Global COVID-19 Vaccine Acceptance Rate: Systematic Review and Meta-Analysis

Dechasa Adare Mengistu (✉ dechasaadare@gmail.com)

Haramaya University College of Health and Medical Science <https://orcid.org/0000-0002-0076-5586>

Yohannes Mulugete Demu

Haramaya University College of Health and Medical Science

Systematic Review

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Abstract

Background: A vaccine against COVID-19 is a vital tool in managing the current pandemic. It is becoming evident that an effective vaccine would be required to control COVID-19. Effective use of vaccines is important in reducing the pandemic and paving the way for an acceptable exit strategy. Therefore, the current review aimed to determine the global acceptance rate of the COVID-19 vaccine that is necessary for better management of the COVID-19 pandemic.

Methods: This review was conducted under the Preferred Reporting Items for Systematic Reviews and Meta-Analysis protocol and considered the studies conducted on the acceptance and / or hesitancy of the COVID-19 vaccine around the world, and written in English language. Articles were searched using electronic databases including PubMed / MEDLINE, Scopus / Science Direct, Web of Science, Embase, CINAHL, and Google Scholars from February to March 2021 (for articles conducted in 2020) and May to June 2022 (for articles conducted in 2021). The quality of the study was assessed using the Joanna Briggs Institute Critical Assessment tool for prevalence studies to determine the relevance of each included article to the study.

Results: A total of 6021 articles were searched through electronic databases, of which 68 articles were included in the systematic review and meta-analysis. The global pooled acceptance rate of the COVID-19 vaccine was found to be 64.9% [95% CI of 60.5 to 69.0%]. Based on the subgroup analysis of the acceptance rate of the COVID-19 vaccine by WHO region, the countries where the study was conducted, occupation, and survey period was 60.8% [95% CI: 56.3, 65.2%], 61.9% [95% CI: 61.3, 62.4%], 81.6% [95% CI: 79.7, 83, 2%] and 64.5% [95% CI: 60.3, 68.5%], respectively.

Conclusions: This review found the variation in the level of COVID-19 vaccine acceptance rate across the world. The study found that the overall prevalence of COVID-19 vaccine acceptance was 64.9%. This finding indicated that even if the COVID-19 vaccine is developed, the issue of accepting or taking the developed vaccine and managing the pandemic may be difficult.

1. Introduction

The Corona virus disease 2019 (COVID-19) has spread drastically throughout the world, since the first case of COVID-19 disease was reported in Wuhan, China [1], and has rapidly become a major public health concern [2]. Vaccination has played a fundamental role in global public health, leading to increased life expectancy[3] and is one of the most cost-effective ways of avoiding the disease and currently prevents between two and three million deaths per year [4]. It is becoming evident that an effective vaccine would be required to control COVID-19 [7]. Effective use of vaccines is necessary to reduce the social and economic burden and to prepare the way for an acceptable exit strategy from the COVID-19 pandemic[8]. Vaccination hesitancy and anti-vaccination movements are increasing and need critical attention [9-11]. Similarly, a vaccine against COVID-19 is a vital tool in the management of the COVID-19 pandemic [5, 6].

Currently, vaccination rates have fallen and public confidence in vaccines has been inconsistent [6, 13] and various studies reported a declining level of willingness to accept the COVID-19 vaccine[14]. Globally, the intention of being vaccinated against the COVID-19 pandemic is declining from time to time [8]. According to the World Health Organization (WHO), vaccine hesitancy has become an emerging global issue and has been identified as one of the top ten threats to global health in 2019 [12].

Although vaccines are developed against COVID-19, many factors compromise the acceptance of the vaccine against COVID-19 and become a public concern [13, 15]. Furthermore, transparent and effective communication efforts are essential to reduce misinformation and vaccine hesitancy and build trust to ensure adequate vaccination coverage will be achieved [8].

Previously, several studies have been conducted and many literatures have been published to capture and address many issues regarding the COVID-19 pandemic. However, to our knowledge, no adequate studies have investigated that provide the global pooled acceptance or hesitancy rate of the COVID-19 vaccine. Thus, the current review aimed to determine the acceptance rate of the COVID-19 vaccine across the world, which is necessary to understand the acceptance or hesitancy of the vaccine in different contexts and can be input for others pandemics also.

2. Materials And Methods

This systematic review was conducted under the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [16].

2.1 Eligibility criteria

Studies that met the following inclusion criteria were included in the systematic review and meta-analysis. The inclusion criteria considered in this review include: -

- **Study Population:** All populations regardless of their age, occupation, ethnicity, gender, etc.
- **Outcomes:** articles aimed to determine the hesitancy and/or acceptance of COVID-19 vaccines that provided a quantitative outcome.
- **Language:** Studies written in English.
- **Types of articles:** Peer-reviewed full text, original, and published articles.
- **Publication year:** Studies published since after the emergency of COVID-19 to the study period (March 2020 to June 2022).
- **Study regions / locations:** Not specified (no limitation).

However, articles not freely available, not peer reviewed manuscripts or preprints; editorial papers; reports; short communications; review articles; the article did not provide outcome of the interest (COVID-19 acceptance rate or prevalence).

2.2 Information sources and search strategy

Article searches were performed using key terms of review; COVID-19, vaccine hesitancy, vaccine acceptance and intention to vaccine, and Medical Subject Headings (MeSH) in combination with Boolean logic operators ("AND", "OR", and "NOT") through various electronic databases from PubMed/Medline, Scopus or Science direct, Web of Science, Embase, CINAHL, and Google scholars. Furthermore, the articles were searched directly from Google. References within eligible papers were screened for additional articles. There was no specific date for the search of the articles for each database. For example, the articles were searched from the first February to March 29, 2021 and May to June 2022 on PubMed, Scopus, Embase, and Google Scholars, while the search on Web of Science, CINAHL, and Google was made from 15 February to 31 March 2021.

The Embase search strategy was made as follows: **(1)** COVID 19 ' OR 'COVID 19'/exp OR Coronavirus OR coronavirus/exp OR '2019 nCoV' OR '2019 nCoV'/exp OR 'severe acute respiratory syndrome coronavirus 2' / exp OR 'SARS-COV-2' OR 'SARS-COV 2/exp; **(2)** Vaccine OR *vaccine/exp* OR *Vaccination* OR *Vaccination/exp OR Immunization OR Immunization/exp; **(3)** acceptance OR acceptance /exp; OR 'hesitancy' OR 'hesitancy/exp' OR 'refusal OR 'refusal/exp'; **(4)** 1 AND 2 AND 3.

The PubMed search strategy was performed as follows: **(1)** 'Corona virus' [MeSH Terms] OR 'Corona virus' [All Fields] OR 'Corona virus' [All Fields] OR 'COVID-19' [All Fields] OR 'SARS-2' [All Fields] OR 'Severe acute respiratory syndrome corona virus 2' [All Fields] OR '2019 nCoV' [All Fields] OR 'SARS COV-2' [All Fields] OR 'Corona virus' [All Fields] AND; **(2)** 'Vaccines' [MeSH Terms] OR 'Vaccine' [All Fields] OR 'Vaccinations' [All Fields] OR 'Vaccines' [All Fields] OR 'Vaccines' [All Fields]; **(3)** "acceptance" [MeSH Terms] OR "hesitancy" [All Fields] OR "refusal" [All Fields] OR "accepted" [All Fields] OR "willingness to accept" [All Fields]; **(4)** 1 AND 2 AND 3.

The **Scopus and Web of Science search strategy** was made using a combination of keywords and Boolean functions: **(1)** (*COVID-19 * OR *Corona virus* OR *nCoV * OR *SARS COV-2*; **(2)** Vaccines *OR *Vaccination *OR *vaccinates*); **(3)** (*acceptance*OR *hesitancy* OR *refusal* OR accepted *OR *willingness to accept*; **(4)** 1 AND 2 AND 3) or 1 AND (2 OR 3)

The search strategy from **Google Scholars and Google** was done using keywords such as (Corona virus, nCoV, SARS, COV-2, COVID-19) AND (Vaccines OR Vaccination OR Vaccinates); **(3)** (acceptance OR hesitancy OR refusal OR accepted OR willingness to accept; **(4)** 1 AND 2 AND 3.

Articles published from March 2021 to June 2022 were searched from the included electronic databases according to their own searching strategies. The search was carried out from the first February 2021 to the last March 2021 and from May to June 2022.

2.3 Study Selection

The study selection process was performed using the PRISMA flow chart, indicating the number of articles included in the review and articles excluded from the study with the reasons. Following the search for articles through selected electronic databases, duplicate studies were removed using the ENDNOTE software version X5 (Thomson Reuters, USA). After removing duplicate articles, the authors (DAM, YAA, and YMD) independently selected the articles based on the titles and abstracts applying the inclusion criteria.

Furthermore, the full text of the relevant articles further read in detail and the inclusion criteria independently evaluated by the authors. Any disagreements made with respect to the inclusion of studies were resolved by consensus after discussion. Finally, studies that met the criteria were included in the systematic review and meta-analysis.

1. Data Extraction

The data were extracted by the authors (DAM, YAA, and YMD) independently. Predetermined tabular format consisting of study characteristics including publication year, survey period, country where the study was conducted, number of respondents, and outcome (COVID-19 vaccine acceptance/hesitancy rate using Microsoft Excel, 2016). Any disagreement made between the authors was resolved through discussion after the same procedures were repeated.

1. Data Quality Assessment/Management

The selected articles were subjected to a rigorous independent assessment using a standardized critical assessment tool, Joanna Briggs Institute (JBI) Critical Assessment Tools for prevalence studies [17]. The evaluation tools have the following nine evaluation criteria/ parameters; (1) appropriate sampling frame; (2) proper sampling technique; (3) adequate sample size; (4) description of the study subject and setting description; (5) sufficient data analysis; (6) use of valid methods for identifying conditions; (7) valid measurement for all participants; (8) use of appropriate statistical analysis and (9) adequate response rate.

The authors ((DAM, YAA, and YMD)) assessed the quality of the included studies. Based on the items in the above appraisal tool, the articles were classified as high quality (80% and above), moderate (60-80% score), and low quality (<60% score). Articles with a score $\geq 60\%$ were included in the review, while those with low quality were excluded from the study. Finally, the disagreements made among the authors were resolved by discussion and repeating the same procedures.

2.5 Outcome Measures

The term 'vaccine hesitancy' refers to 'delay in acceptance or refusal of vaccines despite the availability of vaccine services [6, 18, 19]'. In this review, for articles that did not provide general acceptance of the vaccine among study participants, the prevalence of vaccine acceptance was calculated based on the response of the participants. The participant responded strongly agree, agree, completely agree, accept, all, accept, some accept, and yes to the questions were considered as accepted. Finally, the prevalence was calculated based on the frequency of responses and the total number of respondents. The same principle was applied to the studies that reported the results based on the Likert scale and others (Figure 1).

2.6 Statistical Procedures and Data Analysis

The pooled prevalence / acceptance rate of the COVID-19 vaccine was performed using Comprehensive Meta-Analysis (CMA) version 3.0 statistical software. Forest plots and random-effects models were used to determine and visualize the pooled acceptance rate of the COVID-19 vaccine. The Cochran Q test (Q) and I Squared test (I^2 statistics) were used to evaluate the heterogeneity between the included articles. Then, heterogeneity was classified into low (I^2 index < 25%), medium (I^2 index ranging from 25–75%), and high heterogeneity (I^2 index > 75%). The random-effects model was used to analyze the data. Furthermore, subgroup analysis was performed based on the year of publication, survey period (when the study was conducted), and study area. Publication bias between the included studies was evaluated using funnel plots (Figure 2).

A p -value of < 0.05 was considered as evidence of publication bias. Sensitivity analysis was employed to determine differences in pooled effects by dropping studies that were found to influence the summary estimates, including extreme sample size and outcomes.

3. Results

3.1 Study Selection

A total of 6021 short communications, and editorial articles were searched through electronic databases from PubMed/MEDLINE, Scopus/Science direct, Web of Science, Embase, CINAHL, and Google scholars. The search for the articles was done from February to March 2021 (For articles conducted in 2020) and May to June 2022 (for articles conducted in 2021). After the search for the articles, 1310 duplicate articles were excluded. Furthermore, 2201 articles were excluded after initial selection based on abstracts and titles. Furthermore, 599 articles were excluded after eligibility for full text articles (n = 601). Finally, a total of 68 articles were included in the systematic review and meta-analysis (Figure 3).

3.2 Characteristics of the included articles

In this review, a total of 143,111 study participants were included in 68 original full-text articles throughout the world and published from 2020 to 2022. The included articles were conducted in 38 countries of the world (Figure 3).

Additionally, three articles were conducted in each Malaysia [44-46] and Kuwait [28, 47]. Two articles conducted in each Qatar[48, 49], Italy[15, 50], Jordan [28, 51], Bangladesh [52, 53], Ethiopia [54, 55], Taiwan [56, 57] and Germany [58, 59]. However, only one article was conducted in each of the following countries; Republic of Congo [60], Japan [61], Poland [10], Cameroon[7], Israel [62], Mexico [63], Malta[64], Scotland[6], Indonesia [65], England [66], South Korea [67], Iran [68], Nigeria [69], Tunisia [70], Netherlands [71], Thailand [72], Vietnam [73], United Arab Emirates [74], Botswana [75], Sudan [76], Czechia [77], Uganda [78], France [79], and in Egypt [80].

The included studies were cross-sectional studies with a sample size ranging from 123 [64] to 23,582 [32] study participants. In general, the overall global acceptance rate of the COVID-19 vaccine, regardless of occupation, was 63.4% and ranged from 15.4% [7] to 95.6% [23] (Table 1).

Table 1: Overall characteristics of the articles included in the systematic review and meta-analysis, 2022.

<i>References</i>	<i>Survey period</i>	<i>Publication year</i>	<i>Sample size</i>	<i>Acceptance rate</i>	<i>Hesitance rate</i>	<i>Occupation</i>	<i>Country</i>	<i>WHO Region</i>
[2]	October to November 2020	2021	4080	36.0	64.0	Healthcare workers	United States	American Region
[34]	May 2020	2020	672	67.0	33.0	Adult population	United States	American Region
[60]	August to September, 2020	2021	4131	55.9	44.1	Adult population	Republic of Congo	African Region
[44]	April, 2020	2020	1159	94.3	5.7	Adult population	Malaysia	Western Pacific Region
[20]	July to August, 2020	2021	1200	42.2	57.8	Adult population	China	Western Pacific Region
[40]	September, 2020	2020	1138	68.6	31.4	Healthcare workers	Turkey	European
[61]	September 2020	2021	1100	65.7	34.3	Adult population	Japan	Western Pacific Region
[37]	September to October 2020	2020	5114	71.7	28.3	Adults population	United Kingdom	European
[6]	April, 2020	2020	527	86.0	34.0	Elder adults and patients	United Kingdom	European
[48]	October to November 2020	2021	7821	60.5	39.5	Adult population	Qatar	Eastern Mediterranean Region
[35]	May 2020	2020	2006	69.0	31.0	Adult population	United States	American Region
[21]	August to September 2020	2021	2047	34.8	65.2	Adult population	China	Western Pacific Region
[15]	September to November 2020	2021	599	40.8	59.2	Patients	Italy	European
[28]	December 2020	2021	154	31.8	68.2	Adult population	Saudi Arabia	Eastern Mediterranean Region
[10]	June 2020	2021	1066	37.0	63.0	Adult population	Poland	European
[7]	May to August 2020	2021	2512	15.4	84.6	Adult population	Cameroon	African Region
[14]	March 2020	2020	2058	91.3	8.7	Adult population	China	Western Pacific Region
[62]	March to April 2020	2020	1112	75.0	25.0	Adult population	Israel	European
[38]	October to December 2020	2021	535	29.0	71.0	Adult population	United Kingdom	European
[63]	June 2020	2021	699	76.2	23.8	Adult population	Mexico	American Region

[64]	September 2020	2020	123	61.8	38.2	Healthcare workers	Malta	European
[6]	August 2020	2021	2016	77.5	22.5	High risk population	Scotland	European
[28]	December 2020	2021	771	23.6	76.4	Adult population	Kuwait	Eastern Mediterranean Region
[65]	March to April 2020	2020	1359	93.3	6.7	Adult population	Indonesia	South East Asian Region
[41]	June to July, 2020	2020	759	49.7	50.3	Adult population	Turkey	European
[36]	June, 2020	20021	1878	79.0	22.0	Adult population	United States	American Region
[22]	May to June 2020	2021	3195	83.8	16.2	Adult population	China	Western Pacific Region
[23]	March 2020	2021	2058	52.2	47.8	Adults population	China	Western Pacific Region
[81]	December 2020	2021	2173	28.4	71.6	Adults population	Jordan	Eastern Mediterranean Region
[66]	April to May 2020	2021	1252	55.8	44.2	Parents and guardians	England	European
[45]	December 23–29, 2020	2021	1411	83.3	16.7	Adult population	Malaysia	Western Pacific Region
[67]	May to June 2021	2021	710	70.8	29.2	Adult population	South Korea	Western Pacific Region
[68]	December 2020 to February 2021	2022	4604	69	31	Adult population	Iran	Eastern Mediterranean Region
[69]	March to June 2021	2021	440	40	60	Students	Nigeria	African Region
[52]	February 2021	2021	1497	42.9	46.2	Adult population	Bangladesh	South East Asian Region
[54]	2021	2021	416	59.4	40.6	Patients	Ethiopia	African Region
[47]	March to April 2021	2021	4147	73.8	26.2	Adult population	Kuwait	Eastern Mediterranean Region
[24]	January to March 2021	2022	4227	84.4	15.6	HCW, Students, population,	China	Western Pacific Region
[70]	February 2021	2021	200	35	65	patients	Tunisia	Eastern Mediterranean Region
[71]	January to April 2021	2022	160	69.6	30.4	Minority Ethnic Groups	Netherlands	European
[25]	November 2021	2022	1,724	88.46	11.54	child caregivers, Children	China	Western Pacific Region

[72]	March 2021 to April 2021	2021	705	95.6	4.4	Healthcare workers	Thailand	South East Asian Region
[73]	January to February 2021	2021	651	60.4	39.6	Pregnant Women	Vietnam	Western Pacific Region
[46]	December 2021	2021	1406	64.5	35.5	Adult population	Malaysia	Western Pacific Region
[74]	November 2020 and January 2021	2022	517	58	42	Healthcare workers	United Arab Emirates	Eastern Mediterranean Region
[75]	February 2021	2022	5300	73.4	26.6	Adult population	Botswana	African Region
[56]	June to September 2021	2022	957	74.9	25.1	elderly people	Taiwan	Western Pacific Region
[39]	December 2020	2021	4,535	85	15	Adult population	United Kingdom	European
[29]	November 2020	2021	1512	70	30	Healthcare workers	Saudi Arabia	Eastern Mediterranean Region
[76]	June to July 2021	2022	217	55.8	44.2	Students	Sudan	Eastern Mediterranean Region
[53]	January to February 2021	2021	4175	60.5	39.5	Adult population	Bangladesh	South East Asian Region
[55]	June to July 2021	2022	319	72.73	27.27	Healthcare workers	Ethiopia	African Region
[77]	August to October 2021	2021	362	70.2	29.8	Pregnant and Lactating Women	Czechia	European
[58]	December 2020 to January 2021	2021	1296	57	43	Healthcare workers	Germany	European
[78]	March to April 2021	2021	317	70.1	29.9	High-risk populations	Uganda	African Region
[49]	February 2021	2021	462	62.6	37.4	Employees and students	Qatar	Eastern Mediterranean Region
[42]	December 2020	2021	384	54.7	45.3	Adult population	Turkey	European
[30]	January to February 2021	2021	862	22.4	77.6	Adult population	Saudi Arabia	Eastern Mediterranean Region
[31]	January and March 2021	2021	531	61.8	38.2	Adult population	Saudi Arabia	Eastern Mediterranean Region
[57]	October 2020	2021	1020	52.7	47.3	Adult population	Taiwan	Western Pacific Region
[26]	November 2020	2021	2126	89.1	10.9	Adult population	China	Western Pacific Region

[32]	October to December 2020	2021	23,582	64.9	35.1	Healthcare workers	Saudi Arabia	Eastern Mediterranean Region
[79]	January 2021	2021	237	71.3	28.7	Patients	France	European
[33]	December 2020	2021	2137	48	52	Adult population	Saudi Arabia	Eastern Mediterranean Region
[27]	November 2020	2021	1392	77.4	22.6	Pregnant and Lactating Women	China	Western Pacific Region
[59]	February 2021	2021	4500	91.7	8.3	Healthcare workers	Germany	European
[50]	February to April 2021	2021	3226	91.9	8.1	Students	Italy	European
[51]	November 2020	2021	3,100	37.4	62.6	Adult population	Jordan	Eastern Mediterranean Region
[80]	January 2021	2021	2133	54	46	Students	Egypt	Eastern Mediterranean Region
[43]	January to February 2021	2021	300	37	63	Pregnant and Lactating Women	Turkey.	European

Keys: HCWs: Healthcare Workers

3.3 COVID-19 Vaccine Acceptance

The meta-analysis was performed using Comprehensive Meta-Analysis (CMA) Version 3 statistical software determine the global pooled prevalence / acceptance rate and the hesitancy rate of the COVID-19 vaccine.

3.3.1 The Overall Pooled Prevalence /Rate of COVID-19 Vaccine Acceptance

The pooled prevalence rate for the acceptance of the COVID-19 vaccine was found to be 64.9% [95% CI of 60.5 to 69.0%]; $I^2 = 99.57\%$ with a p -value of <0.001 (Figure 4).

3.3.2 Subgroup analysis of the pooled prevalence rate of COVID-19 vaccine acceptance

Based on the subgroup analysis that was employed based on the World Health Organization Region, the overall pooled prevalence rate of acceptance of the COVID-19 vaccine was 60.8% [95% CI: 56.3, 65.2%]. The lowest prevalence of acceptance rate was reported in the Eastern Mediterranean Region accounting for 60.8% [95% CI: 43.4, 57.2%], whereas the highest prevalence was reported in South East Asian Region which accounted for 81.0% [95% CI: 59.9, 92.4%] (Figure 5).

Based on the countries where the study was conducted, the lowest prevalence of COVID-19 vaccine acceptance rate was reported in Cameroon [15.4% (95% CI: 14.0, 16.9)] followed by the highest prevalence [95.6% (95% CI: 93.8, 96.9%)] of COVID-19 vaccine acceptance was reported in Thailand followed by Indonesia [93.3% (95% CI: 91.8, 94.5%)] (Figure 6).

Based on the study participants, the highest COVID-19 vaccine acceptance rate was reported among the healthcare workers prevalence [71.4% (95% CI: 59.9, 80.7%)] followed by students 64.7% (95% CI: 32.6, 89.2%). The lowest prevalence of COVID-19 vaccine acceptance rate was reported among patients [51.8% (95% CI: 36.8, 66.6%)] (Table 7)

Based on the survey period, the pooled prevalence of the COVID-19 vaccine acceptance rate was 64.5% [95% CI: 60.3, 68.5%]. Relatively, the lowest prevalence [57.9% (95% CI: 49.2, 66.2%)] of vaccine acceptance was reported from September to November 2020, followed by [60.1% (95% CI: 40.5, 76.9%)], whereas the highest prevalence [81.0% (95% CI: 57.3, 93.1%)] was reported between September to November 2021 (Figure 8).

3.4 Publication bias

3.4.1 Sensitivity analysis

Sensitivity analysis was performed by removing low outcome, high outcome, and small sample size. However, the sensitivity analysis did not show a substantial change in the prevalence of COVID-19 acceptance compared to the pooled prevalence without sensitivity analysis [61.1% (95% CI 53.8 to 67.9%)] (Table 2).

Table 2: Results of sensitivity analysis for COVID-19 vaccine acceptance rate, 2022.

Criteria used	Prevalence	Heterogeneity	95% Confidence interval		P-value
			Upper limit	Lower limit	
After removing three articles with small sample size	65.2%		60.8	69.3	<0.001
After removing on article with small sample size	64.85		60.0	69.3	
After removing one article with low outcome	65.5%		61.5	69.4	<0.001
After removing four articles with high prevalence rate	62.0%		57.8	66.1	<0.001
After removing one article with low and four articles with high prevalence rate	65.8%		58.8	66.6	<0.001

4 Discussion

We conducted a systematic review and meta-analysis of data from 68 studies that included 143,111 study participants and found a pooled prevalence of vaccine acceptance of 64.9% [95% CI of 60.5 to 69.0%]. Some articles were conducted by the same authors across various countries. Because of high heterogeneity, the sensitivity analysis was used to assess the cause of high heterogeneity and found no substantial change in the prevalence of COVID-19 vaccine acceptance.

The utility of the vaccine to control COVID-19 pandemics depends on the acceptance of the vaccine [82]. Currently, vaccine hesitancy represents a serious threat to global health. Similarly, the current review found that the worldwide pooled prevalence of COVID-19 vaccine acceptance was 64.9% [95% CI of 60.5 to 69.0%], which was lower than the finding of the global survey reported 71.5% COVID-19 acceptance rate [83]. The possible reason for the disparity in the prevalence estimate could be variation in the population studied or the survey period. The former study mainly conducted in the specific study period, whereas the present study finding depends on the study conducted in the emergency of COVID-19 in this study period.

The lowest prevalence of COVID-19 vaccine acceptance rate was reported in the Cameroon [15.4% (95% CI: 14.0, 16.9)] while the highest prevalence [95.6% (95% CI: 93.8, 96.9%)] of COVID-19 vaccine acceptance was reported in Thailand followed by Indonesia [93.3% (95% CI: 91.8, 94.5%)]. The variation may be as a result of variation in sources of information and types of study participants. Because, the study conducted in Thailand involved healthcare workers, whereas the study conducted in Cameroon involved the general population as the study participants.

Furthermore, the review found a slight difference in the pooled prevalence of COVID-19 vaccine acceptance rate among the studies conducted in United State [60.4% (95% CI 56.6, 64.1%)], the United Arab Emirates [58.0% (95% CI 53.7, 62.2%)], and Taiwan [64.6% (95% CI 41.0, 82.7%)], and Qatar [60.6% (95% CI 59.6, 61.7%)].

Similarly, there was slightly different in the prevalence of COVID-19 acceptance rate among the studies conducted in United Kingdom [71% (95% CI: 51.3, 85.1%)], in South Korea [70.8% (95% CI: 67.3, 74.0%)], Netherland [69.6% (95% CI: 62.0, 76.2%)], Italy [69.2% (95% CI: 30.3, 92.1%)], Iran [69.0% (95% CI: 67.6, 70.3%)], France [71.3% (95% CI: 65.2, 76.7%)] and in Czechia [70.2% (95% CI: 65.3, 74.7%)]. However, in some countries there was a lower prevalence, such as Cameroon and Jordan reported 15.4 and 32%, respectively. In general, the variation in the estimate of the vaccine acceptance rate may be due to the difference in the information and sociodemographic characteristics of the study participants (Figure 9).

Based on World Health Organization Region, the overall pooled prevalence rate of acceptance of the COVID-19 vaccine was 60.8% [95% CI: 56.3, 65.2%] that was slightly lower than the finding without subgroup analysis. The lowest COVID-19 vaccine acceptance rate was reported in the Eastern Mediterranean Region accounting for 60.8% [95% CI: 43.4, 57.2%], followed by Western pacific [74.7% CI: 65.2, 82.3%] and American region (66.4%: CI: 59.4, 82.3%). However, the highest prevalence was reported in South East Asian Region which accounted for 81.0% [95% CI: 59.9, 92.4%]. The variation in vaccine acceptance rate may be related to the level of risk perception, study participants involved, and access to information (Figure 10).

Based on the survey period, the COVID-19 acceptance rate was 76.5%, 60.1%, 57.9%, 61.9%, 72.6%, 68.5% and 81.0% for the articles conducted from March to May 2020, June to August 2020, September to November 2020, December 2020 to February 2021, March to May 2021, June to August 2021 and September to November 2021, respectively. This indicates that there is a decline in COVID-19 vaccine acceptance rate from March to November 2020. The current study is supported by various studies (country or region specific) that reported a decline in willingness to accept the COVID-19 vaccine [6, 13, 14]. Similarly, this finding was in line with the finding of another study that reported a decrease in the acceptance rate of the COVID-19 vaccine from more than 70.0% in March to less than 50% in October [84]. However, there was an increasing in COVID-19 vaccine acceptance rate from December 2020 to November 2021. The increasing in COVID-19 vaccine acceptance rate could be related to the increasing in awareness, change in risk perception, and the round of vaccines given across the world. The variation in the vaccine acceptance rate based on the survey period is indicated in the figure below (Figure 11).

Limitations

There was an unequal distribution of the studies conducted across the world. Furthermore, the acceptance rates of the COVID-19 vaccine in many countries of the world were not included because of the lack of studies that met the eligibility criteria. Similarly, as the result of variation in the unit of measurements/statistical analysis employed for data analysis, we could not able to determine the factors associated to COVID-19 acceptance rate. Furthermore, cross-sectional studies were included and causal relationships between the acceptance rate of the COVID-19 vaccine and the determinant factors cannot be established.

Conclusion

This review found a decline in the acceptance rate of the COVID-19 vaccine in 2020 and relatively increasing acceptance in 2021. The maximum of 8 in 10 people accepted COVID-19 vaccine that needs critical attention to manage the COVID-19 pandemic. This finding indicated that even if the COVID-19 vaccine is developed, the issue of accepting or taking the developed vaccine and managing the pandemic will be difficult unless appropriate measures are taken when it is necessary. Furthermore, we recommend further studies, particularly on the determinants or factors that lead to hesitancy.

Abbreviations

CMA: Comprehensive Meta-Analysis; COVID-19: Coronavirus disease, 2019; JBI: Joanna Briggs Institute; Preferred Reporting Items for Systematic Review and Meta-Analysis; WHO: World Health Organization; MeSH: Medical Subject Heading.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Data Availability

All data are included in this study.

Competing Interests

The authors declare that there is no competing interest in this work.

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Authors' Contributions

DA. Mengistu conceived the idea and had a major role in the review, extraction, and analysis of the data, writing, drafting and editing of the manuscript. YMD and YAA. Demmu has contributed to data extraction, analysis, and editing. Finally, the authors (DAM, YAA, and YMD) read and approved the final version of the manuscript to be published and agreed on all aspects of this work.

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References

1. Lu H, Stratton CW, Tang YW. Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle. *Journal of medical virology*. 2020 Apr;92(4):401.
2. Shekhar R, Sheikh AB, Upadhyay S, Singh M, Kottewar S, Mir H. COVID-19 Vaccine Acceptance among health care workers in the United States. *Vaccines (Basel)*. 2021; 9 (2).
3. Andre FE, Booy R, Bock HL, Clemens J, Datta SK, John TJ, Lee BW, Lolekha S, Peltola H, Ruff TA, Santosham M. Vaccination greatly reduces disease, disability, death and inequity worldwide. *Bulletin of the World health organization*. 2008;86:140-6.
4. Scheres J, Kuszewski K. The Ten Threats to Global Health in 2018 and 2019. A welcome and informative communication of WHO to everybody. *Public Health Management/Zdrowie Publiczne i Zarzadzanie*. 2019 Jan 1;17(1).
5. WHO, WHO Director-General's opening remarks at the media briefing on COVID-19 - 21 August 2020. <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—21-august-2020> last accessed on 6 march 2021. 2020
6. Williams L, Flowers P, McLeod J, Young D, Rollins L, CATALYST Project Team. Social patterning and stability of intention to accept a COVID-19 vaccine in Scotland: will those most at risk accept a vaccine?. *Vaccines*. 2021 Jan 4;9(1):17.
7. Dinga JN, Sinda LK, Titanji VP. Assessment of vaccine hesitancy to a COVID-19 vaccine in Cameroonian adults and its global implication. *Vaccines*. 2021 Feb 19;9(2):175.
8. Gori D, Reno C, Remondini D, Durazzi F, Fantini MP. Are we ready for the arrival of the new COVID-19 vaccinations? Great promises and unknown challenges still to come. *Vaccines*. 2021 Feb 18;9(2):173.
9. DeRoo SS, Pudalov NJ, Fu LY. Planning for a COVID-19 vaccination program. *Jama*. 2020 Jun 23;323(24):2458-9.
10. Feleszko W, Lewulis P, Czarnecki A, Waszkiewicz P. Flattening the curve of covid-19 vaccine rejection—An international overview. *Vaccines*. 2021 Jan 13;9(1):44.
11. Ball P. Anti-vaccine movement could undermine efforts to end coronavirus pandemic, researchers warn. *Nature*. 2020 May 1;581(7808):251-2.
12. WHO, World Health Organization. Ten Threats to Global Health in 2019.. Available online: <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019> (accessed on 31 January 2021). 2019.

13. De Figueiredo A, Simas C, Karafillakis E, Paterson P, Larson HJ. Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: a large-scale retrospective temporal modelling study. *The Lancet*. 2020 Sep 26;396(10255):898-908.
14. Wang J, Jing R, Lai X, Zhang H, Lyu Y, Knoll MD, Fang H. Acceptance of COVID-19 Vaccination during the COVID-19 Pandemic in China. *Vaccines*. 2020 Aug 27;8(3):482.
15. Gerussi V, Peghin M, Palese A, Bressan V, Visintini E, Bontempo G, Graziano E, De Martino M, Isola M, Tascini C. Vaccine hesitancy among Italian patients recovered from COVID-19 infection towards influenza and Sars-Cov-2 vaccination. *Vaccines*. 2021 Feb 18;9(2):172.
16. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews*. 2015 Dec;4(1):1-9.
17. JBI, The Joanna Briggs Institute. Critical appraisal tools for use in the JBI systematic reviews checklist for prevalence studies: The University of Adelaide. Available from: https://joannabriggs.org/sites/default/files/2019-05/JBI_Critical_Appraisal_Checklist_for_Prevalence_Studies2017_0.pdf. 2019.
18. MacDonald NE. Vaccine hesitancy: Definition, scope and determinants. *Vaccine*. 2015 Aug 14;33(34):4161-4.
19. Lane S, MacDonald NE, Marti M, Dumolard L. Vaccine hesitancy around the globe: Analysis of three years of WHO/UNICEF Joint Reporting Form data-2015–2017. *Vaccine*. 2018 Jun 18;36(26):3861-7.
20. Wong MC, Wong EL, Huang J, Cheung AW, Law K, Chong MK, Ng RW, Lai CK, Boon SS, Lau JT, Chen Z. Acceptance of the COVID-19 vaccine based on the health belief model: A population-based survey in Hong Kong. *Vaccine*. 2021 Feb 12;39(7):1148-56.
21. Wang K, Wong EL, Ho KF, Cheung AW, Yau PS, Dong D, Wong SY, Yeoh EK. Change of willingness to accept COVID-19 vaccine and reasons of vaccine hesitancy of working people at different waves of local epidemic in Hong Kong, China: Repeated cross-sectional surveys. *Vaccines*. 2021 Jan 18;9(1):62.
22. Chen M, Li Y, Chen J, Wen Z, Feng F, Zou H, Fu C, Chen L, Shu Y, Sun C. An online survey of the attitude and willingness of Chinese adults to receive COVID-19 vaccination. *Human Vaccines & Immunotherapeutics*. 2021 Jul 3;17(7):2279-88.
23. Wang J, Jing R, Lai X, Zhang H, Lyu Y, Knoll MD, Fang H. Acceptance of COVID-19 Vaccination during the COVID-19 Pandemic in China. *Vaccines*. 2020 Aug 27;8(3):482.
24. Huang Y, Su X, Xiao W, Wang H, Si M, Wang W, Gu X, Ma L, Li L, Zhang S, Yang C. COVID-19 vaccine hesitancy among different population groups in China: a national multicenter online survey. *BMC infectious diseases*. 2022 Dec;22(1):1-2.
25. Qin C, Wang R, Tao L, Liu M, Liu J. Association Between Risk Perception and Acceptance for a Booster Dose of COVID-19 Vaccine to Children Among Child Caregivers in China. *Frontiers in public health*. 2022 Mar 16;10:834572.
26. Han K, Francis MR, Zhang R, Wang Q, Xia A, Lu L, Yang B, Hou Z. Confidence, acceptance and willingness to pay for the COVID-19 vaccine among migrants in Shanghai, China: a cross-sectional study. *Vaccines*. 2021 May 2;9(5):443.
27. Tao L, Wang R, Han N, Liu J, Yuan C, Deng L, Han C, Sun F, Liu M, Liu J. Acceptance of a COVID-19 vaccine and associated factors among pregnant women in China: a multi-center cross-sectional study based on health belief model. *Human Vaccines & Immunotherapeutics*. 2021 Aug 3;17(8):2378-88.
28. Sallam M, Dababseh D, Eid H, Al-Mahzoum K, Al-Haidar A, Taim D, Yaseen A, Ababneh NA, Bakri FG, Mahafzah A. High rates of COVID-19 vaccine hesitancy and its association with conspiracy beliefs: a study in Jordan and Kuwait among other Arab countries. *Vaccines*. 2021 Jan 12;9(1):42.
29. Barry M, Temsah MH, Alhuzaimi A, Alamro N, Al-Eyadhy A, Aljamaan F, Saddik B, Alhaboob A, Alsohime F, Alhasan K, Alrabiaah A. COVID-19 vaccine confidence and hesitancy among health care workers: A cross-sectional survey from a MERS-CoV experienced nation. *PloS one*. 2021 Nov 29;16(11):e0244415.
30. Almaghaslah D, Alsayari A, Kandasamy G, Vasudevan R. COVID-19 vaccine hesitancy among young adults in Saudi Arabia: a cross-sectional web-based study. *Vaccines*. 2021 Apr 1;9(4):330.
31. Yahia AI, Alshahrani AM, Alsulmi WG, Alqarni MM, Abdulrahim TK, Heba WF, Alqarni TA, Alharthi KA, Buhran AA. Determinants of COVID-19 vaccine acceptance and hesitancy: a cross-sectional study in Saudi Arabia. *Human Vaccines & Immunotherapeutics*. 2021 Nov 2;17(11):4015-20.
32. Elharake JA, Galal B, Alqahtani SA, Kattan RF, Barry MA, Temsah MH, Malik AA, McFadden SM, Yildirim I, Khoshnood K, Omer SB. COVID-19 vaccine acceptance among health care workers in the Kingdom of Saudi Arabia. *International Journal of*

33. Alfageeh EI, Alshareef N, Angawi K, Alhazmi F, Chirwa GC. Acceptability of a COVID-19 Vaccine among the Saudi Population. *Vaccines*. 2021 Mar 5;9(3):226.
34. Malik AA, McFadden SM, Elharake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. *EClinicalMedicine*. 2020 Sep 1;26:100495.
35. Reiter PL, Pennell ML, Katz ML. Acceptability of a COVID-19 vaccine among adults in the United States: How many people would get vaccinated?. *Vaccine*. 2020 Sep 29;38(42):6500-7.
36. Khubchandani J, Sharma S, Price JH, Wiblishauser MJ, Sharma M, Webb FJ. COVID-19 vaccination hesitancy in the United States: a rapid national assessment. *Journal of community health*. 2021 Apr;46(2):270-7.
37. Freeman D, Loe BS, Chadwick A, Vaccari C, Waite F, Rosebrock L, Jenner L, Petit A, Lewandowsky S, Vanderslott S, Innocenti S. COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus explanations, attitudes, and narratives survey (Oceans) II. *Psychological medicine*. 2020 Dec 11:1-5.
38. Dickerson J, Lockyer B, Moss RH, Endacott C, Kelly B, Bridges S, Crossley KL, Bryant M, Sheldon TA, Wright J, Pickett KE. COVID-19 vaccine hesitancy in an ethnically diverse community: descriptive findings from the Born in Bradford study. *Wellcome Open Research*. 2021 Aug 16;6:23.
39. Roberts C, Brindle H, Rogers N, Eggo RM, Enria L, Lees S. Data for: "Vaccine Confidence and Hesitancy at the start of COVID-19 vaccine deployment in the UK: An embedded mixed-methods study".
40. Kose S, Mandiracioglu A, Sahin S, Kaynar T, Karbus O, Ozbel Y. Vaccine hesitancy of the COVID-19 by health care personnel. *International Journal of Clinical Practice*. 2021 May;75(5):e13917.
41. Akarsu B, Canbay Özdemir D, Ayhan Baser D, Aksoy H, Fidancı İ, Cankurtaran M. While studies on COVID-19 vaccine is ongoing, the public's thoughts and attitudes to the future COVID-19 vaccine. *International journal of clinical practice*. 2021 Apr;75(4):e13891.
42. İkiışık H, Akif Sezerol M, Taşçı Y, Maral I. COVID-19 vaccine hesitancy: A community-based research in Turkey. *International Journal of Clinical Practice*. 2021 Aug;75(8):e14336.
43. Ayhan SG, Oluklu D, Atalay A, Beser DM, Tanacan A, Tekin OM, Sahin D. COVID-19 Vaccine Acceptance in Pregnant Women. *Obstetric Anesthesia Digest*. 2022 Jun 1;42(2):74-6.
44. Wong LP, Alias H, Wong PF, Lee HY, AbuBakar S. The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay. *Human vaccines & immunotherapeutics*. 2020 Sep 1;16(9):2204-14.
45. Syed Alwi SA, Rafidah E, Zurraini A, Juslina O, Brohi IB, Lukas S. A survey on COVID-19 vaccine acceptance and concern among Malaysians. *BMC Public Health*. 2021 Dec;21(1):1-2.
46. Mohamed NA, Solehan HM, Mohd Rani MD, Ithnin M, Che Isahak CI. Knowledge, acceptance and perception on COVID-19 vaccine among Malaysians: A web-based survey. *Plos one*. 2021 Aug 13;16(8):e0256110.
47. Alibrahim J, Awad A. COVID-19 vaccine hesitancy among the public in Kuwait: a cross-sectional survey. *International Journal of Environmental Research and Public Health*. 2021 Aug 22;18(16):8836.
48. Alabdulla, Reagu, and E.M. Al-Khal A, Jones RM. , COVID-19 vaccine hesitancy and attitudes in Qatar: A national cross-sectional survey of a migrant-majority population. *Influenza Other Respi Viruses*. 2021;00:1–10. <https://doi.org/10.1111/irv.12847>. 2021
49. Al-Mulla R, Abu-Madi M, Talafha QM, Tayyem RF, Abdallah AM. COVID-19 vaccine hesitancy in a representative education sector population in Qatar. *Vaccines*. 2021 Jun 18;9(6):665.
50. Gallè F, Sabella EA, Roma P, De Giglio O, Caggiano G, Tafuri S, Da Molin G, Ferracuti S, Montagna MT, Liguori G, Orsi GB. Knowledge and acceptance of COVID-19 vaccination among undergraduate students from central and southern Italy. *Vaccines*. 2021 Jun;9(6):638.
51. El-Elimat T, AbuAlSamen MM, Almomani BA, Al-Sawalha NA, Alali FQ. Acceptance and attitudes toward COVID-19 vaccines: A cross-sectional study from Jordan. *Plos one*. 2021 Apr 23;16(4):e0250555.
52. Hossain MB, Alam MZ, Islam MS, Sultan S, Faysal MM, Rima S, Hossain MA, Mamun AA. COVID-19 vaccine hesitancy among the adult population in Bangladesh: A nationwide cross-sectional survey. *PloS one*. 2021 Dec 9;16(12):e0260821.
53. Paul A, Sikdar D, Mahanta J, Ghosh S, Javed MA, Paul S, Yeasmin F, Sikdar S, Chowdhury B, Nath TK. Peoples' understanding, acceptance, and perceived challenges of vaccination against COVID-19: A cross-sectional study in Bangladesh. *PloS one*. 2021

54. Berihun G, Walle Z, Berhanu L, Teshome D. Acceptance of COVID-19 vaccine and determinant factors among patients with chronic disease visiting Dessie Comprehensive Specialized Hospital, Northeastern Ethiopia. Patient preference and adherence. 2021;15:1795.
55. Boche B, Kebede O, Damessa M, Gudeta T, Wakjira D. Health Professionals' COVID-19 Vaccine Acceptance and Associated Factors in Tertiary Hospitals of South-West Ethiopia: A Multi-Center Cross-Sectional Study. INQUIRY: The Journal of Health Care Organization, Provision, and Financing. 2022 Mar 3;59:00469580221083181.
56. Huang CY, Lin CC, Hsieh CY, Lin CY, Chen TT, Wu PC, Liu DH, Tou SI, Yen HR. The Willingness of Elderly Taiwanese Individuals to Accept COVID-19 Vaccines after the First Local Outbreak. Vaccines. 2022 Mar 27;10(4):520.
57. Tsai FJ, Yang HW, Lin CP, Liu JZ. Acceptability of COVID-19 vaccines and protective behavior among adults in Taiwan: associations between risk perception and willingness to vaccinate against COVID-19. International journal of environmental research and public health. 2021 May 23;18(11):5579.
58. Nohl A, Afflerbach C, Lurz C, Brune B, Ohmann T, Weichert V, Zeiger S, Dudda M. Acceptance of COVID-19 vaccination among front-line health care workers: a nationwide survey of emergency medical services personnel from Germany. Vaccines. 2021 Apr 23;9(5):424.
59. Holzmann-Littig C, Braunisch MC, Kranke P, Popp M, Seeber C, Fichtner F, Littig B, Carbajo-Lozoya J, Allwang C, Frank T, Meerpohl JJ. COVID-19 vaccination acceptance and hesitancy among healthcare workers in Germany. Vaccines. 2021 Jul 12;9(7):777.
60. Ditekemena JD, Nkamba DM, Mutwadi A, Mavoko HM, Siewe Fodjo JN, Luhata C, Obimpeh M, Van Hees S, Nachega JB, Colebunders R. COVID-19 vaccine acceptance in the Democratic Republic of Congo: a cross-sectional survey. Vaccines. 2021 Feb 14;9(2):153.
61. Yoda and Katsuyama, Willingness to Receive COVID-19 Vaccination in Japan. Vaccines. 2021 Jan;9(1):48. <https://doi.org/10.3390/vaccines9010048>. 2021
62. Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrahi M, Zigran A, Srouji S, Sela E. Vaccine hesitancy: the next challenge in the fight against COVID-19. European journal of epidemiology. 2020 Aug;35(8):775-9.
63. Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, Kimball S, El-Mohandes A. A global survey of potential acceptance of a COVID-19 vaccine. Nature medicine. 2021 Feb;27(2):225-8.
64. Grech V, Bonnici J, Zammit D. WITHDRAWN: Vaccine hesitancy in Maltese family physicians and their trainees vis-à-vis influenza and novel COVID-19 vaccination.
65. Harapan H, Wagner AL, Yufika A, Winardi W, Anwar S, Gan AK, Setiawan AM, Rajamoorthy Y, Sofyan H, Mudatsir M. Acceptance of a COVID-19 vaccine in Southeast Asia: a cross-sectional study in Indonesia. Frontiers in public health. 2020 Jul 14;8:381.
66. Bell S, Clarke R, Mounier-Jack S, Walker JL, Paterson P. Parents' and guardians' views on the acceptability of a future COVID-19 vaccine: A multi-methods study in England. Vaccine. 2020 Nov 17;38(49):7789-98.
67. Achangwa C, Lee TJ, Lee MS. Acceptance of the COVID-19 vaccine by foreigners in South Korea. International Journal of Environmental Research and Public Health. 2021 Nov 16;18(22):12035.
68. Nakhostin-Ansari A, Zimet GD, Khonji MS, Aghajani F, Teymourzadeh A, Rastegar Kazerooni AA, Pirayandeh P, Aghajani R, Safari S, Khalaj K, Memari AH. Acceptance or Rejection of the COVID-19 Vaccine: A Study on Iranian People's Opinions toward the COVID-19 Vaccine. Vaccines. 2022 Apr 23;10(5):670.
69. Mustapha M, Lawal BK, Sha'aban A, Jatau AI, Wada AS, Bala AA, Mustapha S, Haruna A, Musa A, Ahmad MH, Iliyasu S. Factors associated with acceptance of COVID-19 vaccine among University health sciences students in Northwest Nigeria. PloS one. 2021 Nov 29;16(11):e0260672.
70. Khiari H, Cherif I, M'ghirbi F, Mezlini A, Hsairi M. COVID-19 vaccination acceptance and its associated factors among cancer patients in Tunisia. Asian Pacific Journal of Cancer Prevention: APJCP. 2021 Nov;22(11):3499.
71. Antwi-Berko D, Bakuri AZ, Otobil KB, Kwarteng A. Determinants and Variations of COVID-19 Vaccine Uptake and Responses Among Minority Ethnic Groups in Amsterdam, the Netherlands. Frontiers in Public Health. 2022 Feb 17;10:761987.
72. Sirikalyanpaiboon M, Ousirimanechai K, Phannajit J, Pitisuttithum P, Jantarabenjakul W, Chaiteerakij R, Paitoonpong L. COVID-19 vaccine acceptance, hesitancy, and determinants among physicians in a university-based teaching hospital in Thailand.

BMC infectious diseases. 2021 Dec;21(1):1-2.

73. Nguyen LH, Hoang MT, Nguyen LD, Ninh LT, Nguyen HT, Nguyen AD, Vu LG, Vu GT, Doan LP, Latkin CA, Tran BX. Acceptance and willingness to pay for COVID-19 vaccines among pregnant women in Vietnam. *Tropical Medicine & International Health*. 2021 Oct;26(10):1303-13.
74. Saddik B, Al-Blawi N, Shukla A, Barqawi H, Alsayed HA, Sharif-Askari NS, Temsah MH, Bendardaf R, Hamid Q, Halwani R. Determinants of healthcare workers perceptions, acceptance and choice of COVID-19 vaccines: A cross-sectional study from the United Arab Emirates. *Human vaccines & immunotherapeutics*. 2022 Jan 31;18(1):1-9.
75. Tlale LB, Gabaitiri L, Totolo LK, Smith G, Puswane-Katse O, Ramonna E, Mothowaeng B, Tlhakanelo J, Masupe T, Rankgoane-Pono G, Irige J. Acceptance rate and risk perception towards the COVID-19 vaccine in Botswana. *PloS one*. 2022 Feb 4;17(2):e0263375.
76. Raja SM, Osman ME, Musa AO, Hussien AA, Yusuf K. COVID-19 vaccine acceptance, hesitancy, and associated factors among medical students in Sudan. *Plos one*. 2022 Apr 7;17(4):e0266670.
77. Riad A, Jouzová A, Üstün B, Lagová E, Hruban L, Janků P, Pokorná A, Klugarová J, Koščík M, Klugar M. COVID-19 vaccine acceptance of pregnant and lactating women (PLW) in Czechia: an analytical cross-sectional study. *International Journal of Environmental Research and Public Health*. 2021 Dec 19;18(24):13373.
78. Bongomin F, Olum R, Andia-Biraro I, Nakwagala FN, Hassan KH, Nassozi DR, Kaddumukasa M, Byakika-Kibwika P, Kiguli S, Kirenga BJ. COVID-19 vaccine acceptance among high-risk populations in Uganda. *Therapeutic Advances in Infectious Disease*. 2021 Jun;8:20499361211024376.
79. Vallée A, Fourn E, Majerholc C, Touche P, Zucman D. COVID-19 vaccine hesitancy among French people living with HIV. *Vaccines*. 2021 Mar 24;9(4):302.
80. Saied SM, Saied EM, Kabbash IA, Abdo SA. Vaccine hesitancy: Beliefs and barriers associated with COVID-19 vaccination among Egyptian medical students. *Journal of medical virology*. 2021 Jul;93(7):4280-91.
81. Sallam M, Dababseh D, Eid H, Hasan H, Taim D, Al-Mahzoum K, Al-Haidar A, Yaseen A, Ababneh NA, Assaf A, Bakri FG. Low COVID-19 vaccine acceptance is correlated with conspiracy beliefs among university students in Jordan. *International journal of environmental research and public health*. 2021 Mar 1;18(5):2407.
82. Sallam M. COVID-19 vaccine hesitancy worldwide: A concise systematic review of vaccine acceptance rates. *Vaccines*. 2021; 9: 160. Publisher Full Text. 2021.
83. Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, Kimball S, El-Mohandes A. A global survey of potential acceptance of a COVID-19 vaccine. *Nature medicine*. 2021 Feb;27(2):225-8.
84. Lin C, Tu P, Beitsch LM. Confidence and receptivity for COVID-19 vaccines: A rapid systematic review. *Vaccines*. 2021; 9: 16.

Figures

Figure 1

The continuum of vaccine hesitancy and acceptance of all vaccines (Source: [18]).

Figure 2

Study selection process of included articles for systematic review and Meta-analysis, 2021.

Figure 3

Countries of the world where the included articles were conducted.

Figure 4

Forest plot shows the overall pooled COVID-19 vaccine acceptance rate, 2022.

Keys: ArR: African Region; AmR: American Region; EMR: Eastern Mediterranean Region;

SEAR: South East Asian Region; WPR: Western Pacific Region; EuR: European Region.

Figure 5

Forest plot shows the subgroup analysis of the pooled COVID-19 vaccine acceptance rate based on World Health Organization classification of the region 2022.

Figure 6

Forest plot shows the subgroup analysis of the pooled COVID-19 vaccine acceptance rate based on the country where the studies were conducted, 2022.

Figure 7

Forest plot shows the subgroup analysis of the pooled COVID-19 vaccine acceptance rate based on the study participants, 2022

Figure 8

Shows the prevalence of COVID 19 vaccine acceptance abased in the survey period, 2022

Figure 9

COVID-19: Vaccine acceptance rate among the included countries, 2022

Figure 10

COVID-19 vaccine acceptance rate based on World Health Organization region of the world, 2022.

Figure 11

COVID-19 vaccine acceptance rate based on the survey period, 2022.

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