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Abstract Background: Acceptability of COVID-19 vaccine by healthcare workers (HCWs) can affect its acceptability by the general population.

Aim: To assess COVD-19 vaccine acceptability among HCWs in Sana'a, Yemen.

Methods: We conducted a multicentre cross-sectional study among 391 HCWs in Sana'a, Yemen, from January to March 2022. We used a self-administered questionnaire to collect data on the demographics, profession, academic qualifications, and experience of HCWs, as well as their COVID-19 vaccine acceptability or hesitancy. We used univariate and multivariable logistic regression to analyse the association between the independent variables and vaccine hesitancy (P

Results: Of the 391 HCWs, only 194 (49.6%) were willing to accept the COVID-19 vaccine. The most frequent reasons for vaccine hesitancy were fear of adverse reactions (77.7%), concerns about unknown effects of the vaccine in the future (73.1%), and uncertainty about the safety of new vaccines (69.5%). Female gender and working in the public sector were independent predictors of vaccine hesitancy among the HCWs.

Conclusion: Nearly half of the HCWs in Sana'a, Yemen, were willing to accept the COVID-19 vaccine. Female gender and working in the public health sector were independent predictors of vaccine hesitancy. We recommend further studies to compare COVID-19 acceptability among HCWs in the public and private sectors in Yemen.

Keywords: COVID-19, vaccine, acceptability, hesitancy, healthcare workers, safety, adverse reaction, Yemen

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Introduction

Since its emergence in China in December 2019 (1), COVID-19 has spread globally and become a pandemic with serious health and economic threats. The World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern on 30 January 2020 and characterized it as a pandemic on 11 March 2020 (2). With the lack of specific treatment, pandemic containment efforts are directed towards preventive measures, with vaccination being a cost- effective measure to prevent infection and achieve herd immunity. To achieve vaccine equity as a key principle of global health security, the COVID-19 Global Vaccine Access (COVAX) initiative was launched to expedite vaccine development and manufacture and ensure equitable access for all countries (3).

On 10 April 2020, Yemen confirmed its first case of COVID-19 in a 60-year-old man working at Ash-Shihr Port in Hadhramout Governorate (4). Later, 2 healthcare workers (HCWs) were confirmed with COVID-19 in Sana'a City (5). Ongoing conflicts, humanitarian crises, complex

emergencies, and continuous influx of expatriates put the country at potential risk. The fragile health system and ill-equipped facilities were not well prepared to cope with epidemics (6). As of 16 December 2022, 11 945 confirmed cases had been reported, with 2159 deaths (7). However, the actual burden may have been higher because of problems with confirmation and reporting.

Vaccination has been instrumental in controlling the pandemic, but its success is challenged by vaccine hesitancy. Vaccine hesitancy is defined as a "delay in acceptance or refusal of vaccines despite availability of vaccination services" (8) and was emphasized among the 10 leading threats to global health in 2019 (9). Public acceptability of COVID-19 vaccination depends on the attitude of HCWs towards the vaccines (10). More than 25% of Arab HCWs were recently found to be vaccine-hesitant (11). Vaccine uptake by HCWs is key to vaccination success among the general population. Therefore, this study assessed COVID-19 vaccine acceptability or hesitancy among HCWs in Sana'a City, Yemen.

Methods

Study design and ethical considerations

We conducted a multicentre cross-sectional study from January to March 2022 among HCWs of both genders and any profession or qualification level from public and private health facilities in Sana'a. HCWs were included if they had not been vaccinated against COVID-19, provided written informed consent to participate, and satisfied the WHO guidelines for classifying and aggregating health professions (12).

The Ethics Committee of the Faculty of Medicine and Health Sciences, University of Science and Technology, Sana'a approved the study protocol (MECA No.: EAC/ UST206). Additionally, this study complied with the WHO Research Ethics Review Committee checklist. Permission was also sought from health facility administrations. Written informed consent was obtained from HCWs who vaccine hesitancy, along with adjusted ORs (AORs) and 95% CIs. Statistical significance was set at P

Results

Characteristics of HCWs

The majority of HCWs were female (58.6%) and aged ≥30 years (62.4%), with a median age (interquartile range) of 33 (9) years (Table 1). More than half of HCWs were affiliated with the private sector, and most of them were working in hospitals (86.4%). Nursing professionals represented 28.6% of respondents, followed by laboratory professionals (25.6%) and clinicians (23.0%). More than half of HCWs held a bachelor's degree and had ≤ 8 years of experience.

Sample size and sampling method

Based on an assumed vaccine acceptability of 50% among HCWs, a confidence level of 95%, and precision of 5%, a sample of at least 383 HCWs was calculated using OpenEpi, version 3.01 (www.openepi.com). However, 391 HCWs were recruited using 2-stage cluster sampling. Four of 10 districts in Sana'a were randomly selected as the study clusters; namely, Ma'ain (west), Al-Wahdah (southwest), Shu'aub (northeast) and Assafi'yah (southeast). HCWs were conveniently sampled until we attained the required sample size from all hospitals and health centres whose administrations agreed on questionnaire distribution.

Data collection

Data about demographics, health profession, qualification level, years of experience, COVID-19 vaccine acceptability, and vaccine hesitancy and the reasons for acceptability or hesitancy were collected using a self-administered structured questionnaire. The questionnaire was reviewed for content and face validity by 2 community medicine experts and pilot-tested for clarity and length among 20 HCWs not included in the data analysis; after which, minor amendments were made to the content and format of the questionnaire.

Data analysis

Data were analysed using SPSS version 21.0. The proportion of vaccine-accepting HCWs was calculated with its 95% confidence interval (CI), and the reasons for vaccine hesitancy were calculated as proportions of the total number of vaccine-hesitant HCWs. Univariate binary logistic regression was used to test the association of independent variables with COVID-19 vaccine hesitancy, along with the corresponding odds ratios (ORs) and 95% CIs. Multivariable logistic regression was then performed to identify

COVID-19 vaccine acceptability

Among the HCWs, 49.6% (95% CI: 44.6–54.7%) stated that they intended to accept COVID-19 vaccines when they became available. Specifically, 25.6% stated that they would likely and 24.0% very likely accept the vaccine, whereas 23.5% stated that they would unlikely and 26.9% very unlikely to accept the vaccine.

Reasons for COVID-19 vaccine hesitancy

The most frequent reasons for vaccine hesitancy among HCWs were fear of adverse effects (77.7%), followed by concerns about unknown future effects (73.1%) and safety of new vaccines (69.5%) (Figure 1). Just over 60% of vaccine-hesitant HCWs said it was not necessary to take a vaccine, they had doubts about the efficacy of the vaccine, or they were worried about the emergence of new COVID-19 virus variants. More than half of HCWs were hesitant because they did not perceive themselves to be at risk of COVID-19 infection, had concerns about additives used for making vaccines, were concerned about the speed with which the vaccines were developed, or felt that other preventive measures were adequate. More than one-third of HCWs believed that there was adequate herd immunity (36.0%) and less than one-third (28.4%) believed in anti-vaccination media reports. Not having direct contact with patients (15.2%) and having chronic diseases (9.1%) were the least frequently reported reasons for vaccine hesitancy.

Predictors of vaccine hesitancy among HCWs

Vaccine hesitancy was significantly associated with being female (OR = 2.2, 95% CI: 1.5–3.4; P Table 2). However, female gender (AOR = 2.5, 95% CI: 1.5–4.0; P

Discussion

The effectiveness of vaccines for the prevention and control of COVID-19 is determined by their acceptability among the general population, which can also be influenced by acceptability by HCWs. There is disparity in vaccine acceptability by HCWs and the general population across regions and countries (13). A recently study in 12 countries across 4 continents reported 69% vaccine acceptability among HCWs, with high heterogeneity according to country income levels (14). In another study, the average vaccine hesitancy among HCWs was 22.5% (4.3–72%) (15).

This study assessed COVID-19 vaccine acceptability and the reasons for and predictors of vaccine hesitancy among HCWs in 1 of the most populous cities in a conflict- stricken country. The intention of around half of the HCWs to be vaccinated against COVID-19 is concordant with a nationwide survey in Yemen that found that 50% of the general population were willing to be vaccinated (16). In comparison, 61% of adults surveyed online in 4 major cities in Yemen were willing to be vaccinated within the first 2 weeks of the country's COVID-19 outbreak (17). Unlike

facility-based studies, online COVID-19 surveys have shortcomings such as unreliable generalizability, survey fraud, and answering some or all questions without attempting to read or understand them because of disinterest or survey fatigue (17).

Vaccine acceptability rates of 50.5–70% have been reported among HCWs in Saudi Arabia (18–21), compared with lower rates among HCWs in Egypt (21–45.9%) (22, 23) and Palestine (37.8%) (24). Although not inclusive, these rates highlight disparities in vaccine acceptability across countries in the region. Over time, changes may occur following educational campaigns and other enabling factors.

The major reasons for vaccine hesitancy among HCWs in our study were related to safety concerns. Insufficient data on the safety of new vaccines and concerns about

their adverse effects were the most frequent reasons for vaccine hesitancy among HCWs in Saudi Arabia and Egypt (18, 19, 21, 22). Second to safety, a major proportion of HCWs said vaccination was not necessary and that they had doubts about the efficacy of vaccines. Consistently, distrust in vaccine efficacy was the most frequent reason for vaccine rejection by HCWs in Türkiye (25). In contrast,

There may be several for the perception that vaccination was not necessary, including low perceived risk of infection, trust in one’s own health and immunity, and confidence in other preventive measures. Concerns about the additives used in making vaccines and the expedited development accounted for vaccine hesitancy among more than half of the HCWs in our study. Similarly, distrust in the ingredients used in making the vaccines was among the most common reasons for vaccine rejection by Turkish HCWs (25), and inadequate clinical trials was the most common reason among Egyptian HCWs (22). Fear of unknown future adverse effects of rapidly developed vaccines may discourage people

from accepting vaccines. Negative attitudes towards the vaccine should therefore be addressed through evidence- based communication to counter ambiguities about vaccine components.

Emerging virus variants represent a major obstacle to vaccine acceptability, and this accounted for ~60% of vaccine hesitancy among HCWs in our study. Although emerging variants may evade vaccine-induced immunity and adversely affect vaccine confidence, hesitancy and low uptake and coverage can increase the risk of emergence of variants (26). The no-risk perception of COVID-19 infection by more than half of vaccine-hesitant HCWs in this study

could be explained by the downward trend of new cases and absence of systematic monitoring of the impact of COVID-19 on the healthcare workforce. The disproportionate toll of COVID-19 on HCWs in Yemen has been reported, with 97 deaths as of 22 July 2020 (27). Anxiety about the risk and severity of COVID-19 has been reported as a predictor of the intention to accept COVID-19 vaccine at the national level (16). In Saudi Arabia, 20% of HCWs had doubts about the risk of COVID-19 (21), compared with 56.9% in our study (21). The low-risk perception can be attributed to the large amount of misinformation and disinformation. For instance, ~20% of Yemeni adults believed that viruses were produced as biological weapons (17). In this study, half of vaccine- hesitant HCWs considered using nonvaccine preventive measures as an adequate alternative. While using such measures helps reduce exposure, adherence may not prevent COVID-19 infection. According to WHO guidance (28), even vaccinated people in healthcare facilities should adhere to social and public health measures to prevent or limit transmission. Therefore, augmenting COVID-19 preventive measures with vaccination is critical.

The upsurge in anti-vaccination media reports and their rapid propagation through many channels, especially social media, has had a negative impact on pro-vaccination attitudes of HCWs. This impact was observed in our study, where approximately one-third of HCWs attributed their hesitancy to media reports opposing COVID-19 vaccination. The likelihood of vaccine hesitancy increased among Yemeni adults who thought that the virus was human-made for the financial gain of pharmaceutical companies (17). Gaps in evidence- based sources of COVID-19 vaccine information play a role in the spread of fake news on different media outlets and platforms. Therefore, misinformation, rumours, and conspiracy theories through traditional and social media must be debunked with evidence-based strategies. It is noteworthy that only a quarter of HCWs in Sana'a reported peer-reviewed journal articles as their major source of COVID-19 information, compared with > 60% for television/radio and social media (29). Also, 57% of Yemeni HCWs reported social networks and news media as their major COVID-19 information sources (30). HCWs should be advised to obtain verified information from trustworthy and credible sources, such as WHO platforms, peer-reviewed journals, and mainstream media.

Approximately one-third of HCWs in our study were vaccine hesitant because of beliefs about the adequacy of protection obtained through herd immunity. Herd immunity is difficult to assess in Yemen because of the weak COVID-19 surveillance system and paucity of community-based seroprevalence studies. A recent study claimed that Yemen was probably moving towards herd immunity, as demonstrated by the small number of cases and deaths despite the limited restrictions, and freedom of movement and gathering (31). Because vaccination coverage was expected to be difficult, herd immunity was postulated as the only option against COVID-19 in Yemen (31). However, achieving herd immunity against COVID-19 has been more complicated than expected (32). For instance, community transmission due to the absence of mandatory protective measures led to a 10-fold increase in mortality in Sweden compared to neighbouring countries (33).

The least frequent reasons for vaccine hesitancy among HCWs in our study were not having direct contact with COVID-19 patients and having chronic diseases. In contrast, there was a significant association between

contact with COVID-19 patients and vaccine acceptability among Egyptian HCWs (22). Hesitancy among~10% of vaccine-hesitant HCWs due to chronic diseases raises concerns because patients with chronic conditions are more vulnerable to greater disease severity and mortality, and are more likely to be receptive to vaccination (15, 34). While WHO has prioritized vaccination of people with underlying conditions (28), safety concerns and potential adverse effects are major reasons for vaccine hesitancy among chronically ill patients (34).

The finding that female gender was an independent predictor of vaccine hesitancy in our study is consistent with that reported for the general Yemeni population (16, 17) and HCWs elsewhere (15, 19, 21, 22, 24). Pregnancy and planning to conceive can be major reasons for vaccine hesitancy. In the United States of America, pregnant HCWs and those who were planning to conceive were 2- and 3-fold more likely to reject COVID-19 vaccination, respectively (35). Apart from concerns about the potential adverse effects of new vaccines on the reproductive system, there is a need for further studies to explore the reasons for vaccine hesitancy among female HCWs. The lack of association between HCWs' ages and vaccine hesitancy in our study is consistent with that reported for Egyptian HCWs (22) but not for the general Yemeni population (17) and HCWs in Saudi Arabia (20).

In Sana'a, a significantly higher level of knowledge about COVID-19 has been reported among physicians than nurses (30). However, profession was not significantly associated with vaccine hesitancy in our study, which agrees with a study in Egyptian HCWs (22). In Palestine, physicians were significantly associated with intention to be vaccinated (24).

The lack of association between HCWs' qualification level and vaccine hesitancy in our study is consistent with that reported for HCWs in Asia–Pacific countries (36). We found no association between the length of work experience and vaccine hesitancy among HCWs. However, vaccine hesitancy was independently predicted by health sector type, with COVID-19 vaccines being 2-fold more likely to be rejected by public sector HCWs. This could be partly explained by different health administrations' attitudes towards COVID-19 vaccination in both sector types. Exploring the difference in vaccine hesitancy between HCWs in public and private health sectors is recommended using comparative studies. Our study had limitations because it was facility-based, which means that it may not be possible to generalize the findings to HCWs

throughout the country. However, as a multicentre study, the results provide preliminary insights into vaccine acceptability as well as the reasons for and predictors of vaccine hesitancy among HCWs using self-administered questionnaires rather than online surveys through social networks. Although HCWs' attitudes towards COVID-19 vaccination may change over time for several reasons, including awareness- raising campaigns and future availability of evidence, our results provide baseline information to help monitor the change in vaccination intention and reasons for hesitancy. Another limitation may be selection bias as a result of convenience sampling. However, administrative and logistic constraints made it difficult to have a sampling frame of the entire HCWs. This included not having a database of all HCWs in the city, and refusal of some administrations of health facilities to take part in the study. It is noteworthy that convenience sampling in this survey generated a hypothesis of comparable proportions of vaccine-accepting and vaccine-hesitant HCWs for future surveys. The random selection of study clusters (districts) prior to convenience sampling could help reduce such selection bias.

Conclusion

When COVID-19 vaccines became available, around 50% of HCWs in Sana'a City intended to accept vaccination.

Concerns about the safety of new vaccines, and fear of adverse and unknown future effects are the major reasons for vaccine hesitancy, followed by the perceived lack of vaccination necessity, doubts about vaccine efficacy, and emerging virus variants. More than half of vaccine- hesitant HCWs perceive that COVID-19 was not a risk, were concerned about additives used in making vaccines and rapid development of vaccines during the COVID-19 emergency, and the adequacy of other preventive measures. Misconceptions about the adequacy of herd immunity and misinformation through anti-vaccination media reports also contributed to vaccine hesitancy among HCWs. Female gender and working in the public health sector, but not age, profession, qualification level, length of experience, or type of health facility, were independent predictors of vaccine hesitancy.

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WHO EMRO | COVID-19 vaccine acceptability among healthcare workers in Yemen

Competing interests: None declared.

Acceptabilité des vaccins contre la COVID-19 chez les agents de santé au Yémen

Résumé

Contexte : L'acceptabilité des vaccins contre la COVID-19 par les agents de santé peut avoir une incidence sur son acceptabilité par la population générale.

Objectifs : Évaluer l'acceptabilité des vaccins contre la COVID-19 par les agents de santé à Sanaa (Yémen).

Méthodes : Nous avons mené une étude transversale multicentrique auprès de 391 agents de santé à Sanaa, entre janvier et mars 2022. Nous avons utilisé un questionnaire auto-administré afin de recueillir des données sur la démographie, la profession, les qualifications universitaires et l'expérience des agents de santé, ainsi que sur leur acceptabilité et leur réticence face à la vaccination contre la COVID-19. Nous avons utilisé la régression logistique univariée et multivariable pour analyser l'association entre les variables indépendantes et la réticence face à la vaccination (p

Résultats : Sur les 391 agents de santé, seuls 194 (49,6 %) étaient disposés à accepter la vaccination contre la COVID-19. Les raisons les plus fréquemment invoquées pour expliquer la réticence face à la vaccination étaient la crainte de réactions indésirables (77,7 %), l'inquiétude quant aux effets inconnus des vaccins ultérieurement (73,1 %) et l'incertitude quant à l'innocuité des nouveaux vaccins (69,5 %). Le sexe féminin et le fait de travailler dans le secteur public étaient des facteurs prédictifs indépendants de la réticence face à la vaccination chez les agents de santé.

Conclusion : Près de la moitié des agents de santé de Sanaa (Yémen) étaient prêts à accepter les vaccins contre la COVID-19. Le sexe féminin et le fait de travailler dans le secteur de la santé publique étaient des facteurs prédictifs indépendants de la réticence face à la vaccination. Il est recommandé de mener des études complémentaires visant à comparer l'acceptabilité des vaccins contre la COVID-19 par les agents de santé dans les secteurs public et privé au Yémen.

تقبُّل العاملين في مجال الرعاية الصحية للقاحات كوفيد-19 في اليمن

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WHO EMRO | COVID-19 vaccine acceptability among healthcare workers in Yemen

عبد الله المخلافي، مهدي القراوني، رشاد عبد الغني، إبراهيم السبل، أسماء العوضي،
مجاهد نصار، محمد الشهاب، عادل المتوكل، أديب صلاح، أحلام عبد التواب

الخلاصة

: يمكن أن يؤثر تقبُّل العاملين في مجال الرعاية الصحية للقاح كوفيد -19 علىالخلفية
تقبُّل عامة السكان له .

: هدفت هذه الدراسة الى تقييم مدى تقبُّل العاملين في مجال الرعاية الصحيةالأهداف
للقاحات كوفيد -19 في مدينة صنعاء باليمن .

: أجرينا دراسة مقطعية متعددة المراكز على 391 عاملًا في مجال الرعاية الصحيةطرق البحث
في صنعاء، اليمن، في المدة من يناير / كانون الثاني إلى مارس / آذار 2022. واستخدمنا
استبيانًا يُستكمل ذاتيًّا لجمع بيانات عن الخصائص السكانية للعاملين في مجال
الرعاية الصحية ومِهَنهم ومؤهلاتهم الأكاديمية وخبراتهم، فضلًا عن مدى تقبُّلهم
للقاحات كوفيد -19 والتردد في أخذها . واستخدمنا الانحدار اللوجستي الأحادي المتغير
والمتعدد المتغيرات لتحليل الارتباط بين المتغيرات المستقلة والتردد في أخذ اللقاح
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