of vaccine uptake using multinomial logistic regression.

	Unvaccinated Vs. Double-Dosers[1]				Unvaccinated Vs. Single-Dosers[2]				Double-Dosers Vs. Single-Dosers[3]			
	95 % CI				95 % CI				95 % CI			
	AOR	S.E.	Lower	Upper	AOR	S.E.	Lower	Upper	AOR	S.E.	Lower	Upper
Contextual Influences												
Age	1.00	0.05	0.90	1.10	1.06	0.04	0.97	1.15	1.06	0.05	0.97	1.16
Educational Attainment	**1.93**	**0.25**	**1.19**	**3.14**	**1.56**	**0.19**	**1.07**	**2.25**	0.81	0.24	0.50	1.30
Identity-Based Discrimination	0.96	0.03	0.90	1.03	0.98	0.03	0.93	1.03	1.01	0.03	0.95	1.08
Food Insecurity	0.54	0.48	0.21	1.39	0.68	0.34	0.35	1.30	1.24	0.49	0.47	3.27
White v.s. All Other Races	0.65	0.45	0.27	1.57	0.99	0.39	0.46	2.12	1.51	0.41	0.67	3.41
Man/Boy v.s. All of Genders	0.49	0.79	0.10	2.29	0.46	0.59	0.15	1.48	0.95	0.71	0.24	3.83
Cisgender v.s. Gender Diverse	0.73	0.51	0.27	1.99	0.68	0.35	0.35	1.36	0.93	0.50	0.35	2.50
Mpox Disease-Specific												
Mpox Vicarious Exposure	**3.51**	**0.39**	**1.63**	**7.57**	1.43	0.37	0.69	2.96	**0.41**	**0.34**	**0.21**	**0.79**
Mpox-Related Internalized Heterosexism	**1.23**	**0.07**	**1.07**	**1.42**	0.96	0.06	0.85	1.09	**0.78**	**0.07**	**0.68**	**0.89**
Mpox Morbidity Stigma	0.94	0.07	0.83	1.07	1.04	0.06	0.93	1.16	1.10	0.06	0.97	1.25
Fear of Social Rejection Due to Mpox Acquisition	**0.87**	**0.05**	**0.79**	**0.97**	0.96	0.04	0.88	1.04	**1.10**	**0.05**	**1.00**	**1.21**
Mpox Concealment	0.99	0.08	0.86	1.15	0.94	0.06	0.83	1.07	0.95	0.08	0.82	1.10
Mpox Perceived Personal Risk	0.90	0.18	0.63	1.27	1.09	0.13	0.86	1.40	1.22	0.17	0.88	1.70
Mpox Morbidity Safety Concerns	**1.49**	**0.14**	**1.14**	**1.96**	**1.31**	**0.12**	**1.04**	**1.66**	0.88	0.15	0.65	1.19
Mpox-Related Psychological Distress	1.00	0.01	0.98	1.03	0.99	0.01	0.97	1.01	0.99	0.01	0.96	1.01
Mpox-Related Traumatic Stress	1.02	0.06	0.92	1.14	1.05	0.05	0.96	1.14	1.02	0.05	0.92	1.14
Mpox Vaccine-Specific												
Vaccination Attempt	1.29	0.54	0.45	3.69	1.43	0.45	0.59	3.48	1.11	0.49	0.43	2.87
Mpox-Vaccine Hesitancy	**0.48**	**0.15**	**0.35**	**0.65**	0.84	0.09	0.70	1.01	**1.76**	**0.15**	**1.31**	**2.37**

Note: aOR = Adjusted Odds Ratio; 95 % CI = 95 % Confidence Interval; Significant results are bolded; [1]reference group = Unvaccinated; [2]reference group = Unvaccinated; [3]reference group – Double-Dosers.

a referral code, fight for the opportunity to access screening websites that would not load or refresh or physically stand in line for hours for a vaccine dose that they may or may not have been able to receive that day [48,49]. Our findings suggest that the confluence of vaccine requirements and lack of proper healthcare infrastructure may have heavily influence participants vaccine uptake behavior by making the process dependent on individuals' ability to navigate medical information systems, and the social networks within which participants were embedded. For instance, highly educated individuals may have had more ready access to vaccine distribution centers as educational attainment has consistently been demonstrated to be associated with increased healthcare access, utilization, and persistence [50,51]. Furthermore, we posit that the lanuaging of Mpox as an infectious disease that is highly related to one's LGBTQ+ identity in public health campaigns may have resulted in individual's not seeking out the Mpox vaccine in fear that they would be unwillingly labeled as a member of the community. Whether accurate or not, the labeling of a person as a SGM individual would project a upon them an identity characteristic that would be (a) difficult to refute and (b) accompanied by profound social stigma and rejection. This association was illustrated in our findings as individuals who had higher degrees of fear of social rejection due to Mpox acquisition were more likely to be unvaccinated. Consistent with prior investigations, our results indicate that strategic plans that lack attention to matters like perceived stigma, medical mistrust, and the influence of social networks can be as ineffective as the ones that are burdened by operational issues. Hence, public health officials are encouraged to pay a closer attention to social and structural barriers in addition to operational barriers when developing strategic responses to future outbreaks and other public health crises.

5. Limitations

Our study had several limitations. First, this study used a non-probability and cross-sectional sampling strategy that specifically recruited members of the LGBTQ+ community, which limits our ability to generalize findings to broader populations or draw causal conclusions. Second, the study also implemented a retrospective self-report data collection strategy, which presents a risk for recall and social desirability biases. Third, the current study only included youth and young adults aged 19 to 39 limiting the generalizability of our results to different developmental stages (e. g. adolescences and older adulthood). Fourth, our study only included individuals living in the United States, which limits its translatability to other global contexts. Fifth, although we included (a) failed attempted to be received the Mpox vaccine and (b) Mpox specific vaccine hesitancy as covariates in our multinomial model, we were unable to decern the role supply chain shortages may have played in participants Mpox vaccine uptake. Future research on the subject would illustrate the degree to which readily vaccine access may be associated with infectious disease vaccine uptake. Despite these limitations, this study provides important insights into the contextual, Mpox-disease specific, and Mpox-vaccine specific factors associated with Mpox vaccine uptake among SGM individuals.

6. Conclusions

Nearly half of our sample of SGM individuals were unvaccinated. Our findings indicate that socioeconomic stability, fear of social rejection due to disease acquisition, and vaccine hesitancy were significantly associated with participants Mpox vaccine uptake. Our findings highlight important structural targets public health scientists and interventionists must consider when developing vaccine-uptake prevention and intervention strategies tailored to the needs of SGM individuals.

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Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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