Assessment of Vaccination Rates and Barriers in Family Medicine Practices: A Cross-sectional Study

Mohammed Ali Alkahmous [1], Anisah Zead T. Alyahya [2], Abdullah Nasser Almansour [3], Maha turki Aldhfeeri [4,] Amal Abdullah Alsanari [5] Shwog Eissa Yehya Fagehi [6]

(1) Cluster 1, First Health Cluster in Riyadh city, Alandalous, Saudi Arabia
(2) Bachelor of Medicine and Surgery, First Health Cluster in Riyadh, Al Maather Housing Center, Saudi Arabia
(3) Diploma in Nursing, 2022, King Saud University, Riyadh, Saudi Arabia
(4) Diploma in Nursing, Riyadh Primary Health Care Cluster
(5) Diploma in Nursing, Riyadh Primary Health Care Cluster, Al-Muzdafar Housing Primary Health Care Center
(6) Laboratory Technician, Work First Health Cluster in Riyadh, Al Maather Health Center, Academic Qualification

Corresponding author:
Mohammed Ali Alkahmous
Cluster 1, First Health Cluster in Riyadh city, Alandalous,
Saudi Arabia
Phone: 0582583666
Email: alkahmos@hotmail.com

Received: August 2023. Accepted: September 2023; Published: October 1, 2023.
Citation: Mohammed Ali Alkahmous et al. Assessment of Vaccination Rates and Barriers in Family Medicine Practices: A Cross-sectional Study: A Cross-Sectional study. World Family Medicine. October 2023; 21(9): 25-32.
DOI: 10.5742/MEWFM.2023.95256192

Abstract

Background: Vaccination is a crucial tool in public health for preventing the spread of infectious diseases. Understanding the factors influencing vaccine acceptance and addressing barriers to vaccination are essential in promoting vaccine uptake and achieving population-level protection.

Methodology: This study examined the demographic factors, vaccination rates, and barriers to vaccination among 385 participants. The participants were categorized based on age, gender, marital status, having children, monthly income, educational level, occupation, and nationality. Data on willingness to vaccinate, completion of the vaccination course, and barriers to vaccination were collected through surveys.

Results: The study found that 80% of participants expressed their willingness to take the COVID-19 vaccine. Factors included age, having children, monthly income, and educational level, influenced vaccine acceptance. Participants in the 18-25 years age group showed the highest willingness to vaccinate (85%), while those with higher incomes and higher educational levels also demonstrated higher rates of acceptance. Several barriers to vaccination were identified, including fear of vaccination, concerns about vaccine safety, and accessibility issues.

Conclusion: This study highlights the importance of vaccination and provides valuable insights into the demographic factors, vaccination rates, and barriers to vaccination. The findings emphasize the need for targeted interventions to address specific concerns and improve accessibility to vaccines. By addressing these barriers, public health authorities can enhance vaccine acceptance and achieve widespread vaccination coverage, thereby mitigating the impact of infectious diseases on public health.

Key words:
Vaccination rates, Barriers,

Introduction

Vaccinations have long been seen as a pillar of public health, playing a crucial role in preventing and controlling infectious diseases [1,2]. They have had a significant role in decreasing global morbidity and mortality, protecting individuals and communities from a variety of vaccine-preventable diseases [3]. Family medical practices are essential healthcare venues for administering vaccinations, ensuring that people of all ages receive the necessary immunizations to safeguard their health and well-being. Nevertheless, despite the demonstrated advantages of immunizations, inadequate vaccination rates and enduring hurdles continue to be obstacles to reaching optimal immunization coverage [4,5].

Throughout history, vaccine-preventable diseases have been a substantial cause of morbidity and mortality [6]. Vaccinations have been crucial in reducing the global burden of many diseases, sparing millions of illnesses, hospitalizations, and deaths [1–3]. Nevertheless, despite the availability of safe and effective vaccines, immunization rates vary across groups and areas. Inadequate vaccination rates continue to make communities susceptible to outbreaks and impede the possibility of disease eradication.

Family medicine practices serve a crucial role in the delivery of comprehensive healthcare to people and families, including routine vaccines. These offices provide primary care, providing continuity of service and emphasizing preventative medicine. By administering immunizations on-site, family care clinics are well-equipped to meet the immunization requirements of varied patient populations, including children, adolescents, and adults. However, the success of vaccination programs depends on a number of factors, including the knowledge, attitudes, and practices of healthcare practitioners, as well as the existence of obstacles that limit vaccination delivery [7,8].

Understanding the barriers to vaccination within family medicine practices is essential for the development of focused strategies to increase immunization rates. Factors such as vaccine hesitation among patients or healthcare providers, logistical issues in vaccine administration, lack of awareness or understanding regarding immunization schedules and protocols, and inadequate resources or support systems for vaccine delivery are examples of potential barriers [9]. Identifying and resolving these obstacles is crucial for implementing measures that can boost immunization rates, protect vulnerable groups, and improve public health outcomes.

In order to shed light on the factors that contribute to under-vaccination and impede the efficacy of immunization programs, the purpose of this study was to examine vaccination rates and identify barriers within patients who visited family care practices. By gaining knowledge of these characteristics, healthcare practitioners and policymakers can devise tailored interventions to increase vaccination rates and resolve identified impediments, thereby improving public health outcomes.

Methodology

Study Design:
A cross-sectional study design was employed to assess vaccination rates and barriers in family medicine practices. This design allowed for the collection of data at a specific point in time and enabled researchers to examine the relationship between variables.

Sample and Setting:
The study was conducted in multiple family medicine practices across diverse geographic regions. A convenience sampling method was utilized to select practices that were willing to participate in the study. The sample size was determined based on the availability and willingness of participating practices. Inclusion criteria including all patients of both gender, who were older than 18 years old, and who agreed to participate in the questionnaire.

Data Collection:
Data were collected using a questionnaire administered to patients who attended family medicine facilities including PHCs. The questionnaire covered various aspects related to vaccination, including perceptions, knowledge, practices, and barriers. The questionnaire included demographic factors such as age, gender, marital status, having children, number of children, monthly income, educational level, occupation, and nationality. These demographic factors allowed for a comprehensive understanding of the participants' characteristics and their potential influence on vaccination rates and barriers. The questionnaire assessed vaccination rates by asking participants about their willingness to take vaccination and whether they had completed their vaccination against COVID-19. For participants with children, the questionnaire also asked if their child had completed the vaccination course. To identify barriers to vaccination, participants were presented with a list of choices and asked to select the main barriers that prevented them from being vaccinated or vaccinating their children. The choices included options such as fear of vaccination, unavailability of vaccines, perceived lack of importance of vaccination, concerns about vaccine safety, belief that vaccination could lead to other diseases, belief that vaccination could lead to the disease itself, cost-related barriers, distance to vaccination facilities, influence of doctors, friends, or family members, and an option for no barriers.

Ethical Considerations:
The study adhered to ethical guidelines for research involving human subjects. Informed consent was obtained from all participating family medicine practices and healthcare providers. Confidentiality and anonymity of the collected data were ensured, and data were securely stored and accessible only to authorized researchers.

Data Analysis:
MS Excel was used for data entry, cleaning, and coding while SPSS version 26 was used for data analysis. Descriptive statistics were used to summarize the demographic characteristics of the participants. Vaccination rates were

calculated as proportions with corresponding confidence intervals. Bivariate analyses, such as chi-square tests or t-tests, were conducted to explore associations between vaccination rates and demographic factors. Barriers to vaccination were analyzed by calculating the frequencies and percentages of the selected barriers. The most commonly reported barriers were identified based on the responses provided by the participants.

Results

In the current study, we were able to collect the data from 385 participants. The majority of the participants fell in the 26-35 years age group (45%), followed by 18-25 years (30%), 36-45 years (15%), and 46 years and above (10%). The gender distribution was skewed towards males, accounting for 60% of the participants. The majority of participants were married (60%) and had children (53.7%). Among those with children, the distribution of participants based on the number of children was relatively balanced, with 1 child (39.7%), 2 children (29.9%), and 3 or more children (30.4%). In terms of monthly income, 40% of participants had a low income, 45% had a medium income, and 15% had a high income. Educational levels were distributed as follows: high school or below (25%), bachelor's degree (50%), and master's degree or higher (25%). The majority of participants were employed (70%), and 80% were Saudi nationals (Table 1).

Turning to the vaccination rates, the study examined the participants' willingness to take the COVID-19 vaccine and their completion of the vaccination course. The findings revealed that 80% of participants expressed their willingness to take the vaccine, while 20% reported being unwilling. In terms of vaccination completion, 75.1% of participants had completed their COVID-19 vaccination, while 24.9% had not yet completed it. Moreover, the study investigated the completion of the child's vaccination course, and it was found that 97.1% of participants reported that their child's vaccination course was completed (Table 2).

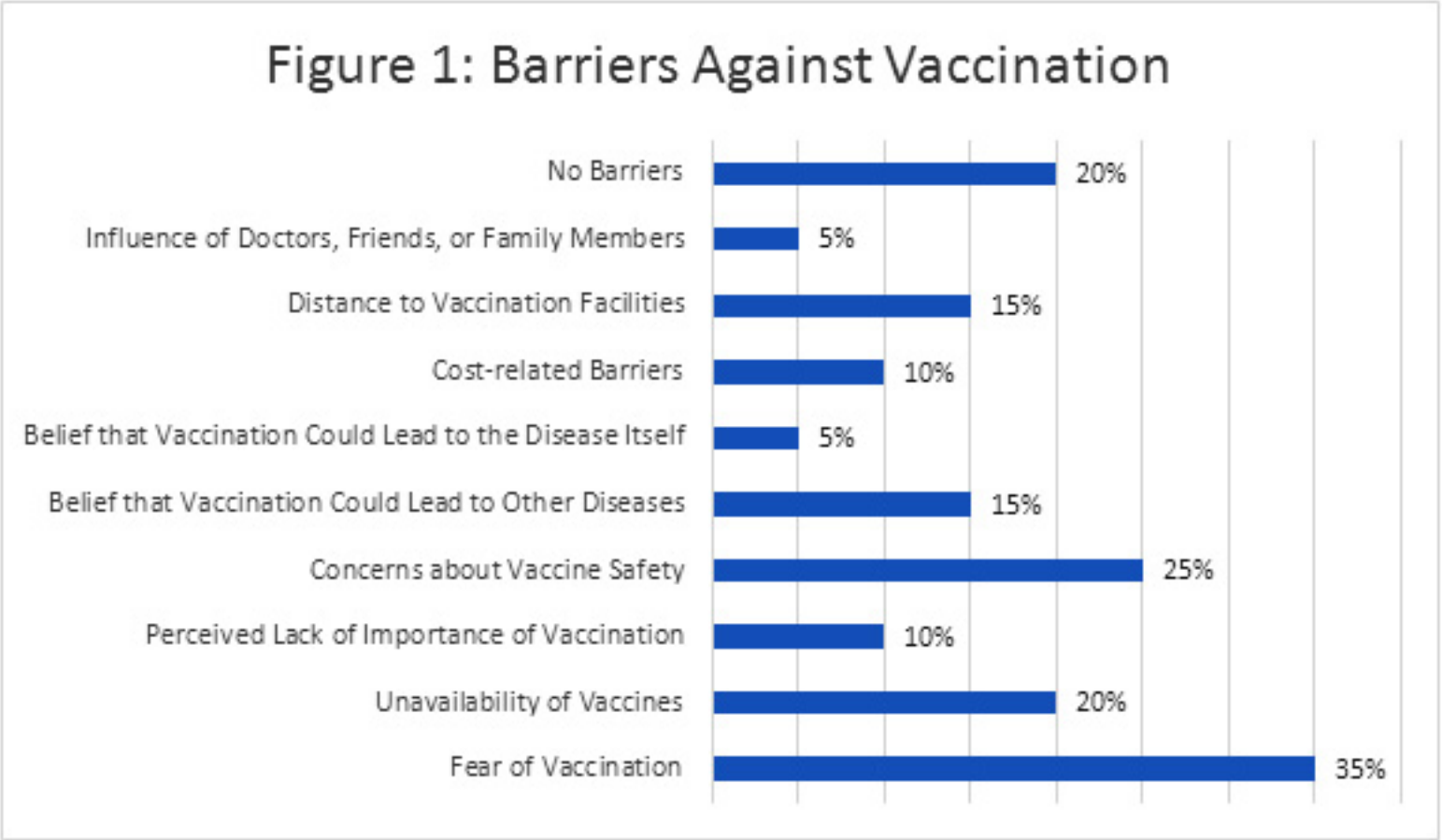
Exploring the relationship between demographic factors and willingness to vaccinate, several interesting patterns emerged. Participants in the 18-25 years age group showed the highest willingness to vaccinate (85%), followed by the other age groups. Gender did not significantly influence the willingness to vaccinate. Participants with children demonstrated a higher willingness to vaccinate (85%) compared to those without children (70%). Monthly income had a significant impact, with participants with a high income (84%) showing a higher willingness to vaccinate. Educational level also played a role, as individuals with a master's degree or higher (85%) exhibited a higher willingness to vaccinate compared to those with a high school education or below (70%) (Table 3).

The study also identified various barriers against vaccination. The most commonly reported barriers included fear of vaccination (35%), concerns about vaccine safety (25%), and the belief that vaccination could lead to other diseases (15%). Participants also mentioned barriers such as unavailability of vaccines (20%), perceived lack of importance of vaccination (10%), cost-related factors (10%), distance to vaccination facilities (15%), and the influence of doctors, friends, or family members (5%). It is worth noting that 20% of participants reported having no barriers to vaccination (Figure 1).

Table 1: Demographic Factors of the participants (N=385)			
	Demographic Factor	**Frequency**	**Percent**
Age	18-25 years	115	30%
	26-35 years	173	45%
	36-45 years	58	15%
	46 years and above	39	10%
Gender	Male	231	60%
	Female	154	40%
Marital Status	Single	135	35%
	Married	231	60%
	Divorced	19	5%
Having Children	Yes	207	53.7%
	No	178	46.3%
Number of Children	1 child	82	39.7%
	2 children	62	29.9%
	3 or more children	63	30.4%
Monthly Income	Low	154	40%
	Medium	173	45%
	High	58	15%
Educational Level	High school or below	96	25%
	Bachelor's degree	192	50%
	Master's degree or higher	96	25%
Occupation	Employed	269	70%
	Unemployed	116	30%
Nationality	Saudi	308	80%
	Non-Saudi	77	20%

Table 2: Vaccination Rates among the participants		
Vaccination Rate	**Frequency**	**Percentage**
Willingness to Take Vaccination		
- Yes	308	80%
- No	77	20%
Completion of COVID-19 Vaccination		
- Completed	289	75.1%
- Not Completed	96	24.9%
Completion of Child's Vaccination Course		
- Completed	374	97.1%
- Not Completed	11	2.9%

Table 3: Relationship between Demographic Factors and Willingness to Vaccinate					
Demographic Factor	**Willing to Vaccinate (%)**				
	Yes		**No**		**P-value**
	Count	**Percent**	**Count**	**Percent**	
Age					
- 18-25 years	98	85%	17	15%	0.030*
- 26-35 years	138	80%	35	20%	
- 36-45 years	44	76%	14	25%	
- 46 years and above	27	69%	12	30%	
Gender					
- Male	185	80%	46	20%	0.268
- Female	116	75%	38	25%	
Marital Status					
- Single	95	70%	40	30%	0.365
- Married	185	80%	46	20%	
- Divorced	14	74%	5	25%	
Having Children					
- Yes	176	85%	31	15%	0.000*
- No	125	70%	53	30%	
Number of Children					
- 1 child	66	80%	16	20%	0.140
- 2 children	47	76%	15	25%	
- 3 or more children	44	70%	19	30%	
Monthly Income					
- Low	116	75%	38	25%	
- Medium	138	80%	35	20%	0.015*
- High	49	84%	9	25%	
Educational Level					
- High school or below	67	70%	29	30%	0.018*
- Bachelor's degree	154	80%	38	20%	
- Master's degree or higher	82	85%	14	15%	
Occupation					
- Employed	215	80%	54	20%	0.281
- Unemployed	87	75%	29	25%	
Nationality					
- Saudi	246	80%	62	20%	0.382
- Non-Saudi	58	75%	19	25%	



Discussion

Vaccination is an indispensable technique for controlling the spread of infectious illnesses and protecting public health [10]. History's triumphs in eradicating or controlling illnesses like smallpox, polio, and measles have demonstrated the significance of immunization [11]. As a result of the outbreak of the COVID-19 pandemic, the production and distribution of vaccines have become crucial for reducing the virus's effects [12]. Understanding the factors that influence an individual's willingness to vaccinate and removing impediments to vaccination are crucial for increasing immunization rates and obtaining population-level protection.

The results of the study provided insight on the vaccination rates of the participants and the factors that affect these rates. Completing the course of COVID-19 was chosen in the current study as it is the last vaccination provided to the public, therefore, completing this course could be an indication of general willingness to receive vaccination. Eighty percent of individuals indicated a willingness to get the COVID-19 vaccine, indicating a rather high level of vaccination preparedness. This result is within the rates reported in some previous studies which reported rates of willing to receive COVID-19 vaccination ranged between 57.8 % - 82.4 % [13–17]. This is a promising conclusion since it indicates a favorable attitude toward vaccination and an understanding of its significance in combatting the pandemic.
Age was identified as a significant factor influencing vaccination acceptance. Participants between the ages of 18 and 25 had the greatest vaccination rate of 85 percent. This result is consistent with earlier findings that younger persons tend to be more receptive to vaccination [18,19], potentially as a result of their higher exposure to vaccination efforts, greater access to information, and stronger feelings of social duty [19]. In the present investigation, a significant connection between gender and vaccine acceptance was not found however; willingness to accept the vaccination was slightly higher among men. This result is consistent with earlier studies that have indicated no significant gender differences in vaccine acceptability with slightly higher hesitancy among women [20,21]. Noting that gender-specific issues, such as cultural beliefs or concerns, may still play a role in particular groups and should be taken into account when designing personalized vaccination tactics is essential. Having children was found to have a favorable effect on vaccination willingness, with 85 percent of those who had children indicating their willingness to be vaccinated. This result emphasizes the importance of parental responsibility and the need to safeguard oneself and one's children against the virus. Campaigns promoting public health should emphasize the significance of vaccination for parents and promote the concept of "vaccinating to protect the entire family."

The willingness to vaccinate was additionally affected by monthly income. Those with a high monthly income were more likely to be vaccinated (84 percent) than those with a low (75 percent) or medium (80 percent) income. Most likely, financial security and access to healthcare services contribute to this gap. Individuals with lower incomes may face financial obstacles, such as the expense of transportation to vaccination sites or the potential loss of income owing to time off work for immunization [4,22]. By addressing these cost hurdles through subsidized or free vaccination programs and by guaranteeing easy access to vaccination sites, this gap can be bridged.

Individuals with a master's degree or higher demonstrated a higher rate of vaccination willingness (85 percent) than those with a high school diploma or less (70 percent). Higher levels of education are frequently related with improved health literacy, information availability, and critical thinking abilities [23,24]. These variables may help in a better comprehension of the advantages of vaccination and an increased possibility of acceptance. Individuals with a lower level of education should be the focus of educational efforts designed to address their specific issues and informational requirements.

The study highlighted a number of barriers to vaccination that must be addressed in order to increase vaccine adoption. Fear of immunization was the most often cited impediment, cited by 35% of responders. This apprehension may be due to a number of factors, including worries about potential adverse effects and widespread disinformation in the community [25]. Addressing vaccine hesitancy through clear and open communication, the provision of evidence-based information, and the rebuttal of myths and misconceptions can help lessen this concern and develop confidence in the immunization procedure. Twenty-five percent of interviewees expressed concerns regarding vaccine safety which was also reported by previous studies [26,27]. The quick development and emergency use authorization of COVID-19 vaccines may give rise to these issues, leading to the perception of insufficient testing or unknown long-term effects [28]. To address these concerns, public health officials should emphasize the stringent safety measures used during vaccine development, the comprehensive testing undertaken throughout clinical trials, and the continued monitoring of vaccine safety following approval. Open communication with healthcare experts can also aid patients in making informed decisions and addressing any particular issues. Accessibility constraints, such as the unavailability of vaccinations (20%) and the distance to immunization centers, were also highlighted (15 %). These obstacles can be solved by ensuring a sufficient supply of vaccines and establishing vaccination facilities in conveniently accessible places [12,29].

Participants also cited perceived lack of importance of vaccination (10%) and cost-related factors (10%) as additional impediments. These obstacles may result from a lack of knowledge regarding the seriousness of COVID-19 or the potential repercussions of refusing vaccination [30,31]. Effective communication efforts should highlight the significance of vaccination in preventing severe illness, hospitalization, and mortality, as well as vaccination's function in achieving herd immunity and protecting vulnerable groups. In addition, providing free or subsidized vaccination services can assist in reducing cost-related barriers and ensuring equal access to vaccines.

Overall, this study provides insightful information regarding vaccination rates especially considering COVID-19 vaccination, variables influencing them, and difficulties faced by individuals. The participants' high willingness to be vaccinated is positive, but it is essential to address the identified causes and barriers to ensure vaccine uptake is equitable across all demographic categories. Customized measures, such as educational campaigns, targeted outreach, and enhanced accessibility, can increase vaccine adoption and contribute to pandemic control.

It is crucial to emphasize that there were limitations to this study. The sample size was restricted to 385 individuals, which may not adequately represent the population's diversity. The study also relied on self-reported data, which may be susceptible to recall bias or social desirability bias. Future research should aim for larger and more diverse samples, longitudinal designs to measure changes in vaccine attitudes over time, and mixed-method approaches to acquire a thorough knowledge of the factors that influence vaccination rates.

In conclusion, immunization serves a critical role in protecting public health, and knowing the factors that influence vaccine uptake is crucial for the effectiveness of vaccination campaigns. This study examines COVID-19 immunization rates, demographic characteristics, and challenges encountered by persons. By addressing barriers such as fear, safety concerns, and accessibility challenges, public health officials can increase vaccine uptake and achieve their aim of widespread immunization coverage. Continued efforts in education, communication, and accessibility will be crucial for controlling the present pandemic and preventing future outbreaks.

References

1. Xue QC, Ouellette LL. Innovation policy and the market for vaccines*. J Law Biosci. 2020;7(1). doi:10.1093/jlb/lsaa026
2. Rodrigues CMC, Plotkin SA. Impact of Vaccines; Health, Economic and Social Perspectives. Front Microbiol. 2020;11. doi:10.3389/fmicb.2020.01526
3. Orenstein WA, Ahmed R. Simply put: Vaccination saves lives. Proc Natl Acad Sci. 2017;114(16):4031-4033. doi:10.1073/pnas.1704507114
4. Anderson EL. Recommended solutions to the barriers to immunization in children and adults. Mo Med. 2014;111(4):344-348. http://www.ncbi.nlm.nih.gov/pubmed/25211867
5. Lindstrand A, Cherian T, Chang-Blanc D, Feikin D, O'Brien KL. The World of Immunization: Achievements, Challenges, and Strategic Vision for the Next Decade. J Infect Dis. 2021;224(Supplement_4):S452-S467. doi:10.1093/infdis/jiab284
6. Frenkel LD. The global burden of vaccine-preventable infectious diseases in children less than 5 years of age: Implications for COVID-19 vaccination. How can we do better? Allergy Asthma Proc. 2021;42(5):378-385. doi:10.2500/aap.2021.42.210065
7. Cordina M, Lauri MA, Lauri J. Attitudes towards COVID-19 vaccination, vaccine hesitancy and intention to take the vaccine. Pharm Pract (Granada). 2021;19(1):2317. doi:10.18549/PharmPract.2021.1.2317

8. Altman JD, Miner DS, Lee AA, et al. Factors Affecting Vaccine Attitudes Influenced by the COVID-19 Pandemic. Vaccines. 2023;11(3):516. doi:10.3390/vaccines11030516
9. McCready JL, Nichol B, Steen M, Unsworth J, Comparcini D, Tomietto M. Understanding the barriers and facilitators of vaccine hesitancy towards the COVID-19 vaccine in healthcare workers and healthcare students worldwide: An Umbrella Review. Harapan H, ed. PLoS One. 2023;18(4):e0280439. doi:10.1371/journal.pone.0280439
10. Lahariya C. Vaccine epidemiology: A review. J Fam Med Prim Care. 2016;5(1):7. doi:10.4103/2249-4863.184616
11. Greenwood B. The contribution of vaccination to global health: past, present and future. Philos Trans R Soc B Biol Sci. 2014;369(1645):20130433. doi:10.1098/rstb.2013.0433
12. Wouters OJ, Shadlen KC, Salcher-Konrad M, et al. Challenges in ensuring global access to COVID-19 vaccines: production, affordability, allocation, and deployment. Lancet. 2021;397(10278):1023-1034. doi:10.1016/S0140-6736(21)00306-8
13. Kateeb E, Danadneh M, Pokorná A, et al. Predictors of Willingness to Receive COVID-19 Vaccine: Cross-Sectional Study of Palestinian Dental Students. Vaccines. 2021;9(9):954. doi:10.3390/vaccines9090954
14. Wang B, Nolan R, Krumeich B, D'Onise K, Marshall H. COVID-19 vaccine willingness prior to and during the COVID-19 vaccination rollout in Australia. Hum Vaccin Immunother. 2022;18(5). doi:10.1080/21645515.2022.2079345
15. Weitzer J, Birmann BM, Steffelbauer I, et al. Willingness to receive an annual COVID-19 booster vaccine in the German-speaking D-A-CH region in Europe: A cross-sectional study. Lancet Reg Heal - Eur. 2022;18:100414. doi:10.1016/j.lanepe.2022.100414
16. Ogilvie GS, Gordon S, Smith LW, et al. Intention to receive a COVID-19 vaccine: results from a population-based survey in Canada. BMC Public Health. 2021;21(1):1017. doi:10.1186/s12889-021-11098-9
17. Amo-Adjei J, Nurzhynska A, Essuman R, Lohiniva A-L. Trust and willingness towards COVID-19 vaccine uptake: a mixed-method study in Ghana, 2021. Arch Public Heal. 2022;80(1):64. doi:10.1186/s13690-022-00827-0
18. Adams SH, Schaub JP, Nagata JM, Park MJ, Brindis CD, Irwin CE. Young Adult Perspectives on COVID-19 Vaccinations. J Adolesc Heal. 2021;69(3):511-514. doi:10.1016/j.jadohealth.2021.06.003
19. Khan MSR, Watanapongvanich S, Kadoya Y. COVID-19 Vaccine Hesitancy among the Younger Generation in Japan. Int J Environ Res Public Health. 2021;18(21):11702. doi:10.3390/ijerph182111702
20. Zintel S, Flock C, Arbogast AL, Forster A, von Wagner C, Sieverding M. Gender differences in the intention to get vaccinated against COVID-19: a systematic review and meta-analysis. J Public Health (Bangkok). 2023;31(8):1303-1327. doi:10.1007/s10389-021-01677-w
21. Ishimaru T, Okawara M, Ando H, et al. Gender differences in the determinants of willingness to get the COVID-19 vaccine among the working-age population in Japan. Hum Vaccin Immunother. 2021;17(11):3975-3981. doi:10.1080/21645515.2021.1947098
22. Pugliese-Garcia M, Heyerdahl LW, Mwamba C, et al. Factors influencing vaccine acceptance and hesitancy in three informal settlements in Lusaka, Zambia. Vaccine. 2018;36(37):5617-5624. doi:10.1016/j.vaccine.2018.07.042
23. Gomes da Silva J, Silva CS, Alexandre B, Morgado P. Education as a Predictor Factor for Knowledge of COVID-19 in Portugal. Front Public Heal. 2021;9. doi:10.3389/fpubh.2021.680726
24. Vamos S, Okan O, Sentell T, Rootman I. Making a Case for "Education for Health Literacy": An International Perspective. Int J Environ Res Public Health. 2020;17(4):1436. doi:10.3390/ijerph17041436
25. Saied SM, Saied EM, Kabbash IA, Abdo SAE. Vaccine hesitancy: Beliefs and barriers associated with COVID-19 vaccination among Egyptian medical students. J Med Virol. 2021;93(7):4280-4291. doi:10.1002/jmv.26910
26. Leib S, Liberatos P, Edwards K. Pediatricians' Experience with and Response to Parental Vaccine Safety Concerns and Vaccine Refusals: A Survey of Connecticut Pediatricians. Public Health Rep. 2011;126(2_suppl):13-23. doi:10.1177/00333549111260S203
27. Troiano G, Nardi A. Vaccine hesitancy in the era of COVID-19. Public Health. 2021;194:245-251. doi:10.1016/j.puhe.2021.02.025
28. Kashte S, Gulbake A, El-Amin III SF, Gupta A. COVID-19 vaccines: rapid development, implications, challenges and future prospects. Hum Cell. 2021;34(3):711-733. doi:10.1007/s13577-021-00512-4
29. Ayenigbara IO, Adegboro JS, Ayenigbara GO, Adeleke OR, Olofintuyi OO. he challenges to a successful COVID-19 vaccination programme in Africa. Germs. 2021;11(3):427-440. doi:10.18683/germs.2021.1280
30. Adane M, Ademas A, Kloos H. Knowledge, attitudes, and perceptions of COVID-19 vaccine and refusal to receive COVID-19 vaccine among healthcare workers in northeastern Ethiopia. BMC Public Health. 2022;22(1):128. doi:10.1186/s12889-021-12362-8
31. Cerda AA, García LY. Hesitation and Refusal Factors in Individuals' Decision-Making Processes Regarding a Coronavirus Disease 2019 Vaccination. Front Public Heal. 2021;9. doi:10.3389/fpubh.2021.626852