

Mpox knowledge and vaccination hesitancy among healthcare workers in Beijing, China: A cross-sectional survey

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ABSTRACT

Background: Mpox, one of the most serious threats to global health, is now being seen in small but rising numbers in Beijing, China. Our study aimed to investigate healthcare workers' (HCWs) knowledge of Mpox and to explore reasons associated with their hesitancy to vaccinate against Mpox in Beijing, China.

Methods: A cross-sectional study was conducted among HCWs in Beijing from July 24 to August 2, 2023, through an online questionnaire. Participants answered questions about sociodemographic characteristics, Mpox information sources, Mpox knowledge, perception of vaccines, and attitudes toward Mpox vaccination. We used Chi-squared test to compare difference in Mpox vaccination hesitancy between different groups. Multivariable logistic regression models were applied to analyze correlates of vaccination hesitancy among HCWs.

Results: A total of 2331 HCWs completed the questionnaire, with an effective response rate of 92.45 % (2155/2331). Most of the HCWs in this study worked at tertiary hospitals (89.65 %), with a mean age of 36.69 ± 9.08 years. Among the 2155 participants, 52.99 % had over ten years of working experience, and 16.66 % were from high-risk departments relevant to Mpox treatment. Approximately 84.41 % knew about Mpox before this study, 80.79 % exhibited a high level of knowledge about Mpox, whereas 42.37 % were hesitant to be vaccinated against Mpox. Moreover, the hesitancy rate of HCWs in high-risk departments (47.91 %) was higher than in lower-risk departments (41.26 %). Higher educational level (aOR = 1.75, 95 %CI: 1.17–2.62), longer working years (1.71, 1.32–2.22), working at high-risk departments (1.34, 1.05–1.71), and lower level of knowledge about Mpox (1.78, 1.13–2.85) appeared as the most significant determinants of Mpox vaccination hesitancy among HCWs who knew about Mpox. For the HCWs who did not know about Mpox, longer working years (1.96, 1.02–3.78) were significant factors associated with their hesitancy. The predominant reason for hesitancy toward Mpox vaccination among HCWs encompassed apprehensions about vaccine side effects.

Conclusion: HCWs had good knowledge of Mpox, whereas their Mpox vaccination hesitancy was also relatively high in Beijing, China. Increasing HCWs' vaccination confidence and knowledge level about Mpox, especially for those working in high-risk departments, may be an essential way of reducing their hesitancy.

1. Introduction

Mpox caused by orthopoxvirus, a double-stranded DNA virus, has become one of the most noticeable threats to global health [1]. The first Mpox case was detected in the Democratic Republic of the Congo in

1970 [2]. Recently, cases of Mpox have been reported frequently from countries where the disease is not endemic [3]. This phenomenon may be related to the cessation of smallpox vaccination, which provided some cross-protection against Mpox, leading to increased human-to-human transmission [4,5]. Since the eradication of smallpox was

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Table 1
Characteristics of HCWs in Beijing, China (N = 2155).

Characteristics	Category	Frequency	Percentage (%)
Age	18~	607	28.17
	31~	874	40.56
	41~	451	20.93
	≥51	223	10.34
Sex	Male	427	19.81
	Female	1728	80.19
Educational level	Junior college or below	428	19.86
	Undergraduate	1174	54.48
	Master	387	17.96
	Doctor degree or higher	166	7.70
Marital status	Unmarried	628	29.14
	Married	1527	70.86
Monthly income (CNY)	< 3000	77	3.57
	3000–5999	298	13.83
	6000–9999	938	43.53
	10000–19999	762	35.36
	≥20000	80	3.71
Type of medical institution	Tertiary hospitals	1932	89.65
	Secondary hospitals	191	8.86
	Community health service centers/ private hospitals	32	1.49
Occupation	Nurses	1171	54.34
	Clinicians	807	37.45
	Medical technicians ^a	138	6.40
	Administrative/ nonclinical support	39	1.81
Professional title	Junior or below	952	44.18
	Intermediate	901	41.81
	Senior	302	14.01
Working years	≤5	489	22.69
	6 ~	524	24.32
	≥11	1142	52.99
Department	Low-risk departments	1796	83.34
	High-risk departments ^b	359	16.66
Mpox knowledge level	Low level	414	19.21
	High level ^c	1741	80.79

a: Medical technicians include inspection, imaging, ultrasound, electrocardiogram, pharmacy, etc.

b: High-risk departments include the infectious diseases department, dermatology department, venereal diseases department, anorectal diseases department, urology/andrology department.

c: A correct answer to 8 or more out of 14 questions about Mpox knowledge was considered a high level of knowledge.

announced by the World Health Assembly in 1980, routine vaccination against smallpox has not been mandated, and immunity to the orthopoxvirus in young people has continuously waned over time [6,7]. With the spread of the Mpox virus, two cases were released in June 2023 [8]. It was the first report from Beijing. According to the surveillance data, a total of 80 new cases of Mpox were reported on the Chinese mainland during November of 2023, with Beijing contributing 10 cases, the second-highest reported cases [9]. As of 1 December 2023, a total of 1513 confirmed cases of Mpox have been reported in China [10].

Emerging evidence suggests vaccines are an effective adjunct to other public health interventions in the context of the Mpox outbreak response [5,11–13]. Judicious use of vaccines can protect vulnerable groups at risk of severe Mpox disease and minimize zoonotic transmission of Mpox virus. Based on assessed risks and benefits, WHO recommends taking primary preventive vaccination and post-exposure prophylaxis for individuals with high Mpox risk [5]. Laboratory personnel working with orthopoxviruses, clinical laboratory and health care personnel performing diagnostic testing for Mpox, and outbreak response team members were classified as high-risk individuals by WHO [5].

HCWs play an instrumental role in primary prevention and health promotion. Although the transmission of Mpox may be a rare event in the HCWs [14,15], maintaining vigilance about the risk of occupational exposure to the Mpox virus is essential. According to the Statistical

Yearbook of Beijing (2023) [16], there were 276,717 staff working in medical institutions in Beijing, including 83,996 clinicians, 111,841 nurses, and 20,309 medical technicians. Currently, there are three vaccines have been approved in a number of countries/territories for the prevention of Mpox. Unfortunately, none of the available Mpox vaccines have been approved for use in the Chinese mainland, and there are no available Mpox vaccines for HCWs in Beijing. As more and more cases of Mpox are reported in Beijing, proactive investigation of the HCWs' knowledge of Mpox and their attitude toward Mpox vaccination is necessary. Our study aimed to investigate HCWs' knowledge of Mpox and to explore reasons associated with their hesitancy to vaccinate against Mpox in Beijing, China.

2. Methods

2.1. Subjects and inclusion criteria

A cross-sectional study was conducted among HCWs from July 24 to August 2, 2023, through an online questionnaire powered by Wenjuanxing (an online survey platform). Wenjuanxing is a program for questionnaire designing with similar functions to Amazon Mechanical Turk (Survey Monkey, Survey Gizmo). The target population was all the employees in medical institutions, including clinicians, nurses, medical technicians (such as inspection, imaging, ultrasound, electrocardiogram, pharmacy), interns (such as medical students), and other administrative staff. The inclusion criteria for this survey were HCWs who worked in Beijing, were 18 years or older, and volunteered to participate. Snowball sampling methods were used to recruit HCWs. We sent the questionnaire link or QR code to the HCWs who keeping close contact with us in daily work. These close-knit HCWs forwarded the link or QR code to their colleagues through their work groups. HCWs who received the questionnaire could also forward it to another, but each participant was only allowed to submit the questionnaire once. No incentives of any kind are involved in the selection of participants.

2.2. Sample size

The sample size was estimated by the calculation formula of simple random samples, $N = [(Z_{\alpha/2})^2 P(1-P)/d^2]$, and the primary outcome was the hesitancy to vaccinate against Mpox among HCWs in China. The estimated sample size was 973 according to previous Chinese studies among HCWs (9.88 %–35.10 %) [17,18], $\alpha = 0.05$, the allowable error was 3 %, and $Z_{\alpha/2} = 1.96$. Considering the possible nonconforming feedback, the sample size should be at least 1071, with a margin of 10 %.

2.3. Study variable

The questionnaire was designed according to published studies on Mpox vaccination among HCWs and other studies related to the theme of Mpox [17–22]. At the same time, we also discussed with experts and conducted a pilot survey before the release of the questionnaire. Our questionnaire for this study consisted of 30 closed-ended items divided into six aspects: a) Sociodemographic characteristics, b) Mpox information sources, c) Mpox knowledge, d) Perception of vaccines, e) Attitudes toward Mpox vaccination, and f) Quality control.

Sociodemographic characteristics included age, sex, educational level, marital status, monthly income, type of medical institution, occupation, professional title, working years, and department. We classified the departments that are involved in the diagnosis, treatment, and management of suspected or confirmed Mpox cases or are at potential risk of contracting the Mpox virus as high-risk departments. These high-risk departments include the infectious diseases department, dermatology department, venereal diseases department, anorectal diseases department, and urology/andrology department.

The awareness of Mpox information was measured by asking whether they knew about Mpox before this survey. Participants who

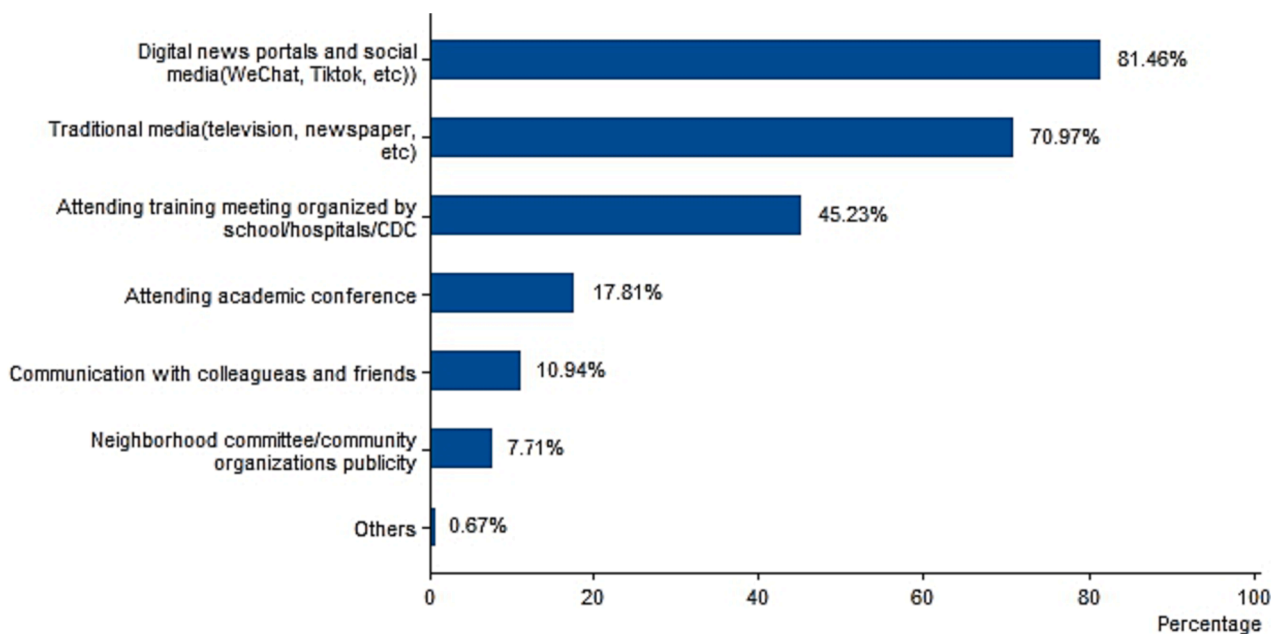


Fig. 1. Sources to access Mpox information among HCWs in Beijing, China (n = 1791).

didn't know about Mpox before the survey could skip the rest items of the Mpox information and knowledge. HCWs who knew about Mpox were asked to recall their Mpox information source (digital news portals and social media, traditional media, attending training meetings organized by school/ hospital/ CDC, attending academic conferences, communication with colleagues/ friends, neighborhood committee/ community organizations publicity, etc.) and how often did they get Mpox information every week (daily attention, frequent attention, occasional attention, little attention, and never attention).

Assessment of HCWs' Mpox knowledge using the subsequent 14 items was only undertaken for the participants who knew about Mpox before this survey. With reference to other research [22], the following Mpox knowledge items were included: 1) Mpox is an infectious disease (TRUE), 2) Mpox is caused by a virus (TRUE), 3) People can get Mpox by close contact with an infected person or animal (TRUE), 4) People are generally susceptible to Mpox (TRUE), 5) There are currently no specific treatments for Mpox (TRUE), 6) There is a vaccine that protects against Mpox (TRUE), 7) Mpox can cause fever (TRUE), 8) Mpox can cause headaches (TRUE), 9) Mpox can cause fatigue or exhaustion (TRUE), 10) Mpox can cause swollen lymph nodes (TRUE), 11) Mpox can cause a body rash (TRUE), 12) Mpox can cause back and muscle aches (TRUE), 13) Selecting the correct transmission routes of Mpox, 14) Which of the following pictures is the Mpox rash.

For items 1–12, there were three options: right, wrong, and don't know. Choosing "right" was recategorized as the correct answer, and other options (including "wrong" and "don't know") were recategorized as the incorrect answer. For item 13, which was a multiple-choice question, participants should choose at least one correct option and must not include any incorrect options. A correct answer to 8 or more out of 14 items was considered a high level of mpox knowledge.

The perception of vaccines among HCWs was assessed by asking "Do you think it is important to get vaccinated?" This item used a five-point Likert scale ranging from strongly important to strongly unimportant, and the data were recategorized as important (1–2), neutrality (3), and unimportant (4–5) when analyzing the results. Follow up with items like "Do you think vaccination is safe?" and "Do you think vaccination is effective?" We also used a five-point Likert scale ranging from strongly safe/effective to strongly unsafe/ineffective, and the data were recategorized as safe/effective (1–2), neutral (3), and unsafe/ineffective (4–5) when analyzing the results. Respectively, we also asked them about their

attitudes toward the safety and effectiveness of domestic and foreign vaccines. Participants were allowed to choose one of three options: domestic vaccines were as good as foreign vaccines, domestic vaccines were better, and foreign vaccines were better.

The Mpox vaccination hesitancy was assessed by asking "Would you like to be vaccinated against Mpox?" All participants (including HCWs who indicated that they did not know about mpox at the start of the survey) need to answer the question about Mpox vaccination hesitancy, and they could choose one of the three options: willing, unwilling, or unsure. Participants who selected "unsure" or "unwilling" were further asked, "Would you like to get the Mpox vaccine if it were free?" Those who were still selected "unsure" or "unwilling" to receive the Mpox vaccine under the condition of free vaccination were classified as the group of Mpox vaccination hesitancy. The questions about the reasons for Mpox vaccine hesitancy were answered only by the participants of the hesitancy group.

To identify the unseriously questionnaires, we also set the following two common sense questions: "Where is the capital of China" and "Which direction does the sun rise in the morning". The questionnaires with the wrong answer will be excluded.

2.4. Statistics analysis

We removed the questionnaires containing missing values and low quality while cleaning the data. We used Chi-squared test to compare difference in Mpox vaccination hesitancy between different groups. Continuous variables were expressed as mean and standard deviation (SD), and categorical variables were presented with frequency and percentage. Multivariate logistic regression was used to analyze correlates of Mpox vaccination hesitancy among HCWs. In the logistic regression, we adopted the stepwise regression method and calculated the aOR and 95 % confidence interval (95 %CI). All analyses were conducted using R 4.2.3 (R Foundation for Statistical Computing, Vienna, Austria).

2.5. Ethics approval

All procedures contributing to this work comply with the ethical standards of relevant national and institutional committees on human experimentation and with the Helsinki Declaration. Online informed

Table 2
Comparison of HCWs' characteristics between those who knew and did not know about Mpox in Beijing, China.

Characteristics	Knew about Mpox before the investigation No. (%)	Did not know about Mpox before the investigation No. (%)	χ^2	P
Age			34.35	<0.01
18~	477 (26.22)	130 (38.69)		
31~	734 (40.35)	140 (41.67)		
41~	412 (22.65)	39 (11.61)		
≥51	196 (10.78)	27 (8.04)		
Sex			1.11	0.29
Male	368 (20.23)	59 (17.56)		
Female	1451 (79.77)	277(82.44)		
Educational level			14.39	<0.01
Junior college or below	342 (18.80)	86 (25.60)		
Undergraduate	987 (54.26)	187 (55.65)		
Master	345 (18.97)	42 (12.50)		
Doctor degree or higher	145 (7.97)	21 (6.25)		
Marital status			7.24	<0.01
Unmarried	509 (27.98)	119 (35.42)		
Married	1310 (72.02)	217 (64.58)		
Monthly income (CNY)			3.73	0.44
< 3000	65 (3.57)	12 (3.57)		
3000–5999	243 (13.36)	55 (16.37)		
6000–9999	803 (44.15)	135 (40.18)		
10000–19999	638 (35.07)	124 (36.90)		
≥20000	70 (3.85)	10 (2.98)		
Type of medical institution			12.68	<0.01
Tertiary hospitals	1649 (90.65)	283 (84.23)		
Secondary hospitals	146 (8.03)	45 (13.39)		
Community health service centers /private hospitals	24 (1.32)	8 (2.38)		
Occupation			27.79	<0.01
Nurses	947 (52.06)	224 (66.67)		
Clinicians	722 (39.69)	85 (25.30)		
Medical technicians	115 (6.32)	23 (6.85)		
Administrative/nonclinical support	35 (1.92)	4 (1.19)		
Professional title			20.42	<0.01
Junior or below	766 (42.11)	186 (55.36)		
Intermediate	786 (43.21)	115 (34.23)		
Senior	267 (14.68)	35 (10.42)		
Working years			19.89	<0.01
≤5	391 (21.50)	98 (29.17)		
6 ~	427 (23.47)	97 (28.87)		
≥11	1001 (55.03)	141 (41.96)		
Department ^b			12.83	<0.01
High-risk departments	326 (17.92)	33 (9.82)		
Low-risk departments	1493 (82.08)	303 (90.18)		

consent will be obtained from all participants before any procedure of this study. The study (including online informed consent) was approved by the Human Research Ethics Committee of the School of Public Health (Shenzhen), Sun Yat-sen University (approval number SYSU-PHS[2022] 051).

3. Results

3.1. Demographic characteristics

A total of 2331 questionnaires were received, with an effective response rate of 92.45 % (2155/2331). Among the 2155 participants, the mean age was 36.69 ± 9.08 years, 80.19 % were females, 70.86 %

were married, and 80.14 % had a bachelor's degree or above. A large proportion of participants worked at tertiary hospitals (89.65 %), had over ten years of working experience (52.99 %), and exhibited a high level of Mpox knowledge (80.79 %). In addition, 16.66 % of participants in this study were recruited from the high-risk departments where HCWs were most likely to be exposed to patients with Mpox. Characteristics of HCWs were presented in Table 1.

3.2. Mpox information and knowledge

Approximately 1819 (84.41 %) of HCWs indicated that they knew about Mpox before this study. The weekly frequency of getting Mpox information was divided into five levels: daily attention, frequent attention, occasional attention, little attention, and never attention, and the percentages were 5.44 % (n = 99), 27.98 % (n = 509), 55.20 % (n = 1004), 9.84 % (n = 179), and 1.54 % (n = 28) respectively. Digital news portals and social media (i.e. WeChat, TikTok, and other internet media) were the main access for HCWs to get the Mpox information, followed by traditional media (i.e. television, newspaper, radio, etc.). Fig. 1 shows the access way to obtain the Mpox information among HCWs who attention to Mpox.

Results indicated that the proportion of participants of young, low educational level, unmarried, worked in low-level hospitals, had low professional titles, had short working years, worked as nurses or medical technicians, and worked in low-risk departments in the group did not know about Mpox were higher than that in the group of knew about Mpox. Table 2 shows the differences in HCWs' characteristics between those who knew and did not know about Mpox.

The results for each knowledge item were shown in Fig. 2. Only three out of the 14 Mpox knowledge items had correct rates below 80 %, while six items had correct rates above 95 %. In this study, the lowest correct rate was the question about the transmission route of Mpox. Nearly 52.37 % (n = 938) of the HCWs chose the wrong option, followed by "There is a vaccine that protects against Mpox" and "Select the correct picture of Mpox", with error rates of 39.36 % and 38.02 % respectively.

3.3. Perception of vaccines

Approximately 67.52 % and 66.31 % of the HCWs had a positive attitude toward the safety and effectiveness of vaccines respectively, and 77.87 % considered that vaccination was important. Among the 2155 participants, nearly 59.68 % believed domestic and foreign vaccines had similar safety, 22.46 % believed foreign vaccines were safer, and 17.86 % believed domestic vaccines were safer. In addition, almost 58.75 % of the HCWs thought the effectiveness of domestic and foreign vaccines were comparable, 24.32 % thought foreign vaccines were more effective, and 16.93 % chose domestic vaccines.

3.4. Mpox vaccination hesitancy

Approximately 44.18 % (n = 952) of the participants did not support the promotion of Mpox vaccination among HCWs, and 42.37 % (n = 913) were hesitant to get the vaccines against Mpox. Chi-squared test results showed that age, educational level, marital status, monthly income, occupation, professional title, working years, hospital department, perceived Mpox, and Mpox knowledge level were significantly associated with Mpox vaccination hesitant among HCWs (Table 3).

The results of multivariable logistic regression indicated that factors such as higher educational level (aOR = 1.75, 95 %CI:1.17–2.62), longer working years (1.71, 1.32–2.22), working at high-risk departments (1.34, 1.05–1.71), lower Mpox knowledge (1.78, 1.13–2.85) were associated with a high hesitancy for Mpox vaccine among HCWs who knew about Mpox before the investigation. For the HCWs who did not know about Mpox before the investigation, longer working years (1.96, 1.02–3.78) were significant factors associated with their hesitancy to vaccinate against Mpox (Table 4).

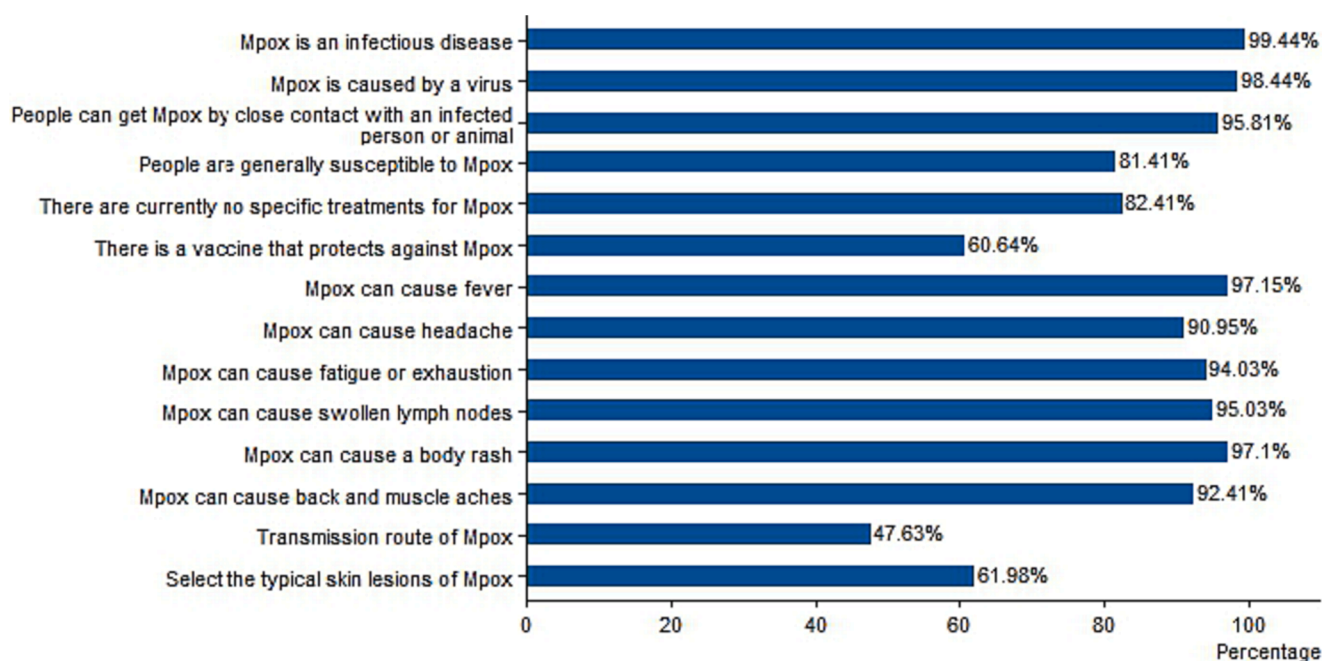


Fig. 2. Knowledge about Mpox among HCWs in Beijing, China (n = 1819) Notes: For items 1–12, there were three options: right, wrong, and don't know. The answer "don't know" was recategorized as an incorrect answer. For item 13, which was a multiple-choice question, participants should choose at least one correct option and must not include any incorrect options.

Fig. 3 shows the reasons for HCWs' hesitancy to be vaccinated against Mpox. According to the results, a total of 913 (42.37 %) HCWs reported they were hesitant to be vaccinated against Mpox. The main reasons for this were that HCWs were worried about the side effects (75.25 %), lacked confidence in the effectiveness of the Mpox vaccines (50.82 %), and believed that their risk of infecting Mpox was low (29.79 %). The first two reasons for hesitancy to receive the Mpox vaccine among HCWs working in high-risk departments and low-risk departments were both worried about side effects and lack of confidence in the effectiveness of the Mpox vaccines. However, the third reason among the two groups is different. HCWs working in the high-risk department chose "I'm not susceptible to Mpox, and my risk of Mpox infection is low", while others working in the low-risk department chose "Mpox will not be endemic in China".

4. Discussion

Our study demonstrated high Mpox knowledge among HCWs in Beijing, whereas their hesitancy towards Mpox vaccination was also relatively high. Higher educational levels, longer working years, working at high-risk departments, and lower Mpox knowledge were significantly associated with Mpox vaccination hesitancy among HCWs. The confidence in the safety and effectiveness of Mpox vaccines among HCWs, especially for HCWs working in high-risk departments, needs to be further increased.

Similar to a previous study conducted in China [17], we found that HCWs in Beijing had good Mpox knowledge. Approximately 80.79 % of the HCWs could correctly answer 8 or more out of 14 Mpox knowledge questions, and only three out of the 14 Mpox knowledge items had correct rates below 80 %. This result seems to be more encouraging than surveys conducted in other countries [17–19,23–25]. A survey conducted in Jordan found that only 60 % of the HCWs have a high level of knowledge about Mpox [23]. At the same time, we also found some HCWs believed that the Mpox virus can be transmitted by insect vectors or the digestive tract. It indicates a potential knowledge gap about the transmission route of Mpox in HCWs. Consistent with studies conducted in other countries [25], digital news portals and social media (i.e.

WeChat, TikTok, etc.) were some of the most utilized sources of information about Mpox while more credible sources (i.e. training organized by schools/hospitals/CDC, attending the academic conference) were relied on by a considerably much less percentage of participants. The gaps in Mpox knowledge among HCWs may be addressed by providing correct knowledge and training through digital news portals and social media. Increasing the frequency of training organized by schools/hospitals/CDC and encouraging HCWs to attend academic conferences are also effective ways to improve their knowledge.

We found higher Mpox vaccination hesitancy among HCWs in Beijing. Approximately 42.37 % were hesitant to be vaccinated against Mpox among the HCWs, which is higher than two existing surveys conducted in China [17,18], but similar to other study results conducted in other countries [26,27]. Existing surveys found that the Mpox vaccination hesitancy among Chinese HCWs ranged from 35.1 % and 9.9 % [17,18]. The reasons for the different results between our study and previous studies may be the inconsistency in methods to measure HCW's Mpox vaccination hesitancy and distribute the questionnaire, and the geographical areas of the participants also vary. Furthermore, Mpox vaccination hesitancy among HCWs who have the potential risk for direct or indirect exposure to patients or infectious materials was even higher than among other HCWs. Besides worrying about side effects and lack of confidence about the effectiveness, the third reason for hesitant to be vaccinated against Mpox among HCWs working in high-risk departments was that they do not consider themselves as vulnerable crowd and believe that their risk of infecting Mpox is low. One possible explanation for this finding is that HCWs working in high-risk departments have sufficient knowledge of Mpox and are less worried about Mpox. Another possibility is that HCWs who work in low-risk departments also believe they are more susceptible to Mpox because they may not have access to the same level of personal protective equipment as their colleagues working in the high-risk departments, and therefore, were more willing to vaccinate against the Mpox [28].

In this study, the Mpox vaccination hesitancy among HCWs was significantly associated with educational level, working years, hospital department, and Mpox knowledge level. Similar to previous studies [17], we found that HCWs with higher educational levels, longer

Table 3
Attitude of Mpox vaccination among HCWs in Beijing, China (N = 2155).

Characteristics	Hesitant to vaccinate No. (%)	Willing to vaccinate No. (%)	χ^2	P
Age			49.21	<0.01
18~	193 (31.80)	414 (68.20)		
31~	377 (43.14)	497 (56.86)		
41~	223 (49.45)	228 (50.55)		
≥51	120 (53.81)	103 (46.19)		
Sex			0.02	0.88
Male	179 (41.92)	248 (58.08)		
Female	734 (42.48)	994 (57.52)		
Educational level			16.26	<0.01
Junior college or below	153 (35.75)	275 (64.25)		
Undergraduate	499 (42.50)	675 (57.50)		
Master	173 (44.70)	214 (55.30)		
Doctor degree or higher	88 (53.01)	78 (46.99)		
Marital status			15.14	<0.01
Unmarried	225 (35.83)	403 (64.17)		
Married	688 (45.06)	839 (54.94)		
Monthly income (CNY)			14.51	<0.01
< 3000	23 (29.87)	54 (70.13)		
3000–5999	112 (37.58)	186 (62.42)		
6000–9999	386 (41.15)	552 (58.85)		
10000–19999	353 (46.33)	409 (53.67)		
≥20000	39 (43.75)	41 (51.25)		
Type of medical institution			1.66	0.44
Tertiary hospitals	808 (42.08)	1112 (57.92)		
Secondary hospitals	88 (43.35)	115 (56.65)		
Community health service centers /private hospitals	17 (53.13)	15 (46.87)		
Occupation			11.20	0.01
Nurses	459 (39.20)	712 (60.80)		
Clinicians	368 (45.60)	439 (54.40)		
Medical technicians ^a	68 (29.28)	70 (50.72)		
Administrative/ nonclinical support	18 (46.15)	21 (53.85)		
Professional title			27.79	<0.01
Junior or below	346 (36.34)	606 (63.66)		
Intermediate	413 (45.84)	488 (54.16)		
Senior	154 (50.99)	148 (49.01)		
Working years			35.02	<0.01
≤5	163 (33.33)	326 (66.67)		
6 ~	201 (38.36)	323 (61.64)		
≥11	549 (48.07)	593 (51.93)		
Department ^b			5.15	0.02
High-risk departments	172 (47.91)	187 (52.09)		
Low-risk departments	741 (41.26)	1055 (58.74)		
Whether know about Mpox before this survey			5.86	0.02
Know	750 (82.15)	1069 (86.07)		
Unknow	163 (17.85)	173 (13.93)		
Mpox knowledge level ^c			9.67	<0.01
Low	204 (49.28)	210 (50.72)		
High	709 (40.72)	1032 (59.28)		

a: Medical technicians include inspection, imaging, ultrasound, electrocardiogram, pharmacy, etc.

b: High-risk departments include the infectious diseases department, dermatology department, venereal diseases department, anorectal diseases department, urology/andrology department.

c: A correct answer to 8 or more out of 14 questions about Mpox knowledge was considered a high level of knowledge.

working years, lower Mpox knowledge, and worked at high-risk departments were less likely to get the Mpox vaccines. HCWs with higher educational levels and longer working years might have more chances to get information about vaccine adverse events, which increases their vaccine hesitancy. Whereas, Mahameed et al [23] showed the significant role of psychological factors and vaccine conspiracy beliefs. Different from what we found, some scholars also showed that Mpox vaccine acceptance was significantly associated with previous vaccination behavior, while Mpox knowledge was not correlated with Mpox vaccination intention [29].

Meanwhile, we found that HCWs' confidence in the importance

Table 4
Correlates of Mpox vaccination hesitancy among HCWs in Beijing, China.

Variables	Knew about Mpox before the investigation		Did not know about Mpox before the investigation	
	Adjusted OR (95 %CI)	P	Adjusted OR (95 %CI)	P
Educational level				
Junior college or below	Ref			
Undergraduate	1.16 (0.88–1.52)	0.29		
Master	1.34 (0.97–1.84)	0.07		
Doctor degree or higher	1.75 (1.17–2.62)	<0.01		
Marital status				
Unmarried			Ref	
Married			1.65 (0.94–2.92)	0.08
Working years				
≤5	Ref		Ref	
6 ~	1.09 (0.81–1.46)	0.59	1.59 (0.86–2.97)	0.14
≥11	1.71 (1.32–2.22)	<0.01	1.96 (1.02–3.78)	0.05
Department				
Low-risk departments	Ref			
High-risk departments ^a	1.34 (1.05–1.71)	0.02		
Mpox knowledge level				
High level ^b	Ref			
Low level	1.78 (1.13–2.85)	0.01		

Data were stratified according to whether knew about Mpox before this study. Statistically significant variables in the chi-squared test were included in the logistic regression model, such as education level, marital status, monthly income, occupation, professional title, working years, departments, and knowledge level. Due to strong collinearity with other variables, age was not included in the model.

a: High-risk departments include the infectious diseases department, dermatology department, venereal diseases department, anorectal diseases department, urology/andrology department.

b: A correct answer to 8 or more out of 14 questions about Mpox knowledge was considered a high level of knowledge.

(77.87 %), safety (67.52 %), and effectiveness (66.31 %) of vaccines need to be further improved. The predominant reason for hesitancy toward Mpox vaccination among HCWs was worry about vaccine side effects. A survey in the Czech found that HCWs' perceived barriers related to Mpox vaccine safety and effectiveness were significantly associated with Mpox vaccine acceptance [19]. Although Mpox transmission is likely a rare event in the provision of medical services, data from investigations of the Mpox virus and other related orthopoxviruses suggested that occupational exposure could occur [30–32]. To curb the spread of the Mpox virus, some countries have or are developing policies to promote vaccination among those who may be at risk such as laboratory personnel and health workers [12,33]. Addressing vaccination hesitancy among HCWs can not only facilitate the achievement of public health strategies that aim to protect high-risk groups and individuals, but it may also improve public confidence in vaccines [34,35].

Our study has several limitations. First, our study was a cross-sectional survey, causality cannot be identified. Second, convenience sampling may lead to section biases, we might lose the information from participants who refuse to participate in the survey or are unconcerned about the situation of Mpox, and the HCWs from the basic-level hospitals account for relatively few. HCWs who received the questionnaire could forward it to their colleagues, but it was difficult to calculate the response rate. Third, given that this study relied on a single item to measure vaccination hesitancy as the primary outcome measure, measurement bias may exist. Fourth, the results may be influenced by possible social desirability bias. Finally, we did not test the validity and reliability of the questionnaire. To mitigate this we designed the questionnaire based on questions used in published studies on Mpox

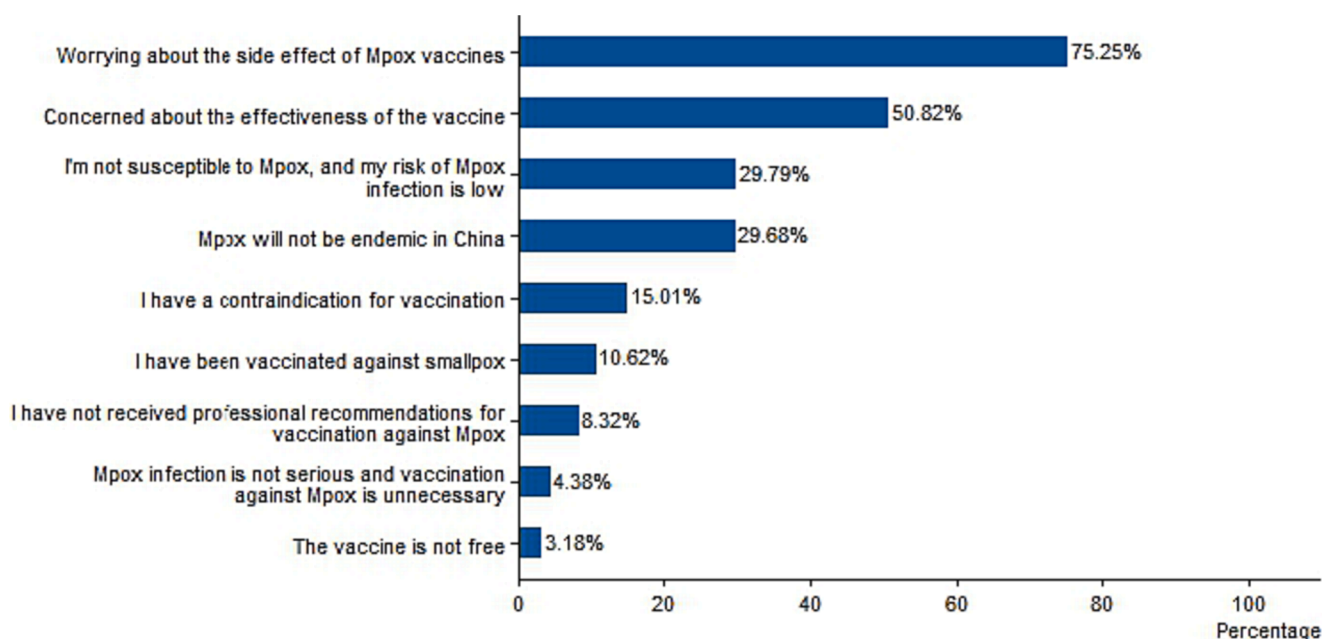


Fig. 3. Reasons for HCWs' hesitancy to get vaccinated against Mpox in Beijing, China (n = 913).

vaccination among HCWs and organized a panel of experts to discuss and finalize the questionnaire.

5. Conclusion

Mpox knowledge and Mpox vaccination hesitancy were both high among HCWs in Beijing, China. Increasing HCWs' vaccination confidence and knowledge level about Mpox, especially for those working in high-risk departments, may be an essential way of reducing their hesitancy.

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CRediT authorship contribution statement

Yuan Yang: Writing – original draft, Data curation, Investigation. **Weijie Zhang:** Writing – original draft. **Baihui Han:** Investigation, Writing – original draft. **Han Meng:** Conceptualization. **Jiaqi Wang:** Writing – original draft. **Ke Wu:** Writing – review & editing. **Leiwen Fu:** Writing – review & editing. **Bingyi Wang:** Writing – original draft. **Xiaohong Jiang:** Writing – review & editing. **Qian Li:** Writing – review & editing. **Zhiyuan Xu:** Writing – review & editing. **Ye Zhang:** Conceptualization. **Xiao Qi:** Conceptualization, Methodology. **Huachun Zou:** Conceptualization, Methodology.

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.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jvax.2024.100434>.

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