



INFECTIOUS DISEASES

Knowledge and attitude towards monkeypox among the Lebanese population and their attitude towards vaccination

YOUSSEF JAMALEDDINE^{1,2}, ASEM ABU EL EZZ³, MAHMOUD MAHMOUD³, OMAR ISMAIL⁴, AHMAD SAIFAN⁵, ZAID MAYTA⁶, ABDALLAH SAAB⁶, PASCALE SALAMEH^{2,5,7,8}

¹ Medical Research Center, Faculty of medical sciences, Lebanese University, Hadath, Lebanon;

² Gilbert and Rose Marie Chagoury School of Medicine, Lebanese American University, Byblos, Lebanon;

³ Neuroscience Research Center, Faculty of Medical Sciences, Lebanese University, Hadath, Lebanon;

⁴ Faculty of Medical Sciences, Université Saint Joseph, Beirut, Lebanon; ⁵ Faculty of Medical Sciences, Lebanese University, Hadath, Lebanon; ⁶ Faculty of Medicine, Beirut Arab University, Beirut, Lebanon; ⁷ Institut National de Santé Publique, Epidémiologie Clinique et Toxicologie (INSPECT-LB), Lebanon; ⁸ University of Nicosia Medical School, Nicosia, Cyprus

Keywords

Monkeypox • Attitude • Knowledge • Practice • Virus • Lebanon

Summary

Introduction. Monkeypox is a currently re-emerging disease in the world and several cases have been detected in Lebanon. For this reason, an assessment of the knowledge and attitude of the Lebanese population towards monkeypox and smallpox or monkeypox vaccines had to be done.

Methods. A cross-sectional study was conducted using a questionnaire developed from previous literature among a sample of Lebanese residents. It recorded the sociodemographic characteristics and comorbidities of the participants and analyzed the patterns of knowledge and attitudes in Lebanon.

Results. Among 493 participants, it was found that there is a generally low knowledge of and an average attitude toward monkeypox. However, knowledge is better with higher educa-

tional levels, COVID-19 vaccination, and residency in the south of Lebanon and poorer with marriage and residency in Beirut. Attitude is better in females but poorer with higher educational levels. Several other effectors have been devised too. As for vaccination, taking the smallpox vaccine as a proactive measure is predicted with previous COVID-19 vaccination and better attitude but not in the residents of the north of Lebanon and married Lebanese residents. Higher educational levels and a better attitude were positive predictions of taking the monkeypox vaccine whenever it is developed.

Conclusion. This study revealed low level of knowledge and attitude towards monkeypox and its vaccines, which can be a rich resource when proactive measures are developed.

Introduction

As early as 1958, monkeypox virus (MPXV) was isolated and identified in monkeys suffering from a vesicular disease during their transportation from Singapore to Denmark for research purposes [1]. The first case of human monkeypox (MPX) was identified during the smallpox eradication campaign in the 1970s in a 9-year-old child suspected of having smallpox [2] and, since then, MPX human cases were identified in 11 African countries [3, 4] with several thousands of cases to date [5], and, hence, these countries are recognized as an endemic source of MPX. This led to the emergence of two distinct clades of monkeypox virus (MPXV): the West African and the Congo Basin, with viruses of the latter being the most virulent [6].

MPXV belongs to the genus Orthopoxvirus as it is a lipoprotein membrane enveloped double helix DNA virus [3, 4, 7]. It is similar to other viruses of orthopoxviruses genus in terms of human infection: variola major virus (smallpox virus), cowpox virus (vaccinia), and variola minor virus (Variola alastrim) [7]. The original source of this virus is wild animals and

transmission to humans can occur in two pathways: animal-to-human pathway (zoonotic transmission in endemic countries) and human-to-human pathway (in both, endemic and non-endemic countries) [7].

Clinically, MPX is similar to smallpox [8, 9] but rather more moderate [10]. They are differentiated from each other by swollen lymph nodes in 90% of MPX cases [7], specifically in the neck, the groin and submandibular areas [7]. The case fatality ratio of monkeypox has historically ranged from 0 to 11% in the general population and has been higher among young children. In recent times, the case fatality ratio has been around 3-6%. [3, 7], mostly within the second week of infection [9]. However, infections with the West African type of MPXV, in this current outbreak, are rarely fatal and over 99% of infected people are likely to survive [10]. The incubation period of MPXV, during which symptoms start to appear, is between 5 to 21 days [7] and symptoms last from 2 weeks to 4 weeks. Most of the early symptoms are rather non-specific ranging between shivers, headaches, fainting, backaches, and myodynia, and later to rash, fever, restlessness, and lymphadenopathy [7, 9]. Until now.

Smallpox vaccine has been used against MPX due to the similarities between their viruses and the likelihood of some effect [11].

Confirmed in May 6, 2022, the first cluster of MPX outbreak in a non-endemic country was identified in the United Kingdom, originated from a British resident coming back from an endemic country suggesting a cluster of transmission that has gone unnoticed in endemic countries [12]. Later in May 21, this disease spread into 13 non-endemic countries and to 15 in May 22 [13]. As of 8th of June, 2022, there was a total of 23,276 cases of MPX in countries with no reports of previous encounters and only 344 cases in endemic countries [14], and on the 7th of February, 2023, there has been detected 85,645 confirmed cases in 110 countries [15]. The majority of these cases belong to young men between 25 and 35 years old, many of which identify themselves as homosexual or bisexual [16, 17]. This global outbreak is one of the largest in history with large transmission chains from endemic to non-endemic countries. 26 cases have been reported in Lebanon according to the Centers for Disease Control and Prevention (CDC) statistics [14].

Within the coming months, the magnitude of the global outbreak will be clarified. This urges a quick and proactive action against the monkeypox outbreak, and the most important measure to start with is a knowledge and attitude (KA) assessment in Lebanon before an outbreak emerges as in the United Kingdom.

Materials and methods

STUDY DESIGN AND POPULATION

A cross-sectional study was carried out among the Lebanese population between the 6th of September, 2022, and the 20th of that same month. Anyone who was a resident in any of Lebanon's six governorates and above the age of 18 was eligible to be a part of this study.

ETHICAL CONSIDERATION

The study protocol was reviewed and approved by the institutional review board of Sahel General Hospital, Beirut Lebanon (Reference number: 4/2022). The study was conducted in accordance with the Declaration of Helsinki. Participants agreed to an informed consent and had to answer a yes/no question to confirm their willingness to participate in this study with guarantees that their anonymity would be preserved.

SAMPLE SIZE CALCULATION

The minimal sample size required was calculated through an online platform called "Raosoft" which is a sample size calculator specifically for population surveys. Using the population of Lebanon, the required sample size was estimated to be 385 for a confidence level of 95% and a 5% margin of error. A total of 518 responses were collected for this study in which data collection was closed September 20, 2022; this would allow taking missing values into account.

DATA COLLECTION

The questionnaire was designed and developed after an extensive search throughout the literature for significant background information and with the use of previous similar surveys. The Google Forms platform was utilized for the generation of the survey which was in the Arabic language as it is the native language of the Lebanese people. The questionnaire was then shared online through a link to reach as many people as possible many in which it included brief background information, study objectives, declarations of confidentiality and anonymity, and instructions on how to follow through with the questionnaire. The final questionnaire, after editing and revision, was divided into the following sections:

1. sociodemographic characteristics such as age, gender, marital status, residency address (governorate), level of education, smoking status, family income, crowding index, health status, and comorbidities among several other characteristics;
2. the knowledge section was made up of 10 questions that would assess the extent of the participant's knowledge of the monkeypox disease. In the absence of specific validated scales, it included questions on the mode of transmission, symptoms, duration between infection and the onset of symptoms, duration of symptoms as well as management methods in case of an infection. The questions consisted of multiple-choice answers with some having more than one correct choice. Each correct answer was designated a single point and incorrect/don't know answers were not designated any point. As such, the highest knowledge index possible was 26, ranging from 0 to 26 with a higher index indicating better knowledge. Participants were also asked to provide their main sources of information regarding monkeypox;
3. the attitude section consisted of 4 questions including the extent of the participant's concern about getting infected, if they think monkeypox will affect their daily life, if they consider it to be a serious disease, and their perception on the chances of getting infected. The scoring was based on a 5-point Likert scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, and 5 = strongly agree) with a range of 4 to a maximum of 20. A higher index indicated a better attitude toward monkeypox;
4. the practice section included 4 questions specifically aimed at the willingness of the participants to receive the smallpox vaccine if it was proven effective against monkeypox, the willingness to receive a new monkeypox vaccine if it was available and how much were they willing to pay for both types of vaccines. In addition to that, participants were asked if they were previously vaccinated against smallpox and COVID-19. The willingness to receive a smallpox or a new monkeypox vaccine served as a dependent variable for bivariate and multivariate analysis in order to assess which factors can affect that willingness.

STATISTICAL ANALYSIS

Statistical analysis was performed through the software

program SPSS (Statistical Package for Social Sciences) version 25.0. Descriptive statistics were reported using frequencies and percentages for categorical variables and means and standard deviations (SD) for continuous variables. Bivariate analysis was performed to assess the factors associated with knowledge, attitude, and willingness to receive a vaccine. Multivariate regression was also used to identify the factors that can impact knowledge and attitude indexes as well as the factors that impact the willingness to receive a vaccine as the dependent variable. Unstandardized B coefficients and their 95% confidence intervals (CI) were reported. For all the statistical tests, a p-value < 0.05 was considered to be significant.

Results

SOCIODEMOGRAPHIC CHARACTERISTICS AND COMORBIDITIES OF THE PARTICIPANTS

Socio-demographics

Out of the 518 responses collected, only 493 were included in the analysis as they have passed the preliminary requirements of the inclusion criteria. Females represented 75.9% of the participants compared to only 24.1% male participants. The mean age was 24.4 ± 8.44 in which this largest number of participants belonged to the age group of 21 to 25 years with 238 participants representing 48.3% of the analysed responses. The majority were single (86%) and belonged to the educational level of bachelor's as either undergraduates or degree holders (41.8%). Almost two-thirds (64.9%) were unemployed with only 16.4% were employees specialized in the healthcare system out which 55.6% identified as medical doctors. Family-wise measurements showed a high crowding index in about half of the participants (49.5%) and a low (0 to 150 US dollars) to slightly better (150 to 300 US dollars) total income in 54.8% participants. Table I summarizes all of the socio-demographic characteristics of the participants.

Health status and comorbidities

The majority of participants were shown to have followed healthy lifestyles. Smoking and drinking were only observed in 15% and 8.9% of the participants, respectively. Furthermore, only 7.8% identified themselves as obese individuals. The presence of chronic diseases was shown to be fairly uncommon with the most frequent one being chronic lung diseases was only marked in 3.4% of respondents. Table II includes details these measurements.

KNOWLEDGE AND ATTITUDE TOWARDS MONKEYPOX

Description of knowledge and attitude indexes

Knowledge towards monkeypox

Overall, poor knowledge was discovered among the participants with a mean index of 12.72 ± 4.83 in which the maximum index that could have been achieved was

Tab. I. Socio-demographic characteristics of the study participants (N = 493).

		Frequency	Percent
Gender	Male	119	24.1
	Female	374	75.9
Age (in years)	Mean (SD)	24.4 (8.44)	
	Median	22	
	Min - Max	18-65	
Age	18-20 years	155	31.4
	21-25 years	238	48.3
	> 25 years	100	20.3
Marital status	Not married	424	86.0
	Married	69	14.0
Governorate	Beirut	26	5.3
	Mount Lebanon	164	33.3
	North Lebanon/Akkar	185	37.5
	South Lebanon/ Nabatiyeh	55	11.2
	Beqaa/Baalbeck	63	12.8
Educational level	Elementary school	5	1.0
	Baccalaureate	76	15.4
	Bachelor degree	206	41.8
	Master degree	116	23.5
	Doctorate/PHD/ Medical degree	90	18.3
Crowding index	Low	142	28.8
	Moderate	107	21.7
	High	244	49.5
Family total income	0 to 150 US dollars	166	33.7
	150 to 300 US dollars	104	21.1
	300 to 450 US dollars	62	12.6
	450 to 600 US dollars	53	10.8
	600 to 750 US dollars	13	2.6
	750 to 900 US dollars	31	6.3
	More than 900 US dollars	64	13.0
Employment status	I don't work	320	64.9
	I am specialized in health care	81	16.4
	I work but not in health care	92	18.7
Specialty in health care	Doctor	45	55.6
	Nurse	12	14.8
	Pharmacist	4	4.9
	Dentist	4	4.9
	Physiotherapist	2	2.5
	Other	14	17.3

26. About 50% of the responders had an index less than 12, 25% had an index between 12 and 16, and 25% had an index higher than 16.

Table III describes the participants responses to the 9 items that contributed to the analysis of the knowledge towards monkeypox. Asterisks indicated that the answers were positive contributors in the calculation of the knowledge index. Most of the participants showcased good knowledge concerning the origin of this disease spreading as a virus (74.8%) and concerning the common continent in which

Tab. II. Health status and comorbidities of the study participants (N = 493).

		Frequency	Percent
Smoking	No	412	83.6
	Ex-smoker	7	1.4
	Smoker	74	15.0
Obesity	No	454	92.1
	Yes	39	7.9
Do you drink alcohol?	No	449	91.1
	Yes, occasionally	42	8.5
	Yes, regularly	2	0.4
Chronic disease	Hypertension	11	2.2
	Cardiovascular diseases other than hypertension (ex: heart failure, coronary artery disease...)	3	0.6
	Cancer	2	0.4
	Chronic Lung Disease (ex: Chronic obstructive pulmonary disease, asthma...)	17	3.4
	Renal failure	3	0.6
	Other diseases	47	9.5

monkeypox was most spread prior to 2022 and that being in Africa (58.6). However, a huge gap of knowledge was prominent in the symptoms of monkeypox; 80.1% have agreed on fever as one of the symptoms while concerning the other symptoms, the participants were not so sure about their responses as the percentages have varied. Poor knowledge was also discovered regarding the incubation period with only 17% responding correctly and regarding the self-limitation of this disease with 36.9% responding correctly on its natural elimination after 2-4 weeks. A similar pattern to the knowledge about symptoms is recognized in transmission and treatment. Regarding transmission, 77.5% were aware the virus spreads through direct contact with infectious rash and liquid, while they were progressively less aware of the other transmission methods. As for treatment of monkeypox, only 60% agreed on the obvious treatment of providing patients with fluids and nutrition then the numbers decrease to nearly 40% awareness on some of the approved treatments. Knowledge of prevention factors was fairly decent with more than 60% of the participants agreeing on all factors; however, more than half of the participants did not know about the effectiveness of smallpox vaccine against monkeypox. Table III details the participants' answers. The most frequent source of information the participants relied on regarding monkeypox was discovered to be social media (52.9%) while more credible sources were relied on by a considerably much less percentage of participants: World Health Organization (27.2%), Ministry of Health (20.7%), Center for Diseases Control and Prevention (16.6%) (Tab. IV).

Attitude index

The attitude towards monkeypox demonstrated a

slightly-higher-than-average mean of 11.78 ± 2.63 in which a maximum index of 20 was obtainable. About 50% of the participants obtained an index of 12 or less. Of the 493 participants, only 34.9% showcased concerns about getting infected monkeypox, 52% think it affected or will have affected their daily lives and 42.6% considered it to be a serious disease. However, more than half of the participants estimated their chances of getting infected as low (50.5%) and 18.5% considered it to be too low (Tab. V).

Bivariate analysis of the factors associated with monkeypox-concerned knowledge and attitude

Knowledge

Although the mean total knowledge index is generally found to be low, there were some significant differences in knowledge based on certain demographic characteristics. The results of the bivariate analysis have shown a statistically significant difference in mean knowledge indexes based on different age groups (p -value = 0.007) in which a higher mean knowledge index was found in the age group 21-25 (13.38 ± 4.78) compared to the other age groups. Married participants were found to have had a significantly lower mean index (13.08 ± 4.81 ; p -value < 0.0001) compared to those unmarried. As for the place of residence, knowledge towards monkeypox showcases a statistically significant difference in some governorates. Others that showcased a statistically significant higher mean knowledge index included, holders of PhD or MD degrees (15.29 ± 5.12 ; p -value < 0.0001), those with a family total income higher than 300 US dollars (13.34 ± 5.23 ; p -value = 0.01), healthcare specialists (15.74 ± 4.77 ; p -value < 0.0001), and finally, participants vaccinated against COVID-19 (13.09 ± 4.84 ; p -value = 0.001). A significantly lower mean knowledge index was found in Beirut residents (10.81 ± 3.35 ; p -value = 0.037) and North Lebanon/Akkar residents (11.97 ± 4.54 ; p -value = 0.007) when compared with residents of other governorates. Table VI (Appendix) details the sociodemographic factors' association with knowledge indexes of the study respondents.

Attitude

As for attitude towards monkeypox, a significantly higher attitude mean index was found in females (12.02 ± 2.7 ; p -value < 0.0001) and holders of the baccalaureate degree (12.2 ± 2.37 ; p -value < 0.0001). Table VI (Appendix) includes further details on the relationship between sociodemographic characteristics and attitude indexes of participants.

Determinants of monkeypox knowledge and attitude

Knowledge

A multiple linear regression model was revised with the mean knowledge as the dependent variable. The results showed that higher educational level (unstandardized $B = 1.132$), residing in South Lebanon/Nabatiyeh

Tab. III. Monkeypox knowledge among the study participants.

		Frequency	Percent
Monkeypox is the result of infectious	Bacteria	47	9.5
	Virus*	369	74.8
	I don't know	77	15.6
Before 2022, monkeypox was common in which continent	Asia	19	3.9
	Africa*	289	58.6
	Europe	5	1.0
	North America	3	0.6
	South America	4	0.8
	Oceania (Australia)	1	0.2
	I don't know	172	34.9
The symptoms of the disease are	Fever*	395	80.1
	Headache*	239	48.5
	Muscle aches and back pain*	163	33.1
	Chills*	123	24.9
	Fatigue*	222	45.0
	Swollen lymph nodes*	147	29.8
	Respiratory symptoms as sore throat, nasal congestions, and cough*	126	25.6
The duration between infection and onset of symptoms is	Skin rash*	436	88.4
	In 3 days	184	37.3
	In 3 weeks*	84	17.0
	In 6 weeks	2	0.4
	In 3 months	1	0.2
The duration of monkeypox disease, that is, how long the symptoms last for in humans	I don't know	222	45.0
	Less than 2 weeks	85	17.2
	2 to 4 weeks*	182	36.9
	4 to 8 weeks	17	3.4
	More than 8 weeks	3	0.6
How does monkeypox spread?	I don't know	206	41.8
	Direct contact with the rash or infectious bodily fluids*	382	77.5
	Respiratory secretions during direct contact: face-to-face or during intimate physical contact as in kissing, cuddling, or sex*	181	36.7
	Touching things like clothing or linens that have previously been in contact with a rash or bodily fluids*	203	41.2
	To the fetus through the placenta in pregnant women*	68	13.8
The cure of monkeypox:	From infected animals: either through scratches or biting by animals or through preparing or eating meat or using products of infected animals*	221	44.8
	Provide patients with appropriate fluids and food to maintain their good nutritional statuses*	296	60.0
	Treat secondary bacterial inflammations as prescribed*	211	42.8
Is the vaccination against smallpox effective against monkeypox?	Treat with tecovirimat medication*	190	38.5
	It is effective*	185	37.5
	It is not effective	38	7.7
Prevention factors against monkeypox:	I don't know	270	54.8
	Avoiding skin-to-skin contact with infected people with a monkeypox-like rash*	423	85.8
	Avoiding touching or contact with the bedding, towels, or clothing of a person infected with monkeypox*	320	64.9
	Wash your hands often with soap and water or use alcohol-based hand sanitizers*	309	62.7
Do you think that monkeypox is more common among the homosexual individuals?	In Central and West Africa, avoid contact with animals that can spread monkeypox virus, which usually are rodents and primates. Also, avoid sick or dead animals, as a well as the bedding or other items that it could've touched it*	287	58.2
	No	70	14.2
	Yes*	222	45.0
	I don't know	201	40.8

* Correct answer.

Tab. IV. Sources of information utilized by the participants regarding the monkeypox disease.

	Frequency	Percent
Friends/Family	80	16.2
Social Media	261	52.9
CDC (Centers for Disease Control and Prevention)	82	16.6
Ministry of Health Website	102	20.7
World Health Organization Website	134	27.2
Other websites/the internet	152	30.8
TV or other broadcast media types	111	22.5
Other sources	45	9.1
I heard about the disease but did not follow up on it or ask about it	102	20.7

Tab. V. Monkeypox attitude among the study participants.

		Frequency	Percent
Are you concerned about getting monkeypox?	I strongly disagree	46	9.3
	I disagree	72	14.6
	Neither disagree nor agree	203	41.2
	I agree	140	28.4
	I strongly agree	32	6.5
Do you think that monkeypox is affecting or will affect your daily life?	I strongly disagree	27	5.5
	I disagree	77	15.6
	Neither disagree nor agree	133	27.0
	I agree	208	42.2
	I strongly agree	48	9.7
Do you consider monkeypox a serious disease?	I strongly disagree	16	3.2
	I disagree	108	21.9
	Neither disagree nor agree	159	32.3
	I agree	182	36.9
	I strongly agree	28	5.7
You consider your chances to get infected with monkeypox	Too low	91	18.5
	Low	249	50.5
	Moderate	142	28.8
	High	8	1.6
	Too high	3	0.6

(unstandardized $B = 1.445$), and having a previous vaccination to COVID-19 (unstandardized $B = 1.296$) were significantly associated with greater knowledge towards monkeypox. On the other hand, marriage (unstandardized $B = -2.004$) and residing in Beirut (unstandardized $B = -2.3$) were associated with a poorer knowledge (Tab. VII).

Attitude

In a multiple linear regression model with attitude towards monkeypox as the dependent variable, females (unstandardized $B = 0.854$) were significantly associated with higher attitude index while a higher education level is significantly associated with lower attitude indexes (Tab. VIII).

Pearson's Correlation between attitude and knowledge showed no significant correlation between the two with a coefficient of 0.023 (p -value = 0.613).

Vaccination as a practice against monkeypox

Vaccination willingness among participants

In our study of 493 participants, 58.4% have been previously vaccinated against smallpox and 79.5% have received at least one shot of the COVID-19 vaccine. When informed that smallpox vaccine was proved to be efficient against monkeypox, 69.4% showed willingness to take the vaccine, and 58.8% would only take it if it was available for free. In case a monkeypox vaccine is developed, 56.4% have agreed to take it and only 25% were willing to pay for it (Tab. IX).

Bivariate analysis of the factors associated with vaccination against monkeypox

The results of the bivariate analysis showed that a statistically significant higher percentage of participants were willing to receive the smallpox vaccine as a proactive measure against monkeypox in North Lebanon/Akkar residents (60%; p -value < 0.0001), Beqaa/Baalbek residents (81%; p -value = 0.033), those with a family total income higher than 300 US dollars (74%; p -value = 0.043), obese and non-obese participants (53.8% and 70.7%, respectively; p -value = 0.028), and in previously vaccinated participants against smallpox (75.7%; p -value < 0.0001) and COVID-19 (75.8%; p -value < 0.0001) (Tab. X, Appendix).

Furthermore, in case a monkeypox specific vaccine was developed, bivariate analysis showed that a higher percentage of participants were willing to receive it in Mount Lebanon residents (62.8%; p -value = 0.049) and in previously vaccinated individuals against smallpox (62.2%; p -value = 0.003) and COVID-19 (64.3%; p -value < 0.001). On the other hand, a significantly lower percentage were willing to receive the vaccine in North Lebanon/Akkar residents (47%; p -value = 0.001) (Tab. X, Appendix).

Those with a higher mean attitude index were found to be more willing to get the smallpox vaccine (12.06 ± 2.51 ; p -value = 0.001) and the monkeypox vaccine (12.16 ± 2.49 ; p -value < 0.0001) compared to those with a lower mean attitude (Tab. X, Appendix).

Multivariate analysis on the factors associated with the willingness to take the vaccine

A multivariate linear regression model was revised with the willingness to take the smallpox vaccine if proven efficient against monkeypox as the dependent variable. It was determined that previously vaccinated participants against COVID-19 and participants with higher attitude indexes are 3.58 and 1.157 times more likely to take the vaccine, respectively (unstandardized $B = 1.275$, OR = 3.58; unstandardized $B = 0.146$, OR = 1.157).

Meanwhile, married participants and residents of North Lebanon/Akkar are 0.51 and 0.605 less likely to take the vaccine compared to unmarried and residents of the other governorates, respectively (unstandardized $B = -0.674$, OR = 0.51; unstandardized $B = -0.503$, OR = 0.605) (Tab. XI).

Tab. VII. Results of linear regression analysis on factors significantly associated with knowledge towards monkeypox.

Model		Unstandardized coefficients	Standardized coefficients	Sig.	95.0% Confidence Interval for B	
		B	Beta		Lower bound	Upper bound
5	(Constant)	10.060		0.000	7.852	12.267
	Educational level	1.132	0.232	0.000	0.712	1.552
	Marital status	-2.004	-0.144	0.001	-3.182	-0.826
	South Lebanon/Nabatiyeh	1.445	0.094	0.028	0.157	2.732
	Beirut	-2.300	-0.107	0.013	-4.108	-0.492
	Are you vaccinated against COVID-19?	1.296	0.108	0.013	0.277	2.315
a. Dependent Variable: Knowledge. Variable(s) entered 1. Educational level (Elementary school, Baccalaureate, Bachelor degree, Master, PhD/Doctorate) 2. Marital status (Not married/married) 3. South Lebanon/Nabatiyeh (No/Yes) 4. Beirut (No/Yes) 5. Are you vaccinated against COVID-19? (No/Yes)						

Tab. VIII. Results of linear regression analysis on factors significantly associated with 276 attitude towards monkeypox.

Model		Unstandardized coefficients	Standardized coefficients	Sig.	95.0% Confidence Interval for B	
		B	Beta		Lower bound	Upper bound
2	(Constant)	11.485		0.000	10.131	12.839
	Sex	0.854	0.139	0.002	0.313	1.394
	Educational level	-0.351	-0.132	0.003	-0.585	-0.117
	Knowledge	0.034	0.025	0.178	-0.015	0.083
Dependent: Attitude (index) Variable(s) entered: 1. Educational level (Elementary school, Baccalaureate, Bachelor degree, Master, PhD/Doctorate) 2. Sex (Male/Female)						

A second multivariate linear regression model was generated but this time taking into account the willingness to take the monkeypox vaccine, if developed, as the dependent variable. Participants in higher educational levels and those with higher attitude indexes are 1.241 and 1.152 times more likely to take the vaccine, respectively (unstandardized B = 0.216, OR = 0.142; unstandardized B = 0.142, OR = 1.152) (Tab. XII).

Discussion

Several infectious diseases have been recently emerging in Lebanon and the world in the past couple of years including COVID-19, monkeypox, and cholera. We have opted in this study to focus on the monkeypox disease as its reemergence has been quite recent. As of February 2023, 26 cases have been recorded in Lebanon so far; all of which were of unknown origin. This re-emergence should urge the Lebanese community to propose a well-adjusted set of measures to control and prevent the spread of monkeypox any further. One of the efficient ways is to assess the knowledge and attitude of the general community before any endemic pushes us to extreme caution.

DISSECTION OF THE KNOWLEDGE AND ATTITUDE INDEXES

One of the challenges in the prevention of monkeypox from re-emerging and spreading is the lack of knowledge in the community. In Lebanon, the knowledge level is generally low and it state is attributed to the fact that monkeypox is uncommon in the region and is currently re-emerging, which is exactly why several countries have reported poorer knowledge among their communities such as in the United Arab Emirates [18], Saudi Arabia's general population [19] and physicians [20], Jordanian college students [21], Italian physicians [22], Indonesian general practitioners [23] and internal medicine practitioners [24], and Bangladesh population [25]. A high percentage of our participants reported adequate knowledge of the source of this disease, which is why 80.1% agreed on fever as a symptom, but the answers to the other items representing symptoms as incubation period, transmission, treatment, and vaccination were shown to be poor-to-average. Indonesian internal medicine residents have reported a similar pattern which was elaborated by the debatable state of these topics in a re-emerging disease [24]. For preventative measures, most people figured out most of them mainly because such measures follow the common sense, which was adjusted lately in the COVID-19 pandemic.

Tab. IX. Vaccination perception by the study participants as a preventative measure against monkeypox.

		Frequency	Percent
Are you vaccinated against smallpox previously?	No	92	18.7
	I don't know/remember	113	22.9
	Yes	288	58.4
Are you vaccinated against COVID-19?	No	101	20.5
	Yes, one shot	16	3.2
	Yes, two shots	266	54.0
	Yes, three shots	100	20.3
	Yes, four shots	10	2.0
If it was proved that the smallpox vaccine is effective against monkeypox, are you willing to take the smallpox vaccine, regardless if you were vaccinated or not?	I strongly disagree	19	3.9
	I disagree	50	10.1
	Neither disagree nor agree	82	16.6
	I agree	245	49.7
	I strongly agree	97	19.7
In case a smallpox vaccine becomes available, are you willing to pay for it? How much are you willing to pay for it?	I will not pay as I do not want it	77	15.6
	I will not pay as it has to be available for free	290	58.8
	I will pay between 1 and 10 US dollars, i.e., less than 10 US dollars)	62	12.6
	I will pay between 10 and 20 US dollars	30	6.1
	I will pay between 30 and 40 US dollars	14	2.8
	I will pay more than 30 US dollars	20	4.1
In case a new vaccine specifically for the monkeypox becomes available, are you willing to get the vaccine?	I strongly disagree	26	5.3
	I disagree	62	12.6
	Neither disagree nor agree	126	25.6
	I agree	219	44.4
	I strongly agree	60	12.2
In case a new vaccine specifically for the monkeypox becomes available, are you willing to pay for it? How much are you willing to pay for it?	I will not pay as I do not want it	87	17.6
	I will not pay as it has to be available for free	283	57.4
	I will pay between 1 and 10 US dollars, i.e., less than 10 US dollars)	57	11.6
	I will pay between 10 and 20 US dollars	30	6.1
	I will pay between 30 and 40 US dollars	14	2.8
	I will pay more than 30 US dollars	22	4.5
	Total	493	100.0

The prevailing beliefs towards the monkeypox re-emergence show a rather average attitude. This can be due to the easily tracked transmission patterns and the uniqueness of the symptoms of monkeypox when compared to those of COVID-19, which is why the concern about monkeypox infection was found to be generally low. Moreover, the participants showcased a moderately better attitude towards the seriousness of the disease and its effect on their daily lives. These mediocre indexes in the Lebanese community can be attributed to the source of their information – social media accounted for 52.9% and other official websites accounted for 30.8%; these platforms might have included a lot of false or misleading information causing a negative attitude toward monkeypox especially with all the peoples' misconceptions and exaggerations.

Social media is also a platform known to harbor a lot of conspiracy theories, which was the case for SARS-COV-2 of COVID-19. This can partially explain the generally poor knowledge in the Lebanese community which is in line with what was found in the Saudi Arabia community [19] and Jordanian college students [21].

EFFECTORS AND PREDICTORS OF MONKEYPOX KNOWLEDGE IN LEBANON

Several factors have been found to affect the diversity of knowledge in the general community, which is not in line with what was found by Indonesian general practitioners; this is mainly because of the studied population: With general practitioners, there is a common pattern with re-emerging and uncommon outbreaks. This pattern is the uniformity of low knowledge regardless of any variable [23].

As for age, knowledge was higher than average in the age group of 21 to 25 years compared to other groups which is probably due to better access to accurate information and curiosity during this period of one's college life. This was in line with a study on Indonesian general practitioners [23] and on Pakistani population [26], however, it was not the case for the United Arab Emirates [18] and Saudi Arabia's population [19] as they have reported greater knowledge in older participants [19] with the exception of Saudi Arabia's physicians only in which knowledge is poorer with older age [20]. Other studies reported no effect of age on monkeypox knowledge at all as in Bangladesh [25].

Unmarried participants showed a higher knowledge index possibly due to more available time to educate one's self, raising a concern for married couples in which their safety, as well as their children's safety, can be in jeopardy. In fact, marriage was found to be a predictor of poor knowledge in the Lebanese community. This finding contradicts what was found in Saudi Arabia general population where married participants reported better knowledge [19] but was still in line with its physicians [20].

Furthermore, in the economic aspect of the Lebanese individuals, when the family's total income was found to be higher than \$300, the knowledge index was higher than the average suggesting that a comfortable lifestyle opens

Tab. XI. Linear regression analysis on the factors significantly associated with the willingness to take the smallpox vaccine

If it was proved that the smallpox vaccine is effective against monkeypox, are you willing to take the smallpox vaccine, regardless if you were vaccinated or not? (No/Yes)	B	S.E.	P-value	OR	95% CI for OR	
					Lower	Upper
Marital status	-0.674	0.283	0.017	0.510	0.292	0.888
North Lebanon/Akkar	-0.503	0.215	0.019	0.605	0.396	0.922
Are you vaccinated against COVID-19?	1.275	0.244	0.000	3.580	2.220	5.775
Attitude	0.146	0.040	0.000	1.157	1.070	1.252
Knowledge	0.006	0.024	0.807	1.006	0.960	1.054
Constant	-0.870	0.585	0.137	0.419		
Dependent: If it was proved that the smallpox vaccine is effective against monkeypox, are you willing to take the smallpox vaccine, regardless if you were vaccinated or not? (No/Yes)						
Variable(s) entered						
1. Are you vaccinated against COVID-19? (No/Yes)						
2. Attitude (index)						
3. Marital status (Not married/married)						
4. North Lebanon/Akkar (No/Yes)						

Tab. XII. Linear regression analysis on the factors significantly associated with the willingness to take the monkeypox vaccine if developed.

In case a new vaccine specifically for the monkeypox becomes available, are you willing to get the vaccine? (No/Yes)	B	S.E.	P-value	OR	95% CI for OR	
					Lower	Upper
Educational level	0.216	0.095	0.023	1.241	1.030	1.497
Attitude	0.142	0.037	0.000	1.152	1.073	1.238
Knowledge	0.026	0.020	0.203	1.026	0.986	1.068
Constant	-2.135	0.589	0.000	0.118		
Dependent: In case a new vaccine specifically for the monkeypox becomes available, are you willing to get the vaccine? (No / Yes)						
Variable(s) entered:						
1. Educational level						
2. Attitude (index)						

access to better and more reliable sources of information. Even the Saudi population had a similar finding [19], however, in China [27] and in Indonesian general practitioners [23], income had no effect whatsoever. Knowledge indexes were found to be higher than average in Mount Lebanon, probably since it is more urbanized than other governorates as other studies reported [19], and in South Lebanon and Nabatiyeh. In fact, the mean knowledge index in South Lebanon and Nabatiyeh residents was even higher than that of Mount Lebanon residents and residency in the former governorates is a predictor of greater knowledge, both of which entails a further look into it to understand the reasons behind it. Beirut participants are the lowest in number in our study, which could have accounted for the low knowledge index. Despite of this, Beirut residency was found to be a predictor of poor knowledge in the Lebanese community contrasting another study in Saudi Arabia [19]. A study on Bangladesh showed no effect of the urban setting on monkeypox knowledge [25]. Higher educational levels, specifically postgraduate levels, including master's students, and doctorate and medical students reported a higher-than-average knowledge index even though monkeypox could not have been a part of their curriculums. This can reflect how education and maturity have influenced their knowledge and their curiosity to search for reliable information.

In line with this study, a similar finding was reported in Bangladesh [25], America [28], the United Arab Emirates [18] and in Saudi Arabia's general populations [19] where higher education is associated with better knowledge, and lower educational levels, as with Jordanian college students, are associated with worse knowledge [21]. Educational level was found to predict higher levels of knowledge. Studies have also focused on how knowledge could've been better if monkeypox was implemented into their curriculums [18, 28]. Healthcare workers reported a high level of knowledge, which is to be expected from professionals in the field and can set a calmer environment when things might run out of control. However, physicians and general practitioners in Italy [22] and Indonesia [23, 24] have shown poorer levels of knowledge but Bangladesh workers [25] and Saudi Arabia healthcare workers [19, 20] showed a similar finding. Finally, vaccinated participants against COVID-19 reported a higher level of knowledge as a similar pattern of awareness and was, in fact, found to be a predictor of better knowledge. Other factors as gender show a controversy about its effect on monkeypox knowledge, suggesting a setting-related condition rather than a general rule that fits a lot of countries. Bangladesh [25] and Indonesian general practitioners [23] have reported no effect of gender, while

Saudi Arabia physicians and United Arab Emirates [18] showcased better knowledge in females.

EFFECTORS AND PREDICTORS OF ATTITUDE TOWARDS MONKEYPOX

Attitude of the Lebanese towards the spreading of monkeypox showcase an average level towards measures of its spreading. Few factors have shown attributes in this issue and even fewer studies have tackled attitude in monkeypox. Higher than mean attitude was discovered in females possibly due to the laxity of males. In fact, this laxity showcases a negative predictor of worst attitude and females predict better attitude. In an opposite pattern to knowledge levels, age and educational level showcase an effect on attitude; better attitude was reported in older age group and the age group 18-20 years and in lower educational levels - doctorate students specifically showed a lower attitude than other educational levels. Higher educational level is in fact a predictor of worse attitude towards monkeypox measures. The opposite pattern of attitude with regards to knowledge is possible since no correlation was found between the two parameters. However, the better attitude in lower educational levels and their corresponding younger ages needs to be investigated with more stratifications; but one explanation of this issue relates their more free time to participation in awareness workshops. Older people usually have a better common sense to not get infected with monkeypox.

PREDICTORS OF VACCINATION WILLINGNESS

Vaccination is an important proactive measure to be taken when available, especially after such preventative measure has been proven to be efficient in the face of the COVID-19 pandemic. Against monkeypox, the already developed smallpox vaccine has been proven efficient to some extent (16) and countries are already considering distributing this vaccine until a reliable monkeypox vaccine is developed. For this reason, both vaccines, smallpox and the potential monkeypox vaccine were included as part of the practice against monkeypox in the analysis of this study.

More than two-thirds of the participants expressed their willingness to receive the smallpox vaccine when informed the smallpox vaccine is efficient against monkeypox and more than half were willing to receive a monkeypox vaccine if ever developed. This shows that the majority of this community is capable of and willing to practice the appropriate protective measures, however, this doesn't line with Italian physicians as they insist of receiving it for free [22]. When asked if the participant were willing to receive the smallpox vaccine as a protective measure against monkeypox: Married participants were less likely to take the smallpox vaccine. This can be attributed to the worse knowledge found with respect to unmarried participants and can be due to the great possibility that they and their children have already received the vaccine previously. North Lebanon and Akkar residents are less likely to take the vaccine which cannot be attributed to a low level of knowledge

or attitude and needs a further look into it, other studies suggest that the type of residency whether urban or rural has no effect on vaccination willingness [22, 27]. Previous vaccination against COVID-19 enhances the probability of taking the smallpox vaccine by a huge factor of 3.58 which is quite reasonable and can be due to adequate awareness that was previously spread in the Lebanese community, this is also true in America [29], and in France and Belgium [30]. Finally, attitude reports an increase in the likability to take the smallpox vaccine as found in this study and others [22, 28], however, if smallpox vaccine was previously taken, it interplays as a negative effector in one's willingness [22].

When asked if the participants were willing to take the monkeypox vaccine if developed in the next few years, only two factors have been positively linked to taking the vaccine: higher educational levels and better attitude towards. Although this may contradict the relationship between educational levels and attitude, it can be explained by the implementation of vaccination in the educational curriculums so it can enhance this practice but not the attitude towards the disease itself. Attitude showcases a consistency in its positive effect on vaccination in other studies [22, 28], but education was reported to have no effect in China [27] and among Indonesians [31].

Gender showcases an almost consistent results in several studies where it is reported to have no effect [22, 27, 30, 31], however, Americans report an increase in the willingness to get vaccinated in men [29]. This study agrees with previous findings outside America.

LIMITATIONS

While this study is among the first to assess KA concerning monkeypox, several limitations to this study were noticed. Random sampling for this study was not revised and a selection bias was present especially with the under-sampling of Beirut residents (26 participants). Although the minimal sample size required was met, the findings may not be representative of the whole Lebanese community. Information bias should also be highlighted as some participants may overestimate or underestimate their responses or they may provide answers that do not reflect their actual opinions. Certain groups could have over-sampled themselves due to their familiarity with the way this survey was conducted. The identification of the association between the dependent and independent variables is more limited in such a cross-sectional study in which causality could not have been demonstrated.

Conclusion

A monkeypox outbreak in Lebanon could lead to devastating effects with the low levels of knowledge and average attitudes of the Lebanese residents. There is an urge to promote public health awareness in general for the transmission of viruses and other bacterial infections, and from this point onwards, educate deeper

and proactively against any outbreak in the globe before it reaches Lebanon.

Ethical approval and consent to participate

Electronic informed consents were obtained from all participants prior to data collection. An institutional review board approval was sought and received from Sahel General Hospital (Reference number: 4/2022). All methods were carried out in accordance with relevant guidelines and regulations of Declaration of Helsinki.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Acknowledgments

Not applicable.

Conflict of interest statement

The author declares no conflict of interest.

Funding

This work was not funded.

Authors' contributions

YJ developed the study concept, designed the study, and developed the questionnaire. OI, YJ and AA conducted the survey distribution and data collection. AS, AS and ZM prepared the results. MM and AA wrote the manuscript; YJ and AA reviewed and edited it. PS supervised the study. All authors have read and approved the submitted version of the manuscript.

References

- [1] Magnus PV, Andersen EK, Petersen KB, Birch-Andersen A. A pox-like disease in cynomolgus monkeys. *Acta Pathol Microbiol Scand* 1959;46:156-76. <https://doi.org/10.1111/j.1699-0463.1959.tb00328.x>
- [2] Doty JB, Malekani JM, Kalemba LN, Stanley WT, Monroe BP, Nakazawa YU, Mauldin MR, Bakambana TL, Liyandja Dja Liyandja T, Braden ZH, Wallace RM, Malekani DV, McColium AM, Gallardo-Romero N, Kondas A, Peterson AT, Osorio JE, Roche TE, Karem KL, Emerson GL, Carroll DS. Assessing Monkeypox Virus Prevalence in Small Mammals at the Human-Animal Interface in the Democratic Republic of the Congo. *Viruses* 2017;9(10). <https://doi.org/10.3390/v9100283>
- [3] World Health Organization. Mpox (monkeypox). Available at: <https://www.who.int/news-room/fact-sheets/detail/monkeypox> (Accessed on: 9/2/2023).
- [4] Moore MJ, Rathish B, Zahra F. Mpox (Monkeypox) [Updated 2022 Nov 30]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing 2023 Jan. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK574519/>
- [5] Reed KD, Melski JW, Graham MB, Regnery RL, Sotir MJ, Wegner MV, Kazmierczak JJ, Stratman EJ, Li Y, Fairley JA, Swain GR, Olson VA, Sargent EK, Kehl SC, Frace MA, Kline R, Foldy SL, Davis JP, Damon IK. The detection of monkeypox in humans in the Western Hemisphere. *New Engl J Med* 2004;350:342-50. <https://doi.org/10.1056/NEJMoa032299>
- [6] Likos AM, Sammons SA, Olson VA, Frace AM, Li Y, Olsen-Rasmussen M, Davidson W, Galloway R, Khristova ML, Reynolds MG, Zhao H, Carroll DS, Curns A, Formenty P, Esposito JJ, Regnery RL, Damon IK. A tale of two clades: monkeypox viruses. *J Gen Virol* 2005;86:2661-72. <https://doi.org/10.1099/vir.0.81215-0>
- [7] Petersen E, Kantele A, Koopmans M, Asogun D, Yinka-Ogunleye A, Ihekweazu C, Zumla A. Human Monkeypox: Epidemiologic and Clinical Characteristics, Diagnosis, and Prevention. *Infect Dis Clin North Am* 2019;33:1027-43. <https://doi.org/10.1016/j.idc.2019.03.001>
- [8] Breman JG, Kalisa R, Steniowski MV, Zanotto E, Gromyko AI, Arita I. Human monkeypox, 1970-79. *Bull World Health Organ* 1980;58:165-82.
- [9] Nalca A, Rimoin AW, Bavari S, Whitehouse CA. Reemergence of monkeypox: prevalence, diagnostics, and countermeasures. *Clin Infect Dis* 2005;41:1765-71. <https://doi.org/10.1086/498155>
- [10] Centers for Disease Control and Prevention. Monkeypox. Available at: <https://www.cdc.gov/poxvirus/mpox/index.html> (Accessed on: 9/2/2023).
- [11] Titanji BK, Tegomoh B, Nematollahi S, Konomos M, Kulkarni PA. Monkeypox: A Contemporary Review for Healthcare Professionals. *Open Forum Infect Dis* 2022;9:ofac310. <https://doi.org/10.1093/ofid/ofac310>
- [12] World Health Organization. Disease Outbreak News; Monkeypox – United Kingdom of Great Britain and Northern Ireland. Available at: <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON381> (Accessed on: 9/2/2023).
- [13] World Health Organization. Disease Outbreak News; Multi-country monkeypox outbreak in non-endemic countries. Available at: <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON385> (Accessed on: 9/2/2023).
- [14] Centers for Disease Control and Prevention. 2022 Monkeypox Outbreak Global Map. Available at: <https://www.cdc.gov/poxvirus/monkeypox/response/2022/world-map.html> (Accessed on: 9/2/2023).
- [15] World Health Organization. 2022 Mpox Outbreak: Global Trends. Available at: https://worldhealthorg.shinyapps.io/mpox_global/ (Accessed on: 9/2/2023).
- [16] European Centre for Disease Prevention and Control. Epidemiological update: Monkeypox outbreak. Available at: <https://www.ecdc.europa.eu/en/news-events/epidemiological-update-monkeypox-outbreak> (Accessed on: 9/2/2023).
- [17] World Health Organization. Multi-country monkeypox outbreak: situation update. Available at: <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON392> (Accessed on: 9/2/2023).
- [18] Jairoun AA, Al-Hemyari SS, Abdulla NM, El-Dahiyat F, Shahwan M, Hassan N, Jairoun OD, Alyousef NG, Sharif S, Jaber AAS. Awareness and preparedness of human monkeypox outbreak among university student: Time to worry or one to ignore? *J Infect Public Health* 2022;15:1065-71. <https://doi.org/10.1016/j.jiph.2022.08.015>

- [19] Alshahrani NZ, Alzahrani F, Alarifi AM, Algethami MR, Alhumam MN, Ayied HAM, Awan AZ, Almutairi AF, Bamakhrama SA, Almushari BS, Sah R. Assessment of Knowledge of Monkeypox Viral Infection among the General Population in Saudi Arabia. *Pathogens* (Basel, Switzerland) 2022;11(8). <https://doi.org/10.3390/pathogens11080904>
- [20] Alshahrani NZ, Algethami MR, Alarifi AM, Alzahrani F, Alshehri EA, Alshehri AM, Sheerah HA, Abdelaal A, Sah R, Rodriguez-Morales AJ. Knowledge and Attitude Regarding Monkeypox Virus among Physicians in Saudi Arabia: A Cross-Sectional Study. *Vaccines* 2022;10:2099. <https://doi.org/10.3390/vaccines10122099>
- [21] Sallam M, Al-Mahzoum K, Dardas LA, Al-Tammemi AB, Al-Majali L, Al-Naimat H, Jardaneh L, AlHadidi F, Al-Salahat K, Al-Ajlouni E, AlHadidi NM, Bakri FG, Mahafzah A, Harapan H. Knowledge of Human Monkeypox and Its Relation to Conspiracy Beliefs among Students in Jordanian Health Schools: Filling the Knowledge Gap on Emerging Zoonotic Viruses. *Medicina* (Kaunas) 2022;58:924. <https://doi.org/10.3390/medicina58070924>
- [22] Riccò M, Ferraro P, Camisa V, Satta E, Zaniboni A, Ranzieri S, Baldassarre A, Zaffina S, Marchesi F. When a Neglected Tropical Disease Goes Global: Knowledge, Attitudes and Practices of Italian Physicians towards Monkeypox, Preliminary Results. *Trop Med Infect Dis* 2022;7:135. <https://doi.org/10.3390/tropicalmed7070135>
- [23] Harapan H, Setiawan AM, Yufika A, Anwar S, Wahyuni S, Asrizal FW, Sufri MR, Putra RP, Wijayanti NP, Salwiyadi S, Maulana R, Khusna A, Nusrina I, Shidiq M, Fitriani D, Muharrir M, Husna CA, Yusri F, Maulana R, Andalas M, Wagner AL, Mudatsir M. Knowledge of human monkeypox viral infection among general practitioners: a cross-sectional study in Indonesia. *Pathog Glob Health* 2020;114:68-75. <https://doi.org/10.1080/020477724.2020.1743037>
- [24] Salim NA, Septadina IS, Permata M, Hudari H. Knowledge, attitude, and perception of anticipating 2022 global human monkeypox infection among internal medicine residents at Palembang Indonesia: An online survey. *J Kedokt dan Kesehat Publ Ilm Fak Kedokt Univ Sriwij* 2022;9:253-62. <https://doi.org/10.32539/JKK.V9I3.18799>
- [25] Nath SD, Islam AMK, Majumder K, Rimti FH, Das J, Tabassum MN, Oishee AN, Mahmood T, Paul M, Akhter M, Bhadra AB, Rimu FH, Chakraborty S, Shom P, Nosaibah SM, Rahman A, Khan AS, Anjum A, Khan S, Hossain MM, Hawlader MDH. Assessment of Knowledge on Human Monkeypox Virus among General Population in Bangladesh: A Nationwide Cross-sectional Study. *medRxiv* 2022.08.31.22279445. <https://doi.org/10.1101/2022.08.31.22279445>
- [26] Kumar N, Ahmed F, Raza MS, Rajpoot PL, Rehman W, Khatri SA, Mohammed M, Muhammad S, Ahmad R. Monkeypox Cross-Sectional Survey of Knowledge, Attitudes, Practices, and Willingness to Vaccinate among University Students in Pakistan. *Vaccines* (Basel) 2022;11:97. <https://doi.org/10.3390/vaccines11010097>
- [27] Hong J, Pan B, Jiang HJ, Zhang QM, Xu XW, Jiang H, Ye JE, Cui Y, Yan XJ, Zhai XF, Yu Q. The willingness of Chinese healthcare workers to receive monkeypox vaccine and its independent predictors: A cross-sectional survey. *J Med Virol* 2023;95:e28294. <https://doi.org/10.1002/jmv.28294>
- [28] Bates BR, Grijalva MJ. Knowledge, attitudes, and practices towards monkeypox during the 2022 outbreak: An online cross-sectional survey among clinicians in Ohio, USA. *J Infect Public Health* 2022;15:1459-65. <https://doi.org/10.1016/j.jiph.2022.11.004>
- [29] Winters M, Malik AA, Omer SB. Attitudes towards Monkeypox vaccination and predictors of vaccination intentions among the US general public. *PloS one* 2022;17:e0278622. <https://doi.org/10.1371/journal.pone.0278622>
- [30] Gagneux-Brunon A, Dauby N, Launay O, Botelho-Nevers E. Attitudes towards monkeypox vaccination among healthcare workers in France and Belgium: an element of complacency? *J Hosp Infect* 2022;130:144-5. <https://doi.org/10.1016/j.jhin.2022.09.010>
- [31] Harapan H, Wagner AL, Yufika A, Setiawan AM, Anwar S, Wahyuni S, Asrizal FW, Sufri MR, Putra RP, Wijayanti NP, Salwiyadi S, Maulana R, Khusna A, Nusrina I, Shidiq M, Fitriani D, Muharrir M, Husna CA, Yusri F, Maulana R, Rajamoorthy Y, Groneberg DA, Müller R, Mudatsir M. Acceptance and willingness to pay for a hypothetical vaccine against monkeypox viral infection among frontline physicians: A cross-sectional study in Indonesia. *Vaccine* 2020;38:6800-6. <https://doi.org/10.1016/j.vaccine.2020.08.034>

Received on March 29, 2023. Accepted on April 18, 2023.

Correspondence: Youssef Jamaledine, Medical Research Center, Faculty of medical sciences, Lebanese University, Hadath, Lebanon. Tel. +961 81650657 - E-mail: youssefjd@outlook.com

How to cite this article: Jamaledine Y, Abou El Ezz A, Mahmoud M, Ismail O, Saifan A, Mayta Z, Saab A, Salameh P. Knowledge and attitude towards monkeypox among the lebanese population and their attitude towards vaccination. *J Prev Med Hyg* 2023;64:E13-E26. <https://doi.org/10.15167/2421-4248/jpmh2023.64.1.2903>

© Copyright by Pacini Editore Srl, Pisa, Italy

This is an open access article distributed in accordance with the CC-BY-NC-ND (Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International) license. The article can be used by giving appropriate credit and mentioning the license, but only for non-commercial purposes and only in the original version. For further information: <https://creativecommons.org/licenses/by-nc-nd/4.0/deed.en>

Appendix

Supplementary tables.

Tab. VI. Association between sociodemographic characteristics and knowledge and attitude indexes.						
	Knowledge			Attitude		
		n	Mean (SD)	P-value	Mean (SD)	P-value
Sex	Male	119	12.65 (5.13)	0.842	11.04 (2.70)	0.000
	Female	374	12.75 (4.74)		12.02 (2.57)	
Age	18-20 years	155	12.41 (4.56)	0.007	11.94 (2.36)	0.069
	21 - 25 years	238	13.38 (4.78)		11.52 (2.79)	
	> 25 years	100	11.66 (5.14)		12.19 (2.60)	
Marital status	Not married	424	13.08 (4.81)	0.000	11.72 (2.62)	0.155
	Married	69	10.55 (4.36)		12.20 (2.70)	
Beirut	No	467	12.83 (4.88)	0.037	11.78 (2.66)	0.843
	Yes	26	10.81 (3.35)		11.88 (2.18)	
Mount Lebanon	No	329	12.39 (4.56)	0.030	11.76 (2.54)	0.792
	Yes	164	13.39 (5.28)		11.83 (2.82)	
North Lebanon/Akkar	No	308	13.18 (4.95)	0.007	11.73 (2.62)	0.554
	Yes	185	11.97 (4.54)		11.88 (2.67)	
South Lebanon/Nabatiyeh	No	438	12.53 (4.87)	0.014	11.81 (2.67)	0.619
	Yes	55	14.24 (4.25)		11.62 (2.34)	
Beqaa/Baalbeck	No	430	12.73 (4.82)	0.920	11.83 (2.65)	0.372
	Yes	63	12.67 (4.91)		11.51 (2.49)	
Educational level	Elementary school	5	7.00 (2.00)	0.000	11.60 (4.04)	0.000
	Baccalaureate	76	11.33 (4.56)		12.20 (2.37)	
	Bachelor degree	206	12.20 (4.76)		11.96 (2.51)	
	Master degree	116	12.83 (4.12)		12.09 (2.74)	
	Doctorate/PHD/Medical degree	90	15.29 (5.12)		10.66 (2.65)	
Smoking	No	419	12.78 (4.85)	0.556	11.74 (2.66)	0.341
	Yes	74	12.42 (4.72)		12.05 (2.47)	
Crowding Index	Low	142	13.46 (5.06)	0.055	11.80 (2.75)	0.879
	Moderate	107	12.85 (4.83)		11.89 (2.45)	
	High	244	12.24 (4.65)		11.73 (2.65)	
Family total income	< 300 US dollars	270	12.21 (4.42)	0.010	11.92 (2.72)	0.216
	> 300 US dollars	223	13.34 (5.23)		11.62 (2.52)	
Obesity	No	454	12.78 (4.85)	0.403	11.74 (2.58)	0.197
	Yes	39	12.10 (4.63)		12.31 (3.14)	
Chronic diseases	No	421	12.88 (4.81)	0.090	11.76 (2.66)	0.682
	Yes	72	11.83 (4.85)		11.90 (2.47)	
Are you vaccinated against smallpox previously?	No	205	12.30 (4.75)	0.102	11.71 (2.84)	0.581
	Yes	288	13.02 (4.87)		11.84 (2.48)	
Are you vaccinated against COVID-19?	No	101	11.29 (4.54)	0.001	11.66 (2.50)	0.603
	Yes	392	13.09 (4.84)		11.82 (2.67)	
Employment status	I don't work	320	12.44 (4.72)	0.000	11.82 (2.51)	0.158
	I am specialized in health care	81	15.74 (4.77)		11.32 (3.11)	
	I work but not in health care	92	11.04 (4.09)		12.08 (2.57)	

Tab. X. Association between sociodemographic factors and the willingness to receive the smallpox vaccine and the monkeypox vaccine in case it was available.

		Population (N = 493)	If it was proved that the smallpox vaccine is effective against Monkeypox, are you willing to take the smallpox vaccine, regardless if you were vaccinated or not?		P-value	In case a new vaccine specifically for the Monkeypox becomes available, are you willing to get the vaccine?		P-value
			No	Yes		No	Yes	
Sex	Male	119 (24.1%)	37 (31.1%)	82 (68.9%)	0.900	48 (40.3%)	71 (59.7%)	0.438
	Female	374 (75.9%)	114 (30.5%)	260 (69.5%)		166 (44.4%)	208 (55.6%)	
Age	18 - 20 years	155 (31.4%)	48 (31.0%)	107 (69.0%)	0.150	74 (47.7%)	81 (52.3%)	0.291
	21 - 25 years	238 (48.3%)	65 (27.3%)	173 (72.7%)		95 (39.9%)	143 (60.1%)	
	> 25 years	100 (20.3%)	38 (38.0%)	62 (62.0%)		45 (45.0%)	55 (55.0%)	
Marital status	Not married	424 (86.0%)	123 (29.0%)	301 (71.0%)	0.053	184 (43.4%)	240 (56.6%)	0.990
	Married	69 (14.0%)	28 (40.6%)	41 (59.4%)		30 (43.5%)	39 (56.5%)	
Beirut	No	467 (94.7%)	143 (30.6%)	324 (69.4%)	0.987	201 (43.0%)	266 (57.0%)	0.486
	Yes	26 (5.3%)	8 (30.8%)	18 (69.2%)		13 (50.0%)	13 (50.0%)	
Mount Lebanon	No	329 (66.7%)	107 (32.5%)	222 (67.5%)	0.196	153 (46.5%)	176 (53.5%)	0.049
	Yes	164 (33.3%)	44 (26.8%)	120 (73.2%)		61 (37.2%)	103 (62.8%)	
North Lebanon/ Akkar	No	308 (62.5%)	77 (25.0%)	231 (75.0%)	0.000	116 (37.7%)	192 (62.3%)	0.001
	Yes	185 (37.5%)	74 (40.0%)	111 (60.0%)		98 (53.0%)	87 (47.0%)	
South Lebanon/ Nabatiyeh	No	438 (88.8%)	138 (31.5%)	300 (68.5%)	0.233	194 (44.3%)	244 (55.7%)	0.263
	Yes	55 (11.2%)	13 (23.6%)	42 (76.4%)		20 (36.4%)	35 (63.6%)	
Beqaa/ Baalbeck	No	430 (87.2%)	139 (32.3%)	291 (67.7%)	0.033	192 (44.7%)	238 (55.3%)	0.146
	Yes	63 (12.8%)	12 (19.0%)	51 (81.0%)		22 (34.9%)	41 (65.1%)	
Educational level	Elementary school	5 (1.0%)	0 (0.0%)	5 (100.0%)	0.179	0 (0.0%)	5 (100.0%)	0.051
	Baccalaureate	76 (15.4%)	27 (35.5%)	49 (64.5%)		37 (48.7%)	39 (51.3%)	
	Bachelor degree	206 (41.8%)	70 (34.0%)	136 (66.0%)		99 (48.1%)	107 (51.9%)	
	Master degree	116 (23.5%)	32 (27.6%)	84 (72.4%)		46 (39.7%)	70 (60.3%)	
	Doctorate/PHD/ Medical degree	90 (18.3%)	22 (24.4%)	68 (75.6%)		32 (35.6%)	58 (64.4%)	
Smoking	No	419 (85.0%)	135 (32.2%)	284 (67.8%)	0.068	188 (44.9%)	231 (55.1%)	0.119
	Yes	74 (15.0%)	16 (21.6%)	58 (78.4%)		26 (35.1%)	48 (64.9%)	
Crowding Index	Low	142 (28.8%)	41 (28.9%)	101 (71.1%)	0.583	61 (43.0%)	81 (57.0%)	0.819
	Moderate	107 (21.7%)	30 (28.0%)	77 (72.0%)		44 (41.1%)	63 (58.9%)	
	High	244 (49.5%)	80 (32.8%)	164 (67.2%)		109 (44.7%)	135 (55.3%)	
Family total income	< 300 US dollars	270 (54.8%)	93 (34.4%)	177 (65.6%)	0.043	127 (47.0%)	143 (53.0%)	0.074
	> 300 US dollars	223 (45.2%)	58 (26.0%)	165 (74.0%)		87 (39.0%)	136 (61.0%)	
Obesity	No	454 (92.1%)	133 (29.3%)	321 (70.7%)	0.028	196 (43.2%)	258 (56.8%)	0.718
	Yes	39 (7.9%)	18 (46.2%)	21 (53.8%)		18 (46.2%)	21 (53.8%)	
Chronic diseases	No	421 (85.4%)	124 (29.5%)	297 (70.5%)	0.171	176 (41.8%)	245 (58.2%)	0.083
	Yes	72 (14.6%)	27 (37.5%)	45 (62.5%)		38 (52.8%)	34 (47.2%)	
Are you vaccinated against smallpox previously?	No	205 (41.6%)	81 (39.5%)	124 (60.5%)	0.000	105 (51.2%)	100 (48.8%)	0.003
	Yes	288 (58.4%)	70 (24.3%)	218 (75.7%)		109 (37.8%)	179 (62.2%)	
Are you vaccinated against COVID-19?	No	101 (20.5%)	56 (55.4%)	45 (44.6%)	0.000	74 (73.3%)	27 (26.7%)	0.000
	Yes	392 (79.5%)	95 (24.2%)	297 (75.8%)		140 (35.7%)	252 (64.3%)	
What is your job?	I don't work	320 (64.9%)	99 (30.9%)	221 (69.1%)	0.108	142 (44.4%)	178 (55.6%)	0.295
	I am specialized in health care	81 (16.4%)	18 (22.2%)	63 (77.8%)		29 (35.8%)	52 (64.2%)	
	I work but not in health care	92 (18.7%)	34 (37.0%)	58 (63.0%)		43 (46.7%)	49 (53.3%)	
Knowledge	Mean (SD)	12.72 (4.83)	12.09 (4.77)	13.01 (4.84)	0.051	12.27 (4.63)	13.08 (4.96)	0.065
Attitude	Mean (SD)	11.78 (2.63)	11.17 (2.81)	12.06 (2.51)	0.001	11.29 (2.73)	12.16 (2.49)	0.000