












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Attitude towards cholera vaccination and its related factors in Jordan amid the 2022 Middle East outbreak

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Abstract

Background An outbreak of cholera was reported in the Middle East by the second half of 2022. Raising public awareness and vaccination against cholera represent critical factors in the preventive efforts. The current study aimed to assess the knowledge of cholera and attitude towards its vaccination among a sample of the general public residing in Jordan.

Methods An online self-administered questionnaire was distributed to the residents in Jordan using a snowball convenience-based sampling approach. The questionnaire based on previously published studies included items to evaluate sociodemographic variables, knowledge about cholera symptoms, transmission, and prevention and the willingness to accept cholera vaccination. Additionally, four items based on the validated 5 C scale in Arabic were included to assess the psychological factors influencing attitude to cholera vaccination.

Results The final study sample comprised 1339 respondents, of whom 1216 (90.8%) heard of cholera before the study. Among those who heard of cholera, and on a scale from 0 to 20, the overall mean cholera Knowledge score (K-score) was 12.9 ± 3.8 . In multivariate analysis, being over 30 years old and occupation as healthcare workers or students in healthcare-related colleges were significantly associated with a higher K-score compared to younger individuals and students in non-healthcare-related colleges. Overall, the acceptance of cholera vaccination if cases are recorded in Jordan, and if the vaccine is safe, effective, and provided freely was reported among 842 participants (69.2%), while 253 participants were hesitant (20.8%) and 121 participants were resistant (10.0%). In linear regression, the significant predictors of cholera vaccine acceptance were solely the three psychological factors namely high confidence, low constraints, and high collective responsibility.

Conclusions In this study, the identified gaps in cholera knowledge emphasize the need to enhance educational initiatives. Although cholera vaccine acceptance was relatively high, a significant minority of the respondents exhibited vaccination hesitancy or resistance. The evident correlation between the psychological determinants and

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attitudes toward cholera vaccination emphasizes the need to consider these factors upon designing public health campaigns aimed at cholera prevention. The insights of the current study highlight the importance of addressing both knowledge gaps and psychological barriers to optimize cholera control strategies.

Keywords *Vibrio*, *V. Cholera*, Vaccine attitude, Oral cholera vaccine, Preparedness, Outbreak

Background

Cholera is an acute severe gastrointestinal bacterial infection caused by the Gram-negative bacterium *Vibrio cholerae* [1, 2]. The major manifestation of cholera is profuse watery diarrhea, which can cause severe dehydration and mortality [2, 3]. The clinical manifestations of cholera are related to the secretion of the potent cholera enterotoxin that affects the intestinal permeability [4]. Besides the profuse watery diarrhea described to have a “rice water” consistency, cholera symptoms include vomiting, anorexia, abdominal cramping, and dehydration [5]. While all age groups are susceptible to cholera, children younger than 5 years have higher susceptibility to develop the disease [6]. Additionally, children have a higher burden of the disease as a result of their propensity to develop severe symptoms [7].

Although there are more than 200 identified serogroups of *V. cholerae*, cholera outbreaks worldwide are predominantly caused by two serogroups, namely O1 and O139 [8]. The cholera outbreaks are commonly associated with suboptimal water, sanitation and hygiene (WASH) measures, with *V. cholerae* transmission occurring through the ingestion of contaminated water or food [2, 9, 10].

To mitigate and control cholera, several critical intervention measures have been proposed [2]. These measures involve the improvement of public hygiene, water sanitation, and sewage systems to prevent cholera outbreaks [11, 12]. Additionally, the mitigation of cholera outbreaks necessitates coordinated efforts involving the international organizations and national authorities, non-governmental organizations (NGOs), healthcare officials and professionals, and importantly, the community engagement [13–15]. These preventive efforts are critical to enhance the outbreak preparedness and to facilitate swift responses to cholera outbreaks [16, 17]. Moreover, effective surveillance systems and strengthening laboratory capacities for identification of suspected cholera cases can be crucial for the disease control and elimination efforts [18, 19]. Importantly, the implementation of cholera vaccination can significantly contribute to immediate reduction in disease burden while other measures are implemented for strategic cholera control and elimination efforts [20]. The World Health Organization (WHO) advocate for the use of oral cholera vaccines (OCVs) alongside WASH interventions in endemic regions, in areas suffering humanitarian crises, and during the outbreaks [21]. The OCVs include Dukoral,

Shanchol, and Euvichol, which confer adequate protection against cholera for up to three years [22, 23].

Despite the availability of OCVs, vaccine acceptance if needed is not a guaranteed outcome [24–26]. In general, the attitude to vaccination and its uptake is modulated via several factors including the psychological constructs as modeled by the 5 C scale which robustly investigates the psychological antecedents for vaccination [27–30]. These psychological factors include confidence in vaccine safety and efficacy, complacency influenced by the perceived risk of the disease, constraints such as the vaccination cost or logistical barriers, calculation of vaccination benefits versus risks, and the sense of collective responsibility to protect vulnerable subpopulations [27–29, 31, 32]. Recognizing the role of these psychological factors is considered essential to tailor targeted communication and intervention measures to promote vaccination in outbreak settings [33, 34].

Globally, cholera causes up to 4 million cases each year, with approximately up to 143,000 deaths [2]. These figures highlight the significant impact of cholera on public health and development in the affected countries [35, 36]. Several countries in Asia and Africa, such as India, Sudan, Pakistan, and Bangladesh, have been particularly affected by cholera outbreaks [37, 38]. The outbreaks of cholera can be exacerbated by conditions involving political and economic instabilities such as wars as well as natural disasters [39]. This association can be related to several reasons as follows. First, during the aforementioned conditions, the water and sanitation systems are often compromised with limited access to clean water leading to contaminated water sources and inadequate sanitation [40]. Second, the displaced populations living in overcrowded and unsanitary conditions (e.g., refugee camps) are more vulnerable to cholera. This higher vulnerability is due to poor access to clean drinking water, poor sanitation, limited access to healthcare, and high population density which facilitates cholera transmission [41]. Third, the limited access to healthcare and resources in such conditions further hinders effective cholera response measures [42]. Fourth, the economic instability compromises healthcare systems and public health interventions, hindering disease surveillance and control efforts including those aimed at cholera prevention [43]. Consequently, these factors pose serious threats for cholera transmission, especially among vulnerable populations in conflict-afflicted and economically unstable regions.

In early September 2022, an outbreak of cholera was declared in Syria, a Middle Eastern country that suffered from the consequences of civil war for more than a decade [44]. The outbreak also affected Lebanon, the neighboring country for Syria, which was suffering from economic instability with a large population of refugees [43]. The cholera outbreaks in Syria and Lebanon led to several measures in Jordan, which is another neighboring Middle Eastern country. These preventive measures in Jordan aimed to enhance the preparedness for possible introduction of cholera into the country and the measures included surveillance and coordinated preventive efforts [17].

The lack of public awareness and knowledge about cholera transmission, early diagnosis, and treatment contributes to its spread; hence, understanding the general public awareness of the disease appears critical to mitigate cholera transmission [45–48]. Such a quest can be guided by evidence via the Knowledge, Attitudes, and Practices (KAP) surveys which are employed to elucidate knowledge gaps regarding a disease; thus, KAP surveys can pinpoint the challenges and obstacles facing disease prevention. In turn, the results of KAP surveys would be helpful to inform the planning and execution of targeted interventions [49]. Consequently, the findings of KAP surveys can be crucial for designing targeted health education campaigns to improve community knowledge and response to cholera outbreaks.

Notably, assessing the attitude to cholera vaccination can be helpful to shed light on possible factors that may influence the willingness to accept cholera vaccination. This investigation is particularly relevant in the Middle East countries where vaccination hesitancy represents a growing concern [50–52]. Thus, the evaluation of attitudes to cholera vaccination in a Middle Eastern country can provide insights into the feasibility and potential success of vaccination programs in the region. This approach is particularly helpful to identify possible factors that could influence attitudes toward vaccination, which subsequently can be addressed to increase vaccination coverage. The findings of such a quest can serve as evidence for policymakers and public health officials to develop targeted strategies and interventions for cholera prevention and control. Therefore, the current study aimed to assess the level of cholera knowledge and attitudes toward its vaccination in a sample from the general public residing in Jordan shortly following the declaration of cholera outbreaks in the neighboring countries, namely Iraq, Syria, and Lebanon.

Methods

Study design

The current study was based on a cross sectional design. The data were collected using a self-administered

questionnaire distributed online using a snowball sampling approach starting with the contacts of the authors in Jordan. The survey structure was based on a previous KAP survey which was conducted in Lebanon by the end of 2022 by Malaeb et al. [53]. Additionally, the assessment of the psychological determinants of attitude towards cholera vaccination was based on four items adopted from the 5 C scale and its validated version in Arabic [27, 28, 54]. The questionnaire was presented to participants in Arabic language and was hosted in Google Forms. The survey distribution started on 3 December 2022 and concluded on 11 December 2022. The participation was voluntary without any forms of incentives. Distribution of the survey link started by the authors in Jordan using WhatsApp and Messenger instant messaging applications and Facebook personal pages and public groups encouraging further distribution of the survey.

Ethics statement

This study was approved by the Scientific Research, Innovation, and Scientific Activities Committee at the Department of Medical Laboratories Sciences, Faculty of Allied Medical Sciences, Zarqa University (Approval number: 7/21/1/72, on 1 December 2022). An electronic informed consent was retrieved from all participants included in the study as a prerequisite for inclusion.

Sample size calculation

In this study, the minimum sample size was determined at 385 participants, based on the following specific equation and assumptions. The calculation utilized the formula: $n = (Z^2 \times P \times (1 - P)) / e^2$, where Z represents the value from the standard normal distribution for the desired confidence level (with $Z = 1.96$ corresponding to a 95% confidence interval), P denoted the anticipated true proportion, which was set at 0.50, and e denoted the desired precision, defined as half the width of the confidence interval. This calculation was derived from the EPITOOLS online resource, within the context of the total population residing in Jordan estimated at about 11,000,000 by the year 2022 [55, 56].

Questionnaire structure

The questionnaire began with an introduction highlighting the study objectives and agreement to several statements indicating that the participant is 18 years of age or older, a resident of Jordan, and assuring the confidentiality of collected information. This was followed by the mandatory electronic consent item “Do you agree to participate in this survey?” with “Yes” needed for inclusion in the study.

The next section assessed eight demographic variables of the participants as follows: (1) Age as a scale variable, which was subsequently dichotomized based on the

median age of the whole sample into two groups (<30 years vs. ≥ 30 years). (2) Sex (male vs. female). (3) The highest/current educational level achieved (high school or less vs. undergraduate (diploma or BSc) vs. postgraduate (MSc or PhD)). (4) Marital status (married vs. single vs. divorced vs. widow/widower). (5) Nationality (Jordanian vs. non-Jordanian). (6) Subjective evaluation of financial status assessed using the following question: On a scale from 1 to 10 how much financial pressure do you feel currently? Where 1 is huge pressure and 10 as no pressure at all. (7) Governorate of residence (Central (Amman, Zarqa, Balqa, or Madaba) vs. North (Irbid, Mafrq, Jerash, or Ajloun vs. South (Karak, Tafilah, Maan, or Aqaba)). (8) Occupation (unemployed vs. employed as a healthcare worker (HCW) vs. employed as a non-HCW vs. student in healthcare (HC)-related colleges vs. student in non-HC-related colleges).

Next, the participants were asked about their prior awareness of cholera through the question “Have you heard of cholera before the study?” Only those responding with a “Yes” proceeded to the remainder of the questionnaire, whereas a “No” response resulted in the submission of their response.

Subsequently, for the respondents acknowledging prior knowledge of cholera, the questionnaire introduced a cholera knowledge section comprising 20 items based on previous relevant studies [46, 48, 53]. These items offered response options of “Yes”, “No”, and “I do not know”. These cholera knowledge items included: (1) Cholera is caused by bacteria; (2) Watery diarrhea is a symptom of cholera; (3) Bloody diarrhea is a symptom of cholera*; (4) Vomiting is a symptom of cholera; (5) Fever is a symptom of cholera; (6) Dehydration is a symptom of cholera; (7) Anorexia is a symptom of cholera; (8) Cholera can be prevented by herbs*; (9) Cholera can be prevented by hand-washing; (10) Cholera can be prevented by thorough food cooking; (11) Cholera can be prevented by boiling water; (12) Cholera can be prevented by thorough fruit and vegetables washing; (13) Cholera is treated by reducing fluid intake*; (14) Cholera is treated by oral rehydration solutions; (15) Cholera is treated by traditional Arabic medicine*; (16) Cholera is transmitted by contaminated food; (17) Cholera is transmitted as a result of poor sanitation; (18) Vaccination is available to prevent cholera; (19) Cholera is infectious; and (20) Cholera can lead to death. The incorrect items are marked with asterisk.

Assessment of attitude to cholera vaccination

To comprehensively assess the participants’ willingness to get cholera vaccination, a survey item was formatted on a 5-point Likert scale. This scale ranged from 1 (strongly agree), (2) agree, (3) neutral/no opinion, (4) disagree, to 5 (strongly disagree). The exact phrasing of the item was “If cases of cholera are recorded in Jordan, I am

willing to get the cholera vaccine if it is provided free of charge”.

Furthermore, to assess the psychological predictors of attitude toward cholera vaccination, four items derived from the 5 C scale were included to measure four dimensions of cholera vaccine acceptance as follows [27, 28, 54]. For Confidence, the item was “I will get cholera vaccination if it is safe and effective”. For Complacency, the item was “I would not get cholera vaccination since the disease is not serious”. For Constraints, the item was “It would be difficult to get cholera vaccination if payment is needed or registration to an electronic platform is needed”. For Collective responsibility, the item was “I feel that getting cholera vaccination is needed to protect the vulnerable elderly and children”. These four items were formatted on a 5-point Likert scale, ranging from 1 (strongly agree), (2) agree, (3) neutral/no opinion, (4) disagree, to 5 (strongly disagree) for the Confidence and Collective responsibility items, while the scoring was reversed for the Complacency and Constraints items.

Finally, a quality control measure was implemented by embedding an image containing a number at the end of the questionnaire. Participants were instructed to accurately write down this number into a text field. Responses that did not correctly reproduce the number were deemed careless and subsequently excluded from final analysis.

Statistical and data analyses

Statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 26. Initial univariate analyses employed the chi-squared (χ^2) test. Variables achieving a P value of <0.100 in univariate analyses were advanced to multivariate analysis, which utilized linear regression and multinomial logistic regression methods with a significance threshold of $P < .050$. The investigation of multicollinearity was conducted through measurement of the Variance Inflation Factor (VIF).

For data analyses, participants’ self-reported financial status was categorized into three groups: 1–3 (poor), 4–7 (average), and 8–10 (good). The cholera Knowledge score (K-score) was derived by summing the scores for each item, with correct answers assigned a value of 1 and incorrect or I do not know responses assigned a value of 0.

As the primary measure in the study, the attitude towards cholera vaccination was classified into three distinct groups: participants who agreed or strongly agreed to receive the vaccine were classified under the “vaccine acceptance” group; those with neutral views or without an opinion were categorized under the “vaccine hesitancy” group; and participants who disagreed or strongly disagreed were classified under the “vaccine resistance” group. For the items assessing the psychological factors

driving vaccination attitude, the “strongly agree” and “agree” responses were grouped as the “agreement” group, while the “strongly disagree” and “disagree” responses were grouped as the “disagreement” group. The “neutral/no opinion” responses were grouped as the “neutral” group”.

Results

Description of the study sample

The total number of responses received was 1361, of which 22 responses were excluded due to the following reasons: 17 did not consent to participate and 5 did not correctly identify the number in picture included to rule out careless responses.

Thus, the final study sample comprised 1339 respondents, of whom 1216 (90.8%) heard of cholera before the study. Demographic features of the total number of final included respondents stratified by prior knowledge of cholera are shown in (Table 1).

Table 1 General features of the respondents stratified by previous knowledge of cholera before the study ($N=1339$)

Variable	Category	Have you heard of cholera before this survey?		<i>P</i> value, χ^2
		Yes	No	
		Count (%)	Count (%)	
Age	< 30 years	703 (86.5)	110 (13.5)	< 0.001 , 46.819
	≥ 30 years	513 (97.5)	13 (2.5)	
Sex	Male	330 (93.2)	24 (6.8)	0.068, 3.340
	Female	886 (89.9)	99 (10.1)	
Occupation	Unemployed	241 (89.6)	28 (10.4)	< 0.001 , 42.290
	Employed (non-HC) ¹	337 (96.0)	14 (4.0)	
	HCW ²	97 (99.0)	1 (1.0)	
	Student (HC) ³	394 (89.7)	45 (10.3)	
	Student (non-HC) ⁴	147 (80.8)	35 (19.2)	
Highest/current educational level	High school or less	255 (83.9)	49 (16.1)	< 0.001 , 29.651
	Undergraduate	795 (91.8)	71 (8.2)	
	Postgraduate	166 (98.2)	3 (1.8)	
Marital status	Single/d/w ⁵	693 (87.6)	98 (12.4)	< 0.001 , 23.775
	Married	523 (95.4)	25 (4.6)	
Nationality	Jordanian	1122 (91.0)	111 (9.0)	0.428, 0.629
	non-Jordanian	94 (88.7)	12 (11.3)	
Self-reported financial status	Poor	284 (90.4)	30 (9.6)	0.832, 0.368
	Average	656 (90.6)	68 (9.4)	
	Good	276 (91.7)	25 (8.3)	
Governorate	Central	674 (90.3)	72 (9.7)	0.306, 2.370
	North	420 (92.3)	35 (7.7)	
	South	122 (88.4)	16 (11.6)	

¹Employed (non-HC): Participants working in fields other than healthcare; ²HCW: Healthcare workers; ³Student (HC): University students in healthcare-related colleges; ⁴Student (non-HC): University students in non-healthcare-related colleges; ⁵d/w: divorced, widows, or widowers. Statistically significant *P* values are highlighted in bold style

Lack of awareness about cholera was significantly more common among younger participants (<30 years), compared to older participants (≥30 years), with rates of 86.5% versus 97.5% ($P<.001$). Among the various groups based on occupation, the comparison revealed that students in non-HC-related colleges had a lower awareness of cholera (80.8%) compared to HCWs at 99.0%, employed non-HCWs at 96.0%, students in HC-related colleges at 89.7%, and unemployed participants at 89.6% ($P<.001$). Additionally, participants with only a high school education or less were found to be less aware of cholera compared to those with undergraduate and postgraduate education, with respective rates of 83.9%, 91.8%, and 98.2% ($P<.001$). Finally, single, divorced, widowed, or widower participants also showed lower awareness of cholera (87.6%) compared to their married counterparts (95.4%, $P<.001$, Table 1). Only respondents who heard of cholera before the study formed the final sample and were considered for final analysis of the cholera knowledge and cholera vaccine acceptance.

Overall cholera knowledge score among the respondents

On a scale from 0 to 20, the overall mean cholera K-score was 12.9 ± 3.8 (median=14.0, interquartile range (IQR)=11.0–16.0). In univariate analyses, cholera K-score above average (>13/20) was observed more frequently among participants ≥30 years compared to those younger than 30 years (57.3% vs. 48.9%, $P=.004$). Additionally, higher cholera K-score was observed among HCWs compared to students in HC-related colleges, employed non-HCWs, unemployed participants, and students in non-HC-related colleges (73.2% vs. 54.8% vs. 52.2% vs. 48.1% vs. 40.1%, respectively, $P<.001$). Moreover, higher cholera K-score was observed among postgraduates compared to undergraduates and participants with high school or less educational level (57.8% vs. 54.1% vs. 43.9%, respectively, $P=.006$). Finally, higher cholera K-score was found among married participants as opposed to single/divorced/widow/widower participants (56.4% vs. 49.5%, $P=.017$, Table 2).

In multivariate analysis using multinomial logistic regression, the following variables showed statistically significant association with a higher cholera K-score (>13/20): Age ≥30 years as opposed to those <30 years (aOR: 1.79, 95% CI: 1.19–2.69, $P=.006$). Occupation as HCW compared to students in non-HC-related colleges (aOR: 2.60, 95% CI: 1.44–4.71, $P=.002$). Occupation as students in HC-related colleges compared to students in non-HC-related colleges (aOR: 1.92, 95% CI: 1.29–2.85, $P=.001$).

Attitude to cholera vaccination

Among those who heard of cholera before the study, the acceptance of cholera vaccination if cases is recorded in

Table 2 Variables associated with cholera knowledge as assessed by 20 cholera knowledge items ($N=1216$)

Variable	Category	Cholera Knowledge Score		<i>P</i> value, χ^2
		Above average > 13/20	Average or below $\leq 13/20$	
		Count (%)	Count (%)	
Age	< 30 years	344 (48.9)	359 (51.1)	0.004 , 8.345
	≥ 30 years	294 (57.3)	219 (42.7)	
Sex	Male	178 (53.9)	152 (46.1)	0.530, 0.394
	Female	460 (51.9)	426 (48.1)	
Occupation	Unemployed	116 (48.1)	125 (51.9)	<0.001 , 28.375
	Employed (non-HC) ¹	176 (52.2)	161 (47.8)	
	HCW ²	71 (73.2)	26 (26.8)	
	Student (HC) ³	216 (54.8)	178 (45.2)	
Highest/current educational level	Student (non-HC) ⁴	59 (40.1)	88 (59.9)	
	High school or less	112 (43.9)	143 (56.1)	0.006 , 10.220
	Undergraduate	430 (54.1)	365 (45.9)	
Marital status	Postgraduate	96 (57.8)	70 (42.2)	
	Single/d/w ⁵	343 (49.5)	350 (50.5)	0.017 , 5.707
Nationality	Married	295 (56.4)	228 (43.6)	
	Jordanian	593 (52.9)	529 (47.1)	0.353, 0.862
Self-reported financial status	non-Jordanian	45 (47.9)	49 (52.1)	
	Poor	132 (46.5)	152 (53.5)	0.069, 5.343
	Average	357 (54.4)	299 (45.6)	
Governorate	Good	149 (54.0)	127 (46.0)	
	Central	359 (53.3)	315 (46.7)	0.800, 0.446
	North	215 (51.2)	205 (48.8)	
	South	64 (52.5)	58 (47.5)	

¹Employed (non-HC): Participants working in fields other than healthcare; ²HCW: Healthcare workers; ³Student (HC): University students in healthcare-related colleges; ⁴Student (non-HC): University students in non-healthcare-related colleges; ⁵d/w: divorced, widows, or widowers. Statistically significant *P* values are highlighted in bold style

Jordan, and if the vaccine is safe, effective, and provided freely was observed among 842 participants (69.2%), while cholera vaccination hesitancy was observed among 253 participants (20.8%) and 121 participants were resistant to vaccination (10.0%).

Stratified per the four items used to assess the psychological predictors of the attitude to cholera vaccination, cholera vaccine acceptance was significantly more common among the following groups: (1) Participants who agreed with the confidence item (85.2% vs. 5.6% among those who disagreed, $P<.001$). (2) Participants who agreed with the collective responsibility item (81.9% vs. 30.4% among those who disagreed, $P<.001$). (3) Additionally, cholera vaccine acceptance was significantly more prevalent among the participants who disagreed with the complacency item (79.8% vs. 68.1% among those who agreed, $P<.001$). (4) Finally, cholera vaccine acceptance was significantly more prevalent among the participants who disagreed with the constraints item (79.3% vs. 71.2% among those who agreed, $P<.001$, Fig. 1).

Univariate analyses for the potential factors affecting attitude to cholera vaccination showed the following. A higher cholera vaccine acceptance was associated with being student in HC-related colleges, cholera K-score above average ($>13/20$), agreement with the confidence and collective responsibility items, and disagreement with the complacency and constraints items (Table 3).

Multivariate analysis of the factors driving acceptance of cholera vaccination

Multivariate analysis using linear regression involved the factors identified in univariate analyses with $P>.100$, and the ANOVA for the regression model yielded an *F* statistic of 193.092 with a $P<.001$, indicating the model robustness. The model, with an adjusted R^2 of 0.558 and a standard error of 0.441, identified only three psychological factors as the significant predictors of cholera vaccine acceptance (Table 4). These factors were: (1) High confidence ($\beta=0.642$, $P<.001$). (2) Low constraints ($\beta=0.041$, $P=.047$). (3) High collective responsibility ($\beta=0.154$, $P<.001$).

Discussion

The principal finding of this study was the demonstration of the significant role of psychological factors in shaping attitudes towards cholera vaccination. The WHO recommends the public readiness to accept cholera vaccination in outbreak regions. This preventive measure is considered crucial for reducing the negative impact and burden of this severe and deadly diarrheal disease [21]. In the study sample, although cholera vaccine acceptance exceeded 69%, there remains a room for improving the attitude to cholera vaccination in Jordan. Based on the results of the study, the efforts to promote cholera vaccine acceptance should focus on boosting confidence in the vaccine safety and efficacy. Additionally, the study findings highlighted the importance of reducing the logistical and financial barriers and emphasizing the

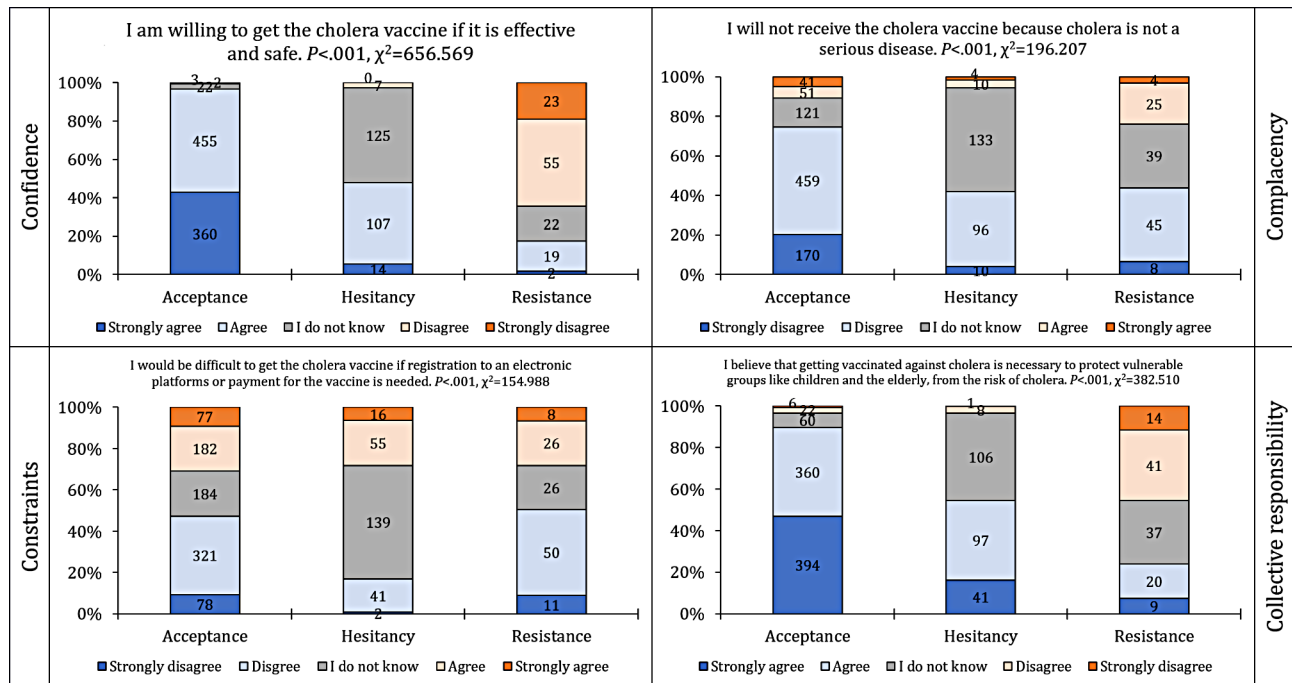


Fig. 1 The correlation between attitude to cholera vaccination and the four psychological factors

concept of collective responsibility to enhance positive attitude to cholera vaccination.

Considering the large sample of participants included in the study, the findings provided a comprehensive overview of the knowledge and attitudes towards cholera and cholera vaccination in Jordan. The study was of particular relevance considering its timing shortly after the declaration of the cholera outbreaks in the neighboring countries, namely Iraq, Syria, and Lebanon [44, 57–60]. The substantial engagement of 1339 respondents in the current study likely reflects the pertinence of cholera awareness in the Middle East. This was evidenced by the 91% of participants with pre-existing knowledge of the disease in this study. This widespread awareness of cholera may stem from the extensive media coverage and government-led community engagement initiatives, particularly in reaction to the outbreaks in neighboring countries [17]. Such efforts aimed to strengthen the preparedness against cholera, highlighting the importance of community engagement in disease prevention strategies [17, 44].

The overall level of cholera knowledge in the study sample can be described as above-average, with a mean cholera K-score of 13/20. Such a level of knowledge appears better in comparison to past studies from the Middle East region among other world regions afflicted by cholera outbreaks. For example, a study from 2021 among the general public in Jazan, Saudi Arabia showed poor level of cholera knowledge manifested in less than 44% who knew that the causative agent is a bacterium [46]. A higher level of knowledge regarding cholera

transmission, treatment, and prevention was reported by Malaeb et al. in a sample of 553 participants surveyed in late 2022 amid the outbreak in Lebanon [53]. An earlier study that was conducted in 2017 in the Yemeni Southern city of Aden identified poor level of knowledge regarding cholera transmission and prevention [61]. Similarly, lower levels of knowledge regarding cholera transmission and prevention as opposed to better knowledge about cholera symptoms was reported in Tanzania, with less than half of the participating households being aware of the 2015 cholera outbreak in the country [62]. An early large study that involved a survey and in-depth interviews in the Capital of Bangladesh, Dhaka with over 2800 respondents, poor cholera knowledge was described among 54% of the study sample [63].

The observed difference in cholera knowledge levels across studies can be attributed to several factors. For example, the timing of our study shortly following the declaration of several outbreaks in neighboring countries may have contributed to heightened level of cholera awareness [17, 44]. Additionally, variable levels of cholera knowledge in various settings could be related to differences in the effectiveness of public health campaigns, varying levels of accessibility to accurate health information, and different levels of community engagement in the preventive efforts [26, 64, 65].

The demographic dissection of the determinants of significantly different cholera knowledge scores among the participants in this study highlighted critical areas for targeted educational campaigns. In this study, the

Table 3 Univariate analyses for the factors driving the attitude to cholera vaccination (N = 1216)

Variable	Category	Cholera vaccine acceptance			P value, χ^2
		Acceptance Count (%)	Hesitancy Count (%)	Resistance Count (%)	
Age	< 30 years	493 (70.1)	151 (21.5)	59 (8.4)	0.099, 4.617
	≥ 30 years	349 (68.0)	102 (19.9)	62 (12.1)	
Sex	Male	225 (68.2)	66 (20.0)	39 (11.8)	0.406, 1.803
	Female	617 (69.6)	187 (21.1)	82 (9.3)	
Occupation	Unemployed	148 (61.4)	63 (26.1)	30 (12.4)	< 0.001 , 30.910
	Employed (non-HC) ¹	227 (67.4)	62 (18.4)	48 (14.2)	
	HCW ²	63 (64.9)	21 (21.6)	13 (13.4)	
	Student (HC) ³	301 (76.4)	73 (18.5)	20 (5.1)	
Highest/current educational level	Student (non-HC) ⁴	103 (70.1)	34 (23.1)	10 (6.8)	0.066, 8.819
	High school or less	171 (67.1)	65 (25.5)	19 (7.5)	
	Undergraduate	555 (69.8)	161 (20.3)	79 (9.9)	
Marital status	Postgraduate	116 (69.9)	27 (16.3)	23 (13.9)	0.127, 4.135
	Single/d/w ⁵	492 (71.0)	142 (20.5)	59 (8.5)	
Nationality	Married	350 (66.9)	111 (21.2)	62 (11.9)	0.477, 1.479
	Jordanian	775 (69.1)	232 (20.7)	115 (10.2)	
Self-reported financial status	non-Jordanian	67 (71.3)	21 (22.3)	6 (6.4)	0.161, 6.566
	Poor	190 (66.9)	62 (21.8)	32 (11.3)	
	Average	445 (67.8)	147 (22.4)	64 (9.8)	
Governorate	Good	207 (75.0)	44 (15.9)	25 (9.1)	0.708, 2.151
	Central	478 (70.9)	134 (19.9)	62 (9.2)	
	North	281 (66.9)	93 (22.1)	46 (11.0)	
Knowledge score	South	83 (68.0)	26 (21.3)	13 (10.7)	< 0.001 , 25.046
	Above average > 13/20	479 (75.1)	99 (15.5)	60 (9.4)	
I am willing to get the cholera vaccine if it is effective and safe	Average or below ≤ 13/20	363 (62.8)	154 (26.6)	61 (10.6)	< 0.001 , 1024.183
	Agree	815 (85.2)	121 (12.6)	21 (2.2)	
	I do not know	22 (13.0)	125 (74.0)	22 (13.0)	
I will not receive the cholera vaccine because cholera is not a serious disease	Disagree	5 (5.6)	7 (7.8)	78 (86.7)	< 0.001 , 188.083
	Disagree	629 (79.8)	106 (13.5)	53 (6.7)	
	I do not know	121 (41.3)	133 (45.4)	39 (13.3)	
I would be difficult to get the cholera vaccine if registration to an electronic platforms or payment for the vaccine is needed	Agree	92 (68.1)	14 (10.4)	29 (21.5)	< 0.001 , 123.369
	Disagree	399 (79.3)	43 (8.5)	61 (12.1)	
	I do not know	184 (52.7)	139 (39.8)	26 (7.4)	
I believe that getting vaccinated against cholera is necessary to protect vulnerable groups like children and the elderly, from the risk of cholera	Agree	259 (71.2)	71 (19.5)	34 (9.3)	< 0.001 , 490.411
	Agree	754 (81.9)	138 (15.0)	29 (3.1)	
	I do not know	60 (29.6)	106 (52.2)	37 (18.2)	
	Disagree	28 (30.4)	9 (9.8)	55 (59.8)	

¹Employed (non-HC): Participants working in fields other than healthcare; ²HCW: Healthcare workers; ³Student (HC): University students in healthcare-related colleges; ⁴Student (non-HC): University students in non-healthcare-related colleges; ⁵d/w: divorced, widows, or widowers. Statistically significant P values are highlighted in bold style

discernible lower levels of cholera knowledge among younger participants appears fathomable, given that the last encounter with cholera in Jordan occurred over four decades ago [17, 66]. Moreover, the superior knowledge observed among HCWs is understandable which can be attributed to their educational background and the heightened awareness resulting from governmental campaigns, especially in response to the recent outbreaks in neighboring countries [17]. These findings highlight the

necessity for public health strategies aimed at closing the observed knowledge gaps, advocating for customized educational interventions targeted at the general public and specifically at the younger demographic.

In this study, the majority of participants exhibited positive attitude to cholera vaccination with acceptance rate slightly exceeding 69%. However, the presence of vaccination hesitancy and resistance, albeit in smaller proportions, indicated the need for comprehensive

Table 4 Linear regression analysis of the predictors influencing attitude to cholera vaccination

Model	Coefficients ¹		Standardized Coefficients	T statistic	P value	VIF ³
	Unstandardized Coefficients	SE ²				
Adjusted R ² = 0.558, SE = 0.441						
ANOVA F statistic = 193.092, P value < 0.001	B		Beta			
(Constant)	0.265	0.102		2.606	0.009	
Age	-0.026	0.033	-0.019	-0.779	0.436	1.700
Occupation	-0.011	0.012	-0.022	-0.89	0.373	1.630
Highest/current educational level	-0.034	0.023	-0.030	-1.489	0.137	1.087
Knowledge score	0.046	0.026	0.034	1.772	0.077	1.029
High confidence	0.717	0.027	0.642	26.169	<0.001	1.656
Low complacency	0.001	0.021	0.001	0.029	0.977	1.281
Low constraints	0.033	0.016	0.041	1.989	0.047	1.184
High collective responsibility	0.168	0.026	0.154	6.46	<0.001	1.561

¹Dependent Variable: Cholera vaccine acceptance; ²SE: Standard error; ³VIF: Variance inflation factor. Statistically significant P values are highlighted in bold style

communication strategies to address concerns and possible misconceptions about cholera vaccination. From a broader perspective, the acceptance rate of cholera vaccine in this study, which was 69%, appeared lower compared to the rates reported in various different settings. For example, a 2010 study in the Katanga province of the Democratic Republic of the Congo (DRC) revealed a near universal acceptance of cholera vaccination, with 97% of the participants being willing to receive OCVs if provided free of charge [67]. Similarly, a recent study from Lebanon revealed an acceptance rate or at least possible acceptance of 86% for a freely provided cholera vaccine [68]. Employing meta-analytic approach, three cross-sectional studies involving 1095 respondents across three African regions, namely Southeastern DRC, Western Kenya, and Zanzibar demonstrated a high acceptance rate for free OCV of over 93% [69]. Taken together, these observations indicate a comparatively lower cholera vaccine acceptance in our study relative to other regions, suggesting a potential for improvement in cholera vaccine acceptance rates in Jordan. This pattern is consistent with previous studies indicating the pervasive occurrence of vaccination hesitancy in Jordan for other vaccines, which emphasizes the need for targeted interventions to promote vaccine acceptance in the country [51, 70].

A novel finding of our study in the context of attitude to cholera vaccination was the elucidation of the central role of the psychological factors, namely confidence, constraints, and collective responsibility, as predictors of cholera vaccine acceptance. This particular insight based on the central role of psychological determinants of vaccine acceptance could have several implications for public health policy for cholera prevention. Such a result highlights the importance of tailoring the public health messages in the psychological framework to build trust in vaccine safety and efficacy, reduce barriers to vaccine access, and emphasize the role of vaccination as a commitment to protect vulnerable groups in communities. The central role of the psychological factors as

determinants of vaccination attitudes in various vaccination contexts appears universal [27, 28, 34, 71, 72]. Such an association was reported previously in the context of COVID-19, influenza, and recently monkeypox vaccination [30, 32, 73, 74].

Finally, several limitations of this study should be fully acknowledged and taken into consideration in the interpretation. First, despite the large sample size in this study with over 1300 participants, selection bias may have influenced the outcomes due to a notable female predominance among the participants. This outcome is possibly related to sex distribution of the research team with eight out of ten Jordanian authors being females. It is possible that the predominance of female researchers contributing to this study could have facilitated more effective outreach to female participants, possibly influencing their greater representation in our study. Second, the dependence on single-item measures for assessing psychological predictors for vaccine attitude might limit the robustness of the findings; however, this methodological approach was chosen to minimize the possibility of respondent fatigue considering the length of the questionnaire. Additionally, the potential for social desirability bias should be considered, as the participants might have responded in a way they perceive as favorable to the researchers in terms of attitude to vaccination and its psychological determinants. Finally, while the convenience sampling strategy expedited sample collection, it inherently carries the risk of selection bias, which in turn could affect the generalizability of the study conclusions.

Conclusions

This study elucidated the significant association between the psychological determinants and attitudes to cholera vaccination. Considering the persistent threat of cholera, understanding the significant determinants of OCV vaccine acceptance appears as a key factor to implement effective prevention measures. Additionally, to strengthen community preparedness in response

to the threats of cholera, the health authorities should strengthen community education, ease of access to vaccination, and address issues of trust in vaccine safety and efficacy.

The association between the psychological determinants and cholera vaccine acceptance highlights the importance of adopting comprehensive promotional measures. These measures should combine reducing the constraints with strong communication to raise community trust in vaccination safety and efficacy. Additionally, it is important to emphasize the collective responsibility role in protecting vulnerable groups in the community who are challenged by a higher burden of cholera (e.g., children). Effective public health campaigns must address cholera knowledge gaps and psychological barriers that could challenge the successful implementation of cholera vaccination campaigns if needed in outbreak settings.

Abbreviations

ANOVA	Analysis of variance
aOR	Adjusted odds ratio
CI	Confidence interval
DRC	Democratic Republic of the Congo
HC	Healthcare
HCW	Healthcare worker
K-score	Cholera Knowledge score
KAP	Knowledge, Attitudes, and Practices
NGOs	Non-governmental organizations
OCVs	Oral cholera vaccines
V. cholerae	Vibrio cholera
VIF	Variance Inflation Factor
WASH	Water, sanitation and hygiene
WHO	World Health Organization

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Author contributions

Conceptualization: M.S.; Data curation: M.S., R.Y.A., R.A., L.A., L.J., S.O., T.M., A.S., S.H., M.B., A.M.; Formal analysis: M.S.; Investigation: M.S., R.Y.A., R.A., L.A., L.J., S.O., T.M., A.S., S.H., M.B., A.M.; Methodology: M.S., R.Y.A., R.A., L.A., L.J., S.O., T.M., A.S., S.H., M.B., A.M.; Visualization: M.S.; Project administration: M.S.; Supervision: M.S., A.M.; Writing - original draft: M.S.; Writing - review & editing: M.S., R.Y.A., R.A., L.A., L.J., S.O., T.M., A.S., S.H., M.B., A.M.; All authors contributed to the article and approved the submitted version.

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Data availability

The datasets analyzed during the current study are available upon a reasonable request from the corresponding author (M.S.).

Declarations

Ethics approval and consent to participate

This study was approved by the Scientific Research, Innovation, and Scientific Activities Committee at the Department of Medical Laboratories Sciences, Faculty of Allied Medical Sciences, Zarqa University (Approval number: 7/21/1/72, on 1 December 2022). The consent to participate in this study was ensured by the inclusion of a mandatory electronic consent item necessary to submit the response.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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