



Evaluation of the Acceptance Rate of Covid-19 Vaccine and its Associated Factors: A Systematic Review and Meta-analysis

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Abstract

Covid-19 has caused various problems in the world in terms of health, economy, social and political therefore, the purpose of the present systematic review and meta-analysis is to determine the acceptance rate of Covid-19 vaccine and its related factors. To find related studies, PubMed, Embase, Scopus, Web of Science (WoS) and Google Scholar databases with no time limit until May 2021 using the keywords Related to the purpose of the research and all possible combinations were explored. I^2 test was used to calculate the heterogeneity of studies and Begg and Mazumdar rank correlation test was used to investigate publication bias. Finally, 98 articles related to inclusion criteria with a sample size of 660,604 people were included in the study. Overall estimate of the worldwide acceptance of Covid-19 vaccine; 63.9% (95% CI: 59.1–68.4) was obtained, with the highest percentage of acceptance reported in the Australian continent, 76.4% (95% CI: 72.6–79.8). In the majority of studies, vaccine acceptance was significantly more reported in the elderly and the young people, medical staff, employees, higher education level and socioeconomic status, with trust in vaccine and positive vaccination history. The results of this systematic review and meta-analysis demonstrate that the acceptance rate of Covid-19 vaccine is higher among young people and the elderly, medical staff, employees, higher education level and socioeconomic status, with trust in vaccine and positive vaccination history, which can be considered by experts and policymakers in this field.

Keywords Vaccine · Covid-19 · Systematic review · Meta-analysis

Abbreviations

WoS Web of science

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MeSH Medical subject headings; Joanna Briggs Institute
PRISMA Preferred reporting items for systematic reviews and meta-analysis

Introduction

Corona virus is an RNA virus belonging to the family Coronaviridae and the order of Nidovirales and is widely found in humans and other mammals. Although most coronavirus infections in humans are mild, epidemics of beta-coronavirus, Severe Acute Respiratory Syndrome corona virus (SARS-CoV) and Middle East Respiratory Syndrome corona virus (MERS-CoV) have caused more than 10,000 cases in the past 20 years, with 10% mortality rate for SARS-CoV and 37% for MERS-CoV. Previously detected coronaviruses may be just the tip of the iceberg, appearing in new and more severe human and animal potential events (Huang et al., 2020).

The COVID-19 pandemic has caused severe disease worldwide (Pastorino et al., 2021). According to the WHO, so far the number of patients are 467,256,593 and the number of deaths due to Covid-19 has been reported more than 6 million worldwide (Bhagavathula et al., 2022). Covid-19 mortality rates are higher in the elderly, obese people, people with comorbidities (diabetes, hypertension, cardiovascular disease, cancer), patients with mental disorders, and patients admitted to the ICU (Hussain et al., 2020; Noor & Islam, 2020; Toubasi et al., 2021).

It has been reported that most infected people recover on their own within 7–10 days. Whereas other patients develop fatal complications such as multiple organ failure, septic shock, severe pneumonia, pulmonary edema, and acute respiratory distress syndrome (ARDS). The elder people with underlying diseases are at higher risk of severe illness and death (Yang et al., 2020).

Since, immunization is one of the most successful and cost-effective health interventions to prevent infectious diseases, receiving the COVID-19 vaccine is very important for its prevention and control (Shacham et al., 2021). Countries across the world are working to accelerate the research and production of the COVID-19 vaccine, and it has been reported that more than 160 candidate vaccines have been available so far (Kaplan & Milstein, 2021).

Although great progress has been made, there are still major challenges to immunization against COVID-19, one of which is the uncertainty about the general acceptance of COVID-19 vaccination (Gagneux-Brunon et al., 2021). According to the WHO definition, hesitation in vaccination is considered as delayed acceptance or refusal of vaccination despite the availability of effective and safe vaccine. Thus, the high rate of vaccine acceptance reflects a general understanding of the risk of disease and a greater demand for vaccination among the general population, which is essential for the success of vaccination programs (Chu & Liu, 2021; MacDonald, 2015). In this case, knowledge of the vaccine acceptance rate, the factors affecting the acceptance of COVID-19 vaccination, and identifying common barriers and facilitators for decision-making in this area are important aspects in designing effective strategies to improve vaccine coverage among the population. Several preliminary studies have been conducted in different parts of the world regarding the acceptance rate of Covid-19 vaccine and its associated factors, but no comprehensive study has been found to evaluate and summarize their

results; therefore, the purpose of the present systematic review and meta-analysis is to determine the acceptance rate of Covid-19 vaccine and its related factors.

Methods

The present study is based on the PRISMA 2020 protocol (<http://www.prisma-statement.org/>) with steps including: Identification, screening, eligibility and inclusion for systematic review and meta-analysis studies (Page et al., 2021). To avoid bias, all stages of article search, study selection, qualitative evaluation and data extraction were performed independently by two researchers (F.R and M.K). Disagreements between reviewers were resolved by the decision of a third independent reviewer.

Identification of the Articles

In order to find related studies, PubMed, Embase, Scopus, Web of Science (ISI) databases with no time limit until May 2021 using the keywords "hesit *", "accept*", "behavior*", "percep*", "attitude", "confidence *", "respons*", "benefit*", "facilat*", "barrier*", "knowledge", "adher*", "undrestand*", "compliance", "resistance", "trust", "fear", "worr*", "misinformation", "misunderstand", "obstacle*", "reject", "admiss*", "volunt*", "covid-19", "2019-ncov", "SARS-CoV2", "2019-nCoV", "Coronavirus" and their corresponding MeSH/Emtree terms were searched using AND and OR operators. The Google Scholar scientific search engine as well as the sources of the final articles were manually studied for final review. As some studies evaluated the vaccine hesitancy instead of vaccine acceptance rate, we included the hesitancy, fear, worry, and other synonym keywords to make this systematic review as comprehensive as possible. Then we calculated the acceptance rate minus the vaccine hesitancy rate of 100%. The search strategy in the selected databases is shown in Table 1.

Inclusion Criteria

Inclusion criteria include: (1) studies that evaluate the acceptance rate of Covid-19 vaccine or related factors, (2) observational studies (descriptive, analytical, descriptive-analytical, etc.), (3) original research studies.

Exclusion Criteria

Exclusion criteria include: (1) studies unrelated to the purpose of the research, (2) systematic review and meta-analysis studies, case reports, dissertations, letters to the editors and conference papers, (3) preprint studies.

Table 1 (continued)

Database	Search type	Search strategy	Date	Number
ISI	Advance search	<p>#1 TITLE: (accept*) OR TITLE: (behavior*) OR TITLE: (hesit*) OR TITLE: (percep*) OR TITLE: (attitude) OR TITLE: (confidence) OR TITLE: (respons*) OR TITLE: (benefit*) OR TITLE: (facilat*) OR TITLE: (barrier*) OR TITLE: (knowledge) OR TITLE: (adher*) OR TITLE: (undrestand*) OR TITLE: (compliance) OR TITLE: (resistance) OR TITLE: (trust) OR TITLE: (fear) OR TITLE: (wor*) OR TITLE: (misinformation) OR TITLE: (misunderstand) OR TITLE: (obstacle*) OR TITLE: (reject) OR TITLE: (admiss*) OR TITLE: (volunt*)</p> <p>#2 TOPIC: (covid-19) OR TOPIC: (covid19) OR TOPIC: ('2019 novel coronavirus infection') OR TOPIC: ('coronavirus disease 2019') OR TOPIC: ('coronavirus covid-19') OR TOPIC: (2019-ncov) OR TOPIC: (SARS-CoV2) OR TOPIC: (SARS-CoV-2) OR TOPIC: (SARS Coronavirus 2) OR TOPIC: (Coronavirus 2) OR TOPIC: (2019-nCoV) OR TOPIC: ('novel coronavirus 2019')</p> <p>#3 TOPIC: (immunization) OR TOPIC: (vaccin*)</p> <p>#4 #3 AND #2 AND #1</p>	17 May 2021	731

Table 1 (continued)

Database	Search type	Search strategy	Date	Number
Embase	Advance search	('intent*' OR 'accept*' OR 'behavior'/exp OR 'behavior' OR 'behavior' OR 'behavior and behavior mechanisms' OR 'behavior development' OR 'behavior facilitation' OR 'behavior pattern' OR 'behavior variable' OR 'behavioral activity' OR 'behavioral characteristic' OR 'behavioral response' OR 'behavioral specificity' OR 'behavioral symptoms' OR 'behavioral variable' OR 'behavior' OR 'behaviour and behavior mechanisms' OR 'behaviour development' OR 'behaviour facilitation' OR 'behaviour pattern' OR 'behaviour variable' OR 'behavioural activity' OR 'behavioural characteristic' OR 'behavioural response' OR 'behavioural specificity' OR 'behavioural symptoms' OR 'behavioural variable' OR 'human behavior' OR 'human behaviour' OR 'intention' OR 'manual behavior' OR 'manual behaviour' OR 'marking behavior' OR 'marking behaviour' OR 'multitasking behavior' OR 'power (psychology)' OR 'power; psychological' OR 'psychological and psychiatric phenomena' OR 'psychological and psychosocial phenomena' OR 'refractory behavior' OR 'refractory behaviour' OR 'schedule controlled behavior' OR 'schedule controlled behaviour' OR 'hesit*' OR 'percep*' OR 'attitude' OR 'behavior, permissive' OR 'behaviour, permissive' OR 'faculty attitude' OR 'knowledge, attitudes, practice' OR 'permissive behavior' OR 'permissive behaviour' OR 'permissiveness' OR 'rejection (psychology)' OR 'rejection, psychology' OR 'confidence'/exp OR 'inflammation'/exp OR 'respons*' OR 'benefit finding/ exp OR 'facilitat*' OR 'barrier'/exp OR 'knowledge'/exp OR 'patient compliance'/exp OR 'undre- stand*' OR 'compliance (physical)'/exp OR 'resistance'/exp OR 'trust'/exp OR 'fear'/exp OR 'patient worry'/exp OR 'misinformation'/exp OR 'misunderstand*' OR 'obstacles'/exp OR 'attitude'/exp OR 'hospital admission'/exp OR 'volunteer'/exp) AND ('vaccination'/exp OR 'immunization'/exp) AND 'coronavirus disease 2019'/exp	18 May 2021	324

Selection Process of Studies

After exploring in various databases with the search strategy assigned to each database, the data for the found articles was transferred to EndNote software (Version X8). In the next step, the duplicate articles in different databases were deleted.

Because some studies measured vaccine acceptance and some studies measured individuals' attitudes toward vaccines, they were all included in the study. However, some of the questions raised reflected people's beliefs about the vaccine, not their intention or actual behavior.

Subsequently, to avoid bias in selecting studies, the names of the authors and the titles of the articles were removed and a checklist was prepared based on the titles and abstracts of the studies. In the next step, two authors (F.R and M.K) independently screened the title and abstract of the studies and eliminated studies that were not related to the research based on the inclusion and exclusion criteria. Then, the full texts of all remaining articles were investigated. Studies that did not meet the inclusion criteria were excluded. All articles included to the systematic review and meta-analysis process were entered the quality assessment stage.

Methodological Quality Assessment

The quality assessment was performed by two reviewers (F.R) and (M.K) using the Joanna Briggs Institute (JBI) critical appraisal checklist and guidance reports developed for prevalence reviews. The checklist consists of 9 different questions concerning the sample frame, participants, sample size, study subjects and setting described in detail, data analysis, valid methods for identifying conditions, measuring the situation, statistical analysis, and adequate response rate. A study was considered to be of high quality with scores more than 70% of total, moderate quality if scores between 50 and 70% and low quality when scoring below 50% (Dijkshoorn et al., 2021).

Data Extraction

After selecting the studies and evaluating the quality, data was extracted and the studies were summarized using a prepared checklist. Checklist information included: article title, first author name, year, sample size, research location, age, study population, and acceptance rate.

Statistical Analysis

To analyze and combine the results of different studies, the percentage of vaccine acceptance was considered as the probability of Binomial distribution in each study and its variance was calculated through Binomial distribution. Heterogeneity of studies was assessed using I^2 test. Random effect model was used in case of I^2 index above 50%. In this model, difference of parameters between studies are also

considered in the calculations, so it can be said that the results of this model in heterogeneous conditions can be more generalized than the model with a fixed effect. Begg and Mazumdar rank correlation tests were used to evaluate the publication bias. The power of this test is low. However, Begg and Mazumdar (1994) indicate that the test is ‘fairly powerful when the number of the included studies are 75. As our study included 98 studies, this test could assess the publication bias properly. Data was analyzed using Comprehensive Meta-Analysis (Version 2) software and the significance level of the test was set to 0.05.

Results

In the first stage, 3561 articles were found and 524 duplicate studies were omitted. A number of 3037 studies entered the screening stage and 2902 articles were removed according to the inclusion and exclusion criteria of the research through evaluation of the title and abstract of the study. In the next stage (evaluation of eligibility), out of 135 studies remaining from the screening stage, 37 articles were removed by reviewing the full text due to irrelevant subject and lack of access to the full text. The quality evaluation of 98 included studies was performed using the JBI checklist, all of which were of medium and high quality according to the criteria of this tool. Therefore, these 98 related articles entered to systematic review. From all 98 articles included, 82 articles reported vaccine acceptance rate and were included in the

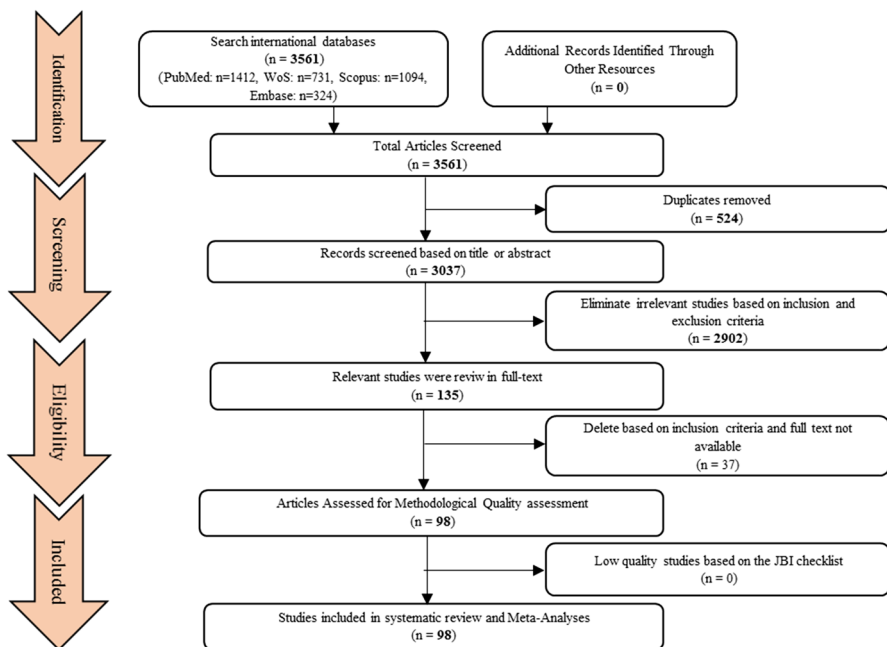


Fig. 1 Preferred reporting items for systematic reviews and meta-analyses (PRISMA 2009) flow diagram

meta-analysis. One of the articles reported the acceptance rate in both students and other population. Therefore, they were considered separately (Fig. 1).

General characteristics of the studies: The total sample size of the studies was 660,604. The studies were published between 2020 and 2021. The lowest sample size was for the study of Salmon et al. (2021) with 100 subjects and the highest sample size was for the study of Urrunaga-Pastor et al. (2021) with 472,521 subjects. Most studies in the USA were conducted with 18 articles, as well as most studies on the general population with 50 articles. The methodological quality assessment of studies are given in Table 2.

The Percentage of Covid-19 Acceptance

Totally, 82 articles with a sample size of 625,820 people reported the acceptance rate of Covid-19 vaccine in different parts of the world. The result of I^2 test for the acceptance rate shows a significant heterogeneity among studies ($I^2=99.81$), thus, the data were analyzed by meta-analysis method using a random effects model. Due to this high heterogeneity, sensitivity analysis was performed and the effect of each study on the final result and the degree of heterogeneity was evaluated. It was revealed that publication bias existed in the studies based on Begg and Mazumdar rank correlation tests. The Kendall's tau without continuity and Kendall's tau with continuity corrections were 0.259 and 0.258, respectively ($p < 0.05$) (Fig. 2).

As a result of combining the studies, the pooled estimate of the acceptance rate of Covid-19 vaccine was 63.9% (95% CI: 59.1–68.4) based on the random effects model (Fig. 3). The largest sample size was for the study of Urrunaga-Pastor et al. (2021) with 472,521 people that reported a vaccine acceptance rate of 80%.

Due to the different population structure, culture, prevalence and mortality due to Covid-19, type of vaccine used, stress and anxiety, education level, etc. in different countries and geographical areas, we observed high heterogeneity among studies ($I^2 > 99\%$). Therefore, we decided to perform subgroup analysis by different continents to find the source of heterogeneity (Asia, Europe, Africa, Australia and America). The highest percentage was related to the continent of Australia with 76.4% (95% confidence interval: 79.8–72.6%) (Table 3).

Factors Associated with Covid-19 Vaccine Acceptance

Some factors were associated to the Covid-19 acceptance rate as follow: Sex: A total of 51 articles examined gender as a factor related to the acceptance of the Covid-19 vaccine. In 18 studies (Alabdulla et al., 2021; Dinga et al., 2021; Grech & Gauci, 2020; Green et al., 2021; Harapan et al., 2020; Head et al., 2020; Khubchandani et al., 2021; Latkin et al., 2021c; Murphy et al., 2021; Petravić et al., 2021; Prati, 2020; Rabi et al., 2021; Robertson et al., 2021; Seale et al., 2021; Sun et al., 2021; Urrunaga-Pastor et al., 2021; Wang, Lu, et al., 2021; Zigron et al., 2021), vaccine acceptance was reported more in women than men. But in 21 studies (Akarsu et al., 2021; Allen et al., 2021; Chen et al., 2021; Grech & Gauci, 2020; Grech, Gauci, et al., 2020; Grüner & Krüger, 2020; Hursh et al., 2020; Kose et al., 2021; Malik

Table 2 Characteristic of studies included in the systematic review and meta-analyses

Author, Year, [Reference]	Country	Age (Mean \pm SD)	Sample size (n)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Pastorin, 2021 (Pastorino et al., 2021)	Italy	23.0 (22–25)	436	307 / 129	77.52	University Students	The results showed that vaccine acceptance in men compared to women, age range 22–25, medical school students, Rome, Understand preventive measures, Concern about the COVID-19 pandemic, Fear about the increase in deaths, Fear about the increase in positive cases, Suffering from the impossibility of attending university, previously vaccinated were significantly higher. ($p < 0.05$)	Moderate
Shacham, 2021 (Shacham et al., 2021)	Israel	39.04 \pm 15.59	501	395 / 106	–	Healthcare workers	The results showed that a positive attitude towards the vaccine, increased health awareness, distrust of the benefits of the vaccine, concern about unforeseen side effects in the future, significantly affect the acceptance of the Covid-19 vaccine ($p < 0.05$). But lack of confidence in the benefits of the vaccine had no significant effect ($p > 0.05$)	Moderate
Kaplan, 2021 (Kaplan & Milstein, 2021)	USA	> 18	1000	487 / 513	–	General population	The possibility of side effects and the possibility of vaccine efficacy were reported as factors related to the acceptance of Covid-19 vaccine	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Gagneux-Brunon, 2021, (Gagneux-Brunon et al., 2021)	France	>30	2047	1514 Female / 533 Male	76.9	Healthcare workers	The results showed that vaccine acceptance was significantly higher among males, the elderly, physiotherapists, influenza vaccine injection in the previous season, fear of coronary artery and negative history of vaccination ($p < 0.05$). But it was not significant in chronic patients ($p > 0.05$)	High
Chu, 2021 (Chu & Liu, 2021)	USA	46.01 ± 17.7	934	468 Female / 466 Male	–	General population	Fear of Covid-19, attitudes and beliefs towards the vaccine, positive vaccination history, were reported as factors associated with Covid-19 vaccination	High
Turcu-Stiolica, 2021 (Turcu-Stiolica et al., 2021)	Bulgaria and Romania	Bulgaria = 30 and Romania = 26	395	344 Female / 51 Male	50.0	Pharmacists	The results illustrated that in the elderly, males, people with high income and higher quality of life, the acceptance of Covid-19 vaccine was significantly higher ($p < 0.05$)	Moderate
Grüner, 2020, (Grüner & Krüger, 2020)	Germany	>18	2053	– Female / – Male	–	Healthcare Professionals, Healthcare students and Non-healthcare students	Confidence in the effectiveness of the vaccine is an important factor in accepting the Covid-19 vaccine	Moderate
Prati, 2020 (Prati, 2020)	Italy	32.31 ± 12.69	624	239 Female / 385 Male	75.8	General population	The results showed that more acceptance of Covid-19 vaccine was reported significantly more in the elderly, females, belief in the abnormal origin of the vaccine, lack of employment, good economic status. ($p < 0.05$)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Rhodes, 2021 (Rhodes et al., 2021)	Australia	–	2018	– / –	82.8	General population	The results showed that in males, higher economic status, age over 60 years, higher level of education and people with previous Covid-19 more vaccination were reported	High
Pogue, 2020 (Pogue et al., 2020)	USA	> 18	319	160 / 159	68	General population	Vaccine efficacy, opinion about Covid-19, place of vaccine production, type of vaccine, personal relationships with patients with Covid-19, knowledge of Covid-19 were the most important factors related to vaccine acceptance	High
Sun, 2020, (Sun et al., 2021)	China	20.35 ± 1.97	1912	578 / 1334	64.01	Young adults	Young age, low socioeconomic status, female gender, perception of the possibility of COVID-19 infection during the epidemic were factors that facilitated vaccination ($p < 0.05$). In addition, distrust of public health had a significant interaction with vaccine acceptance ($p < 0.05$)	High
Olagoke, 2021 (Olagoke et al., 2021)	USA	32.44 ± 11.94	501	277 / 224	79.3	General population	Religious belief was directly related to the acceptance of Covid-19 vaccine ($p < 0.05$)	Moderate
Woko, 2020, (Woko et al., 2020)	USA	47.6 ± 18	1074	633 / 441	–	Black Americans	Black people were less likely to accept the Covid-19 vaccine than the white people ($p < 0.05$)	High

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Mo, 2021 (Mo et al., 2021)	China	19.4 ± 1.51	6922	4402 / 2520	78.9	Healthcare students	Understanding the effect of the vaccine, social media, vaccine efficacy, and its availability without charge were reported as factors associated with the acceptance of the Covid-19 vaccine	Moderate
Okorodudu, 2021 (Okorodudu & Okorodudu, 2021)	USA	> 18	1056	– / –	20.0	Black patients	Public distrust of blacks was reported as the most important reason for not receiving the Covid-19 vaccine	Moderate
Szmyd-1, 2021, (Szmyd, Bartoszek, et al., 2021)	Poland	21 (20–24)	687	445 / 242	91.99	Medical Students	Concerns about vaccine side effects were reported as the most important factor in not accepting Covid-19 vaccine (<i>p</i> < 0.001)	High
Szmyd-2, 2021, (Szmyd, Bartoszek, et al., 2021)	Poland	20 (19–22)	1284	556 / 728	59.42	Non-medical students	Concerns about vaccine side effects were reported as the most important factor in not accepting Covid-19 vaccine (<i>p</i> < 0.001)	Moderate
Head, 2020, (Head et al., 2020)	USA	46.9 ± 16.8	3159	1657 / 1497	–	General population	Vaccine acceptance was significantly lower among the less educated and health care workers (<i>p</i> < 0.05). But it was more reported in females and the young people (<i>p</i> < 0.05)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Palamenghi, 2020, (Palamenghi et al., 2020)	Italy	> 18	968	– / –	59.0	General population	Lack of trust in scientific research, negative attitude towards vaccine positive effect, middle-aged (18–34 years) and the elderly over 60 years were reported as the most important factors for not accepting the Covid-19 vaccine ($p < 0.001$). But there was no significant difference between men and women and smokers and non-smokers ($p > 0.05$)	Moderate
Pierantoni, 2021, (Pierantoni et al., 2020)	Italy	> 18	1812	– / –	91.1	Parents of students	–	Moderate
Sallam, 2021, (Sallam et al., 2021a)	Jordan and Kuwait among other Arab Countries	31.4 ± 13.4	3414	2299 / 1115	29.4	General population	Vaccine acceptance was reported among males, people with higher education and chronic patients ($p < 0.001$). But there was no significant relationship between age and history of Covid-19 ($p > 0.05$)	Moderate
Mouchtouri, 2020, (Mouchtouri et al., 2020)	Greece	49.2 ± 17.4	1837	1081 / 756	81.1	General population	Vaccination was less reported among males, low-income and certain occupations (freelancers, unemployed, housewives, retirees)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Sallam, 2021, (Sallam et al., 2021b)	Jordan	20.8 ± 2.7	1106	802 / 304	34.9	University Students	Vaccine acceptance was significantly higher among men, dependent on social networks, over 21 years of age, public university, non-Jordanian (P < 0.001). But there was no significant relationship between undergraduate students and higher, vaccination history, chronic diseases and previous Covid-19 infection (<i>p</i> > 0.05)	Moderate
Campochario, 2021, (Campochario et al., 2021)	Italy	> 18	202	106 / 96	82.0	Rheumatological patients	Old age, comorbidities, and chronic glucocorticoid therapy (10 mg daily) were reported as negative factors for vaccine administration (<i>p</i> < 0.05)	High
Padureanu, 2021 (Padureanu et al., 2020)	Romania	35.34 ± 10.75	529	167 / 362	69.0	Healthcare workers	Vaccine acceptance was higher among physicians than other health care workers (<i>p</i> < 0.05). Fear of infection and complications from the vaccine had a significant relationship with vaccine acceptance (<i>p</i> < 0.05). But there was no significant relationship between gender and age with vaccine acceptance (<i>p</i> > 0.05)	High
Nehme, 2020 (Nehme et al., 2020)	Switzerland	52 ± 15.1	1425	740 / 685	55.0	General population	–	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Ruiz, 2021, (Ruiz & Bell, 2021)	USA	> 18	804	431 Female / 373 Male	–	General population	Vaccine acceptance was more reported in males, the elderly, having vaccine knowledge, influenza vaccine injection ($p < 0.05$). But people believing in vaccine conspiracy theories were less reported ($p < 0.05$). There was no significant relationship between race, cultural identity, education and preferred media for virus news ($p > 0.05$)	High
Bell, 2020, (Bell et al., 2020)	UK	32.95 ± 4.56	1252	1190 Female / 62 Male	90.1	Parents of students	Confidence and belief in the importance of vaccination and fear of vaccine risk were reported to be the most important reasons for not accepting the Covid-19 vaccine	Moderate
Taylor, 2020, (Taylor et al., 2020)	Australia	53 ± 15	1125	483 Female / 642 Male	75.0	General population	Vaccine distrust, negative attitude towards vaccine were the most important factors for vaccine rejection ($p < 0.001$)	Moderate
Ahmed, 2021, (Ahmed et al., 2021)	Saudi Arabia	> 25	100	78 Female / 22 Male	32.0	General population	Vaccine distrust, negative attitude towards vaccine were the most important factors for vaccine rejection ($p < 0.001$)	High

Table 2 (continued)

Author, Year, [Reference]	Country	Age (Mean \pm SD)	Sample size (n)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female/Male				
Murphy, 2021, (Murphy et al., 2021)	Ireland and UK	> 18	3066	1487 Female 1579 Male	31.02	General population	Vaccine distrust was reported to be the most important factor in vaccine rejection. The results showed that vaccine acceptance was higher in females, people aged 35–44 years ($p < 0.05$). Vaccine acceptance was inversely related to mental health ($p < 0.05$). Vaccination was not significantly associated with race, place of residence, education, employment and income ($p > 0.05$)	High
Ilesanmi, 2021, (Ilesanmi et al., 2021)	Nigeria	37.22 \pm 15.36	595	303 Female 292 Male	67.30	General population	Media, cultural beliefs, attitudes toward vaccines, economic status, were the most important factors for vaccine acceptance ($p < 0.05$). But there was no significant relationship between employment, education, marital status ($p > 0.05$)	High
Robertson, 2021, (Robertson et al., 2021)	UK	> 16	12,355	7689 Female 4666 Male	82.0	General population	Vaccine hesitancy was higher in females, young people (16–24 years old), low education level, black people. But in people over 70, it was less reported	Moderate
Hursh, 2020, (Hursh et al., 2020)	India	41.5 \pm 13.4	534	262 Female 272 Male	58.8	General population	Vaccine acceptance was higher in males and those who had received the flu vaccine in the past 3 years ($p < 0.05$). But it was lower in those who believed in conspiracy ($p < 0.05$)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Graffigna, 2020, (Graffigna et al., 2020)	Italy	44 ± 14	1004	511 / 493	–	General population	General attitude was the most important factor in vaccine acceptance ($p < 0.05$)	Moderate
Alvarado-Socarraz, 2021, (Alvarado-Socarraz et al., 2021)	Colombia	45.1 ± 19	1066	503 / 563	90.7	Physicians	There was no significant relationship between the type of specialty and the workplace of physicians with vaccine acceptance ($p > 0.05$)	Moderate
Williams, 2021, (Williams et al., 2021)	Scotland	> 18	3385	2719 / 666	74.0	General population	In young white individuals, Asian race, high income and education level, vaccine acceptance were more reported. ($p < 0.05$). But no significant difference was reported between men and women ($p > 0.05$)	High
Trueblood, 2021, (Trueblood et al., 2021)	USA	46	1000	510 / 490	–	General population	Fear of vaccine side effects and vaccine efficacy were reported as the most important factors in vaccine rejection	Moderate
Priori, 2021, (Priori et al., 2021)	Italy	> 18	626	419 / 207	–	Rheumatic and musculoskeletal diseases	Vaccine acceptance in musculoskeletal patients, the elderly and males was significantly higher ($p < 0.01$)	Moderate
Abdallah & Lee, 2021	USA	> 18	647	– / –	91.64	Undergraduate students	Estimated Descriptive Norms were directly related to vaccine acceptance ($p < 0.001$). But no significant relationship was reported regarding age, sex and Estimated Injunctive Norms ($p > 0.05$)	Moderate
Meyer, 2021, (Meyer et al., 2021)	Rosica	43	16,292	11,893 / 4399	55.3	Healthcare workers	Vaccine acceptance was higher in staff who had contact with Corona patients and trusted the vaccine ($p > 0.05$)	High

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Latkin, 2021, (Latkin et al., 2021c)	USA	39.9 ± 11.4	592	332 / 260	59.1	General population	The results showed that vaccine acceptance was higher in non-Asian races, women, students ($p < 0.05$). But no significant relationship was reported between education and income level ($p > 0.05$)	High
Largent, 2020, (Cascini et al., 2021)	USA	> 18	2724	1250 / 1474	61.6	General population	Fear of Covid-19 and black race were reported as factors related to not receiving Covid-19 vaccine ($p < 0.05$)	High
Green, 2021, (Green et al., 2021)	Israel	51.9 ± 15.3	957	527 / 430	26.5	General population	Vaccination was higher in men compared to women and also higher in people with high education level ($p < 0.05$)	Moderate
Wong, 2020, (Wong et al., 2020)	Malaysia	> 18	1159	765 / 394	48.2	General population	Namely believe the vaccination decreases the chance of infection (OR = 2.51, 95% CI 1.19–5.26) and the vaccination makes them feel less worry (OR = 2.19, 95% CI 1.03–4.65), were found to have the highest significant odds of a definite intention to take the vaccine	Moderate
Gerussi, 2021, (Gerussi et al., 2021)	Italy	53	599	320 / 279	40.8	General population	Older people, infected with the flu in 2019, hospitalized in the acute phase of Covid-19 were skeptical about receiving the vaccine ($p < 0.05$)	Moderate
Schradig, 2021, (Schradig et al., 2021)	USA	> 18	1314	824 / 490	86.0	Healthcare workers	Black race, lack of safety, concerns about the safety were reported as reasons for not receiving the vaccine	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Grech-1, 2020, (Grech, Gauci, et al., 2020)	USA	> 18	9681	– / –	–	Healthcare workers	Fear of unknown complications and injection of influenza vaccine were the reasons for not accepting the vaccine. Vaccine acceptance was more common among physicians	Moderate
Grech-2, 2020, (Grech, Bonnici, et al., 2020)	USA	> 18	288	– / –	33.3	Physicians	Vaccine acceptance was higher in men than women but was not statistically significant ($p > 0.05$), vaccine acceptance was more reported with older age ($p < 0.05$). Insufficient knowledge was reported as the main reason for not receiving the vaccine	Moderate
Barello, 2020, (Barello et al., 2020)	Italy	–	735	– / –	86.1	University students	–	Moderate
Grech-3, 2020, (Grech & Gauci, 2020)	USA	> 18	3704	– / –	23.0	Dentistry and Medicine	Vaccine acceptance was reported more in men and pharmacy students. Inadequate knowledge and fear of possible side effects were the most important factors in uncertainty about vaccine acceptance. Vaccine acceptance increased with age ($p < 0.05$)	Moderate
Adebisi, 2021, (Adebisi et al., 2021)	Nigeria	> 18	517	223 / 294	74.5	General population	Uncertainty of clinical trials, belief in virus resistance, insufficient knowledge and young age were reported as factors associated with vaccine rejection ($p < 0.05$)	High
Lueck, 2020, (Lueck & Spiers, 2020)	USA	> 18	197	– / –	–	General population	Autonomy and self-confidence were associated with vaccine rejection ($p < 0.05$)	High

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Kelkar, 2021, (Kelkar et al., 2021)	USA	> 18	205	161 / 44	71.0	Cancer Patients	The main reason for vaccine hesitancy was the fear of the side effects. By educating patients, this fear disappeared to some extent	Moderate
Mercadante, 2021, (Mercadante & Law, 2021)	USA	18–49	525	– / –	66.7	General population	Lack of confidence in efficacy, low income, black race and low education were the most important factors of vaccine rejection ($p < 0.05$)	High
Akarsu, 2021, (Akarsu et al., 2021)	Turkey	> 18	759	477 / 282	49.7	General population	Vaccination was inversely related to being female, having insurance, anxiety and intention to have children ($p < 0.05$)	High
Kose, 2021, (Kose et al., 2021)	Turkey	> 15	1138	825 / 313	68.6	Healthcare workers	Men, students, younger age groups, and those who had previously received the flu shot were willing to get the COVID-19 vaccine ($p < 0.05$)	Moderate
Saied, 2021, (Saied et al., 2021)	Egypt	20.24 ± 1.78	2133	1391 / 742	90.5	Medical students	Inadequate knowledge, concern about side effects, ineffectiveness of the vaccine were the most important factors for vaccine rejection ($p < 0.05$)	Moderate
Di Giuseppe, 2021, (Napolitano et al., 2021)	Italy	36 ± 14.2 (18–73)	1518	923 / 595	21.4	University students	Vaccination was more reported in women, young people, those who agreed that Covid-19 is a severe disease, faculty members and married individuals ($p < 0.001$). However, having symptoms of Covid-19 and insufficient information about Covid-19 had no significant relationship with vaccine acceptance ($p > 0.05$)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Alabdulla, 2021, (Alabdulla et al., 2021)	Qatar	26–45	7821	3176 Female / 4645 Male	79.8	Migrant-majority population	Citizens and women were more likely to be vaccinated than immigrants and men	High
Ditekemena, 2021, (Ditekemena et al., 2021)	Congo	35 ± 11.5	4131	2825 Female / 1306 Male	55.9	General population	Middle and high-income category (OR = 1.85, CI: 1.46–2.35 and OR = 2.91, CI: 2.15–3.93, respectively), being tested for COVID-19 (OR = 4.71, CI: 3.62–6.12; $p < 0.001$), COVID-19 community vaccine acceptance (OR = 14.45, CI: 2.91–71.65; $p = 0.001$) and acknowledging the existence of COVID-19 (OR = 6.04, CI: 4.42–8.23; $p < 0.001$) were associated with an increased willingness to be vaccinated. Being a healthcare worker was associated with a decreased willingness for vaccination (OR = 0.46, CI: 0.36–0.58; $p < 0.001$)	High
García, 2021, (García & Cerda, 2020)	Chile	–	566	– Female / – Male	–	General population	The results showed that vaccine acceptance was significantly higher in people with chronic diseases, higher level of knowledge, decent job and economic status, quarantine adaptation and recovered from Covid-19 ($p < 0.05$)	Moderate
Allen, 2021, (Allen et al., 2021)	USA	27–45	396	396 Female / 0 Male	56.8	sample of women	Vaccine acceptance was lower in white, Chinese, without health insurance unemployed, low-income women ($p < 0.05$)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Harapan, 2020, (Harapan et al., 2020)	Indonesia	>20	1359	893 / 496	93.3	General population	Vaccine acceptance was significantly higher with increased vaccine efficacy, higher perception of Covid-19, health care workers, women and young people ($p < 0.05$)	Moderate
Di Genmaro, 2021, (Di Genmaro et al., 2021)	Italy	35.5 ± 11.8	1723	920 / 803	67.0	Healthcare workers	Vaccine acceptance was higher in young people, those who did not receive the flu vaccine and those who were in direct contact with Covid-19 patients ($p < 0.05$). But gender, previous infection were not directly related to vaccine acceptance ($p > 0.05$)	Moderate
Kociolek, 2021, (Kociolek et al., 2021)	USA	≤ 40 ($n = 2,312$) ≥ 41 ($n = 1,855$)	4448	3377 / 759	59.8	General population	Vaccination was significantly higher in women, blacks, Hispanics, and history of Covid-19 ($p < 0.05$). But age had no significant relationship with vaccine acceptance ($p > 0.05$)	Moderate
Khubchandani, 2021, (Khubchandani et al., 2021)	USA	> 18	1878	976 / 902	77.0	General population	Vaccine acceptance was significantly higher in women, children at home, and employed people ($p < 0.05$). But age had no significant relationship with vaccine acceptance ($p > 0.05$)	Moderate
Dinga, 2021, (Dinga et al., 2021)	Cameroon	> 18	2512	- / -	15.4	Adults	Communication and media environment, understanding of the pharmaceutical industry, reliability and/or source of vaccine, and cost were factors associated with vaccine rejection	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Latkin, 2021, (Latkin et al., 2021a)	USA	> 18	592	417 Female / 175 Male	59.1	General population	had significantly lower levels of trust in the CDC as a source of COVID-19 information (aOR = 0.29, CI = 0.17–0.50), reported lower social norms of COVID-19 preventive behaviors (aOR = 0.67, CI 0.51–0.88), scored higher on COVID-19 Skepticism (aOR = 1.44, CI = 1.28–1.61), identified as more politically conservative (aOR = 1.23, CI = 1.05–1.45), were less likely to have obtained a flu vaccine in the prior year (aOR = 0.21, CI = 0.11–0.39), were less likely to be female (aOR = 0.51, CI = 0.29–0.87), and were much more likely to be Black compared to White (aOR = 10.70, CI = 4.09–28.1)	Moderate
Kwok, 2021, (Kwok et al., 2021)	China	40.79 ± 10.47	1205	1084 Female / 121 Male	63.0	Nurses	Vaccine acceptance was reported in individuals with higher self-esteem, responsibility, history of chronic disease, and satisfaction (<i>p</i> < 0.05). But age and sex did not have a significant relationship with vaccine acceptance (<i>p</i> > 0.05)	High
Ledda, 2021, (Ledda et al., 2021)	Italy	> 30	1323	688 Female / 635 Male	75.0	Healthcare workers	Vaccine acceptance was reported to be higher in people who had flu shots, physicians and those with high education levels (<i>p</i> < 0.05)	High

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Machida, 2021, (Machida et al., 2021)	Japan	>20	2956	1498 Female / 1458 Male	62.1	General population	Vaccination was significantly lower among women, people aged 20–49 years, those without underlying diseases, single, and those with low income levels ($p < 0.001$). But employment status, residential area, access to educational facilities were not significantly related to vaccine acceptance ($p > 0.05$)	High
Papagiannis, 2021, (Papagiannis et al., 2021)	Greece	45.67 ± 11.00	340	167 Female / 173 Male	78.5	Healthcare workers	Vaccine acceptance was significantly higher in people over 45 years of age, fear of Covid-19, and receiving information from the CDC (Reliable Information from Greek CDC (E.O.D. Y.)) ($p < 0.05$)	High
Nzaji, 2020, (Nzaji et al., 2020)	Congo	>18	613	301 Female / 312 Male	–	Healthcare workers	Vaccine acceptance was significantly higher in patients with Covid-19, physicians, young people, and positive attitude toward Covid-19 ($p < 0.05$). Gender, marital status did not have a significant relationship with vaccine acceptance ($p > 0.05$)	High
Qattan, 2021, (Qattan et al., 2021)	Saudi Arabia	>18	736	200 Female / 536 Male	49.71	Healthcare workers	Vaccine acceptance in men, high perception of the risk of infection, belief that the vaccine should be mandatory, were significantly higher ($p < 0.05$)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Malik, 2020, (Malik et al., 2020)	UK	> 18	672	386 Female / 280 Male	67.0	General population	Men (72%) compared to women, older people (55 years; 78%) compared to young adults, Asians (81%) compared to other racial and ethnic groups and holders of university and / or postgraduate degrees (75%) compared to people with a university degree were less likely to receive the vaccine ($p < 0.05$)	High
Rabi, 2021, (Rabi et al., 2021)	USA	> 30	639	511 Female / 121 Male	–	Nurses	Significant factors associated with vaccination intention were as follows: age (adjusted OR 1.42, 95% CI: 1.02–1.99); lack of knowledge about the vaccine (adjusted OR 2.6, 95% CI 1.81– 3.8); concern about long- term side effects (adjusted OR 2.0, 95% CI 1.4– 2.9); fear of injection (adjusted OR 1.5, 95% CI 1.04– 2.13); natural immunity preference (adjusted OR 5.8, 95% CI 4.5– 8.3); media misrepresentation (adjusted OR 1.7, 95% CI 1.2– 2.4); and getting COVID- 19 from the vaccine (adjusted OR 1.5, 95% CI 1.1– 2.1)	High

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Salali, 2020, (Salali & Uysal, 2020)	UK and Turkey	> 18	5024	- / -	17.67	General population	Participants who had higher COVID-19-related anxiety scores had higher odds of vaccine acceptance. Perceived risk of catching COVID-19 and frequency of watching/listening/reading to the news had positive effects on vaccine acceptance. Compared to women, men in Turkey were more likely to accept a COVID-19 vaccine, and believe in the natural origin of the virus ($p < 0.05$)	High
Salmon, 2021, (Salmon et al., 2021)	USA	> 18	100	52 / 48	-	General population	Vaccination was significantly higher in men, people over 60 years of age, higher education level, blacks and non-Hispanics ($p < 0.05$)	Moderate
Schwarzinger, 2021, (Schwarzinger et al., 2021)	France	18–64	1942	993 / 949	28.8	General population	Vaccination was less reported in people with fear of side effects compared to men ($p < 0.05$). But more were reported in people over 50 years ($p < 0.05$)	Moderate
Seale, 2021, (Seale et al., 2021)	Australia	> 18	1143	614 / 529	80.0	General population	Vaccination was significantly higher in women, people over 70, indigenous, those who traveled in 2020, had private insurance, and had a significantly higher incidence of chronic diseases ($p < 0.05$)	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Petravić, 2021, (Petravić et al., 2021)	Slovenia	> 15	12,042	6026	6016	Healthcare workers	Vaccination was significantly higher in men, physicians, students, the elderly, those who had previously received the flu vaccine, those who had Covid-19 previously and those with more trust in experts ($p < 0.05$)	Moderate
Sharun, 2021, (Sharun et al., 2020)	India	–	351	204	147	General population	–	High
Vallée, 2021, (Vallée et al., 2021)	France	53 ± 18	237	56	181	People Living with HIV	Vaccination was significantly associated with chronic disease ($p = 0.026$), concern for side effects ($p < 0.0001$), and thought to be immune to the vaccine ($p = 0.008$)	Moderate
Szmyd, 2021, (Szmyd, Karuga, et al., 2021)	Poland	26.94	2300	970	1330	healthcare workers	Vaccine acceptance was inversely related to depression ($p = 0.008$), and directly related to stress, vaccination history, fear of Covid-19, fear of transmission to relatives ($p < 0.0001$) but no significant relationship with anxiety, gender was found ($p > 0.05$)	Moderate
Shekhar, 2021, (Shekhar et al., 2021)	USA	40	3479	2598	864	Healthcare workers	From the entire study population, fewer women (31%), blacks (19%) and v-lagers (26%) were willing to use the vaccine as soon as it became available	Moderate
Vergier, 2021, (Vergier et al., 2021)	France	> 18	1209	736	473	Healthcare workers	Vaccination was less reported in men over 40 years of age and those with a history of negative vaccination	Moderate
Volpp, 2021, (Volpp et al., 2021)	USA	–	1438	747	691	General population	Vaccination was reported lower among blacks, less educated people, and men	Moderate

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Urrunaga-Pastor, 2021, (Urrunaga-Pastor et al., 2021)	Peru	> 18	472,521	263,026 / 205,569	80.0	General population	Vaccination was significantly higher among women, economic insecurity, family member infected with Covid-19 and depressed people ($p < 0.05$)	High
Wang-1, 2021, (Wang, Lu, et al., 2021)	China	> 18	2058	1267 / 791	91.9	General population	The results show that vaccine acceptance has no significant relationship with age, sex, marital status ($p > 0.05$)	High
Wang-2, 2021, (Wang, Wong, et al., 2021)	Hong Kong	42.0	423	255 / 168	44.2	General population	Vaccination was significantly higher in people aged 40–49 and over 60 years, flu vaccine, married, chronic diseases ($p < 0.05$). But vaccine acceptance has no significant relationship with sex ($p > 0.05$)	Moderate
Sherman, 2020, (Sherman et al., 2021)	UK	> 18	1494	765 / 729	64.0	Adults	Vaccination was higher among older people who were vaccinated against the flu last year. The most important reasons for not receiving the vaccine were fear of side effects and uncertainty about the vaccine	Moderate
Wang-3, 2020, (Wang, Wong, et al., 2020)	China	> 18	806	705 / 101	40.0	nurses	Vaccine acceptance is significantly higher in people with chronic diseases, women, and those who had direct contact with Covid-19 patients ($p < 0.05$). But it has no significant relationship with age ($p > 0.05$)	High
Zigron, 2021, (Zigron et al., 2021)	USA	> 18	506	288 / 218	50.0	Dental Professionals	Vaccine acceptance has been reported more in the employed and experts, but it has no association with gender	High

Table 2 (continued)

Author, Year, [Reference]	Country	Age (<i>Mean</i> ± <i>SD</i>)	Sample size (<i>n</i>)		Vaccine acceptance %	Study population	Result	Quality
			Total	Female / Male				
Wang, 2021, (Wong et al., 2021)	Hong Kong	> 18	1200	856 / 344	37.2	healthcare workers	($p > 0.05$). Vaccination was significantly higher in people aged 18–44 years, over 65 years, married, and chronic diseases ($p < 0.05$). But it has no significant relationship with sex ($p > 0.05$)	Moderate
Latkin, 2021, (Latkin et al., 2021b)	USA	> 18	1043	731 / 312	53.6	General population	Vaccination was significantly higher in people over 65 years and in the age range of 59–40 years, single, black, employed, concerned about Covid-19, higher education level ($p < 0.05$)	Moderate
Thaker, 2021, (Thaker, 2021)	New Zealand	> 18	1040	609 / 431	74.0	General population	Vaccine acceptance was significantly higher in men, higher education level, average income, non-smoker ($p < 0.05$)	Moderate
Lin, 2021, (Lin et al., 2020)	China	18–70	3541	1839 / 1702	54.6	General population	Vaccination was significantly higher in people with age range (26–35) and (70–46 years), married ($p < 0.05$). But it has no significant relationship with sex and income ($p > 0.05$)	Moderate
Chen, 2021, (Chen et al., 2021)	China	> 18	3195	2032 / 1163	83.8	Adults	Vaccine acceptance is significantly higher in people with an age range of 18–25, Han ethnicity, higher level of education ($p < 0.05$). But it has no significant relationship with sex and income ($p > 0.05$)	Moderate

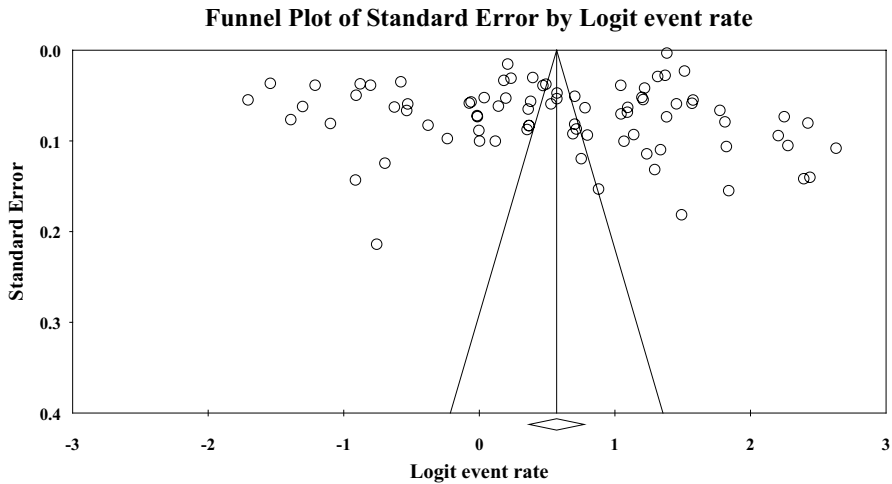


Fig. 2 Funnel plot results for the overall estimate of the prevalence of Covid-19 vaccine worldwide

et al., 2020; Papagiannis et al., 2021; Pastorino et al., 2021; Priori et al., 2021; Rhodes et al., 2021; Ruiz & Bell, 2021; Sallam et al., 2021a, 2021b; Schwarzingler et al., 2021; Sharun et al., 2020; Turcu-Stiolică et al., 2021; Verger et al., 2021; Volpp et al., 2021), vaccine acceptance in men was reported more than women. Also in 12 studies; (Abdallah & Lee, 2021; Chen et al., 2021; Di Gennaro et al., 2021; Latkin et al., 2021b; Lin et al., 2020; Padureanu et al., 2020; Palamenghi et al., 2020; Shekhar et al., 2021; Sherman et al., 2021; Wang, Lu, et al., 2021; Wang, Wong, et al., 2020; Williams et al., 2021), no significant relationship was reported between gender and acceptance rate of Covid-19 vaccine ($p > 0.05$). Based on the mentioned results, the difference between the two groups was definitely not towards either of them, and the superiority of each was in accordance with the study conditions and was relatively reported. Therefore, in terms of acceptance rate of Covid-19 vaccine, there was no difference between men and women.

Age: A total of 44 articles age as a factor associated with acceptance of the Covid-19 vaccine. In 19 studies; (Campochiaro et al., 2021; Gagneux-Brunon et al., 2021; Gerussi et al., 2021; Grech, Bonnici, et al., 2020; Grech, Gauci, et al., 2020; Latkin et al., 2021c; Lin et al., 2020; Papagiannis et al., 2021; Petravić et al., 2021; Priori et al., 2021; Rhodes et al., 2021; Ruiz & Bell, 2021; Sallam et al., 2021a; Schwarzingler et al., 2021; Seale et al., 2021; Sherman et al., 2021; Turcu-Stiolică et al., 2021; Wang, Wong, et al., 2020, 2021), vaccine acceptance was reported more in the age group over 60 years. But in 18 studies; (Chen et al., 2021; Di Gennaro et al., 2021; Harapan et al., 2020; Head et al., 2020; Kose et al., 2021; Lin et al., 2020; Malik et al., 2020; Murphy et al., 2021; Nzaji et al., 2020; Palamenghi et al., 2020; Pastorino et al., 2021; Rabi et al., 2021; Robertson et al., 2021; Salmon et al., 2021; Sun et al., 2021; Verger et al., 2021; Wang, Lu, et al., 2021; Williams et al., 2021), vaccine acceptance was reported more in young people. Also in 7 studies; (Abdallah & Lee, 2021; Dinga et al., 2021; Khubchandani et al., 2021; Ledda et al., 2021;

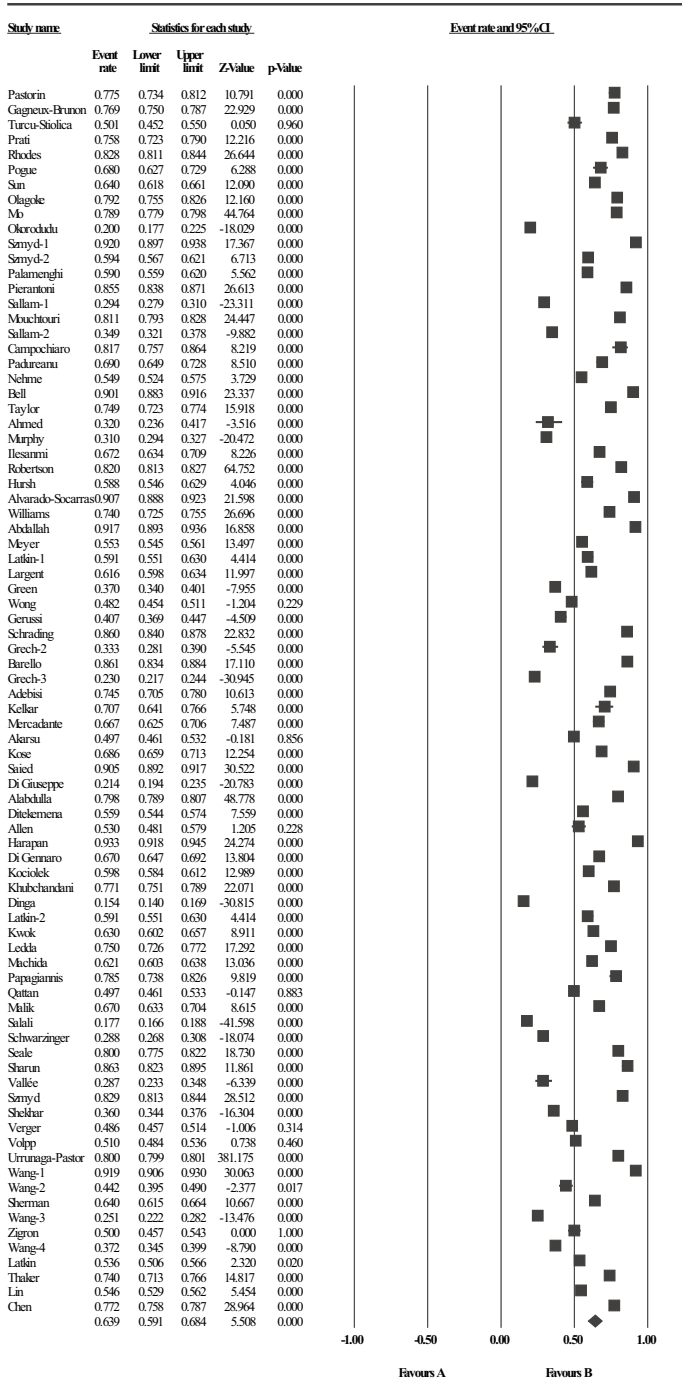


Fig. 3 Overall estimation of the acceptance rate of Covid-19 vaccine in the world based on the random effects model

Table 3 Subgroup analysis of estimating the acceptance rate of Covid-19 vaccine by continent

Continent	N	Sample size	I ²	Begg and Mazumdar	Acceptance percentage (95% CI)
Asia	19	40,798	99.68	0.624	61.4 (95% CI: 51.4–70.5)
Europe	35	72,649	99.69	0.334	64.4 (95% CI: 57.0–71.2)
America	20	495,763	99.79	0.051	63.8 (95% CI: 53.1–73.3)
Africa	5	9888	99.80	0.462	62.6 (95% CI: 33.1–85.0)
Australia	3	3308	84.07	1.000	76.4 (95% CI: 72.6–79.8)

Palamenghi et al., 2020; Wang et al., 2020; Wang, Wong, et al., 2021), no significant relationship was reported between age and acceptance of Covid-19 vaccine ($p > 0.05$). According to various studies, it seems that vaccine acceptance is higher in young age groups (20–40 years old) and the elderly (over 60 years old) compared to other age groups.

Marital status: In the study of Latkin et al. (Latkin et al., 2021a), vaccine acceptance rate was reported more in single people. But in studies by Machida et al. (Machida et al., 2021), Wang-2 et al. (Wang, Wong, et al., 2020) and Wang-4 et al. (Wang, Lu, et al., 2021), vaccine acceptance was more common in married couples. In addition, Ilesanmi et al. (2021) and Wang-1 et al. (Wang, Wong, et al., 2020) did not report a significant relationship between marital status and acceptance rate of Covid-19 vaccine ($p > 0.05$). Based on these results, the difference between single and married people in receiving Covid-19 vaccine was definitely not towards either group. Therefore, in terms of acceptance rate of Covid-19 vaccine, it can be said that there is no difference between single and married people.

Race: A total of 11 articles examined race as a factor associated with the acceptance of the Covid-19 vaccine. In 4 studies; (Khubchandani et al., 2021; Latkin et al., 2021b; Robertson et al., 2021; Schwarzinger et al., 2021), vaccine acceptance was more reported in black people. But in 6 studies; (Latkin et al., 2021c; Schradling et al., 2021; Shekhar et al., 2021; Volpp et al., 2021; Williams et al., 2021; Woko et al., 2020), vaccine acceptance was more reported in white people. Furthermore, Ruiz et al. (Ruiz & Bell, 2021) did not report a significant relationship between race and acceptance of the Covid-19 vaccine ($p > 0.05$). According to these studies, the difference between blacks and whites in accepting the Covid-19 vaccine is definitely not towards either group and the dominance of each is pursuant to the study conditions and is reported in relative terms. Therefore, there is no difference between blacks and whites in accepting the Covid-19 vaccination.

Education level: A total of 36 articles assessed the level of education as a factor related to the acceptance of Covid-19 vaccine. In 22 studies; (Adebisi et al., 2021; Chen et al., 2021; Di Gennaro et al., 2021; García & Cerda, 2020; Grech & Gauci, 2020; Grech, Gauci, et al., 2020; Green et al., 2021; Head et al., 2020; Kose et al., 2021; Lin et al., 2020; Machida et al., 2021; Mercadante & Law, 2021; Rhodes et al., 2021; Robertson et al., 2021; Saied et al., 2021; Salmon et al., 2021; Seale et al., 2021; Shacham et al., 2021; Thaker, 2021; Wang, Lu, et al., 2021; Williams et al., 2021), a positive correlation between education levels and vaccine acceptance was

reported. But in the study of Malik et al. (Malik et al., 2020), vaccine acceptance was inversely related to education level. Also, in 5 studies; (Ilesanmi et al., 2021; Latkin et al., 2021b; Murphy et al., 2021; Ruiz & Bell, 2021; Sallam et al., 2021b), no significant relationship was reported between education level and acceptance rate of Covid-19 vaccine ($p > 0.05$). Four studies reported more acceptance of the Covid 19 vaccine among students (Grech, Gauci, et al., 2020; Latkin et al., 2021b; Pierantoni et al., 2020; Vallée et al., 2021). Padureanu et al. (2020), Grech-1 et al. (Grech, Bonnici, et al., 2020), and Petravić et al. (Petravić et al., 2021) reported more acceptance rate of the Covid 19 vaccine in physicians (Green et al., 2021; Padureanu et al., 2020; Vallée et al., 2021). Gagneux-Brunon et al. (Gagneux-Brunon et al., 2021) reported more vaccine acceptance rate by physiotherapists. According to included studies, vaccine acceptance rate seems to be higher in people with higher education level.

Employment: A total of 14 articles examined employment as a factor related to the acceptance of the Covid-19 vaccine. In 10 studies; (Allen et al., 2021; Dinga et al., 2021; Ditekemena et al., 2021; Gagneux-Brunon et al., 2021; García & Cerda, 2020; Harapan et al., 2020; Lin et al., 2020; Meyer et al., 2021; Mouchtouri et al., 2020; Wong et al., 2020), vaccine acceptance rate was reported more in employed people. But in the study by Head et al. (Head et al., 2020), vaccine acceptance rate was more reported in the unemployed population. In addition, in 3 studies; (Ilesanmi et al., 2021; Murphy et al., 2021; Nzaji et al., 2020), no significant relationship was reported between employment and acceptance of Covid-19 vaccine ($p > 0.05$). Therefore, it seems that vaccine acceptance is higher among the employed individuals, especially health care providers.

Economic status: In overall, 15 articles investigated the economic status as a factor related to the acceptance of the Covid-19 vaccine. In 10 studies; (Allen et al., 2021; García & Cerda, 2020; Ilesanmi et al., 2021; Mercadante & Law, 2021; Mouchtouri et al., 2020; Nzaji et al., 2020; Prati, 2020; Rhodes et al., 2021; Turcu-Stiolică et al., 2021; Williams et al., 2021), vaccine acceptance was more reported in people from higher-income groups. However, in 3 studies; (Mo et al., 2021; Sun et al., 2021; Wang, Wong, et al., 2020), vaccine acceptance rate in people from high-income groups was less reported. Also, Latkin et al. (Latkin et al., 2021c) and Chen et al. (Chen et al., 2021) did not find a significant relationship between economic status and acceptance of the Covid-19 vaccine ($p > 0.05$). So, the results show that the vaccine acceptance is better in people categorized in high-income groups.

Vaccine side effects: Totally, in 17 studies; (Chu & Liu, 2021; Grech & Gauci, 2020; Grech, Gauci, et al., 2020; Head et al., 2020; Kaplan & Milstein, 2021; Kelkar et al., 2021; Latkin et al., 2021c; Padureanu et al., 2020; Pastorino et al., 2021; Petravić et al., 2021; Saied et al., 2021; Sallam et al., 2021a; Shacham et al., 2021; Shekhar et al., 2021; Trueblood et al., 2021; Turcu-Stiolică et al., 2021; Zigron et al., 2021), fear of side effects was an important factor in not accepting the Covid-19 vaccine.

Vaccine trust: Overall, in 15 studies; (Adebisi et al., 2021; Ahmed et al., 2021; Bell et al., 2020; Hursh et al., 2020; Kwok et al., 2021; Ledda et al., 2021; Meyer et al., 2021; Murphy et al., 2021; Okorodudu & Okorodudu, 2021; Palamenghi et al., 2020; Prati, 2020; Schradling et al., 2021; Shacham et al., 2021; Sun et al.,

2021; Taylor et al., 2020) confidence in safety was reported as an influential factor in accepting the Covid-19 vaccine. Furthermore, in 15 studies; (Adebisi et al., 2021; Grüner & Krüger, 2020; Harapan et al., 2020; Kaplan & Milstein, 2021; Kwok et al., 2021; Ledda et al., 2021; Malik et al., 2020; Mercadante & Law, 2021; Meyer et al., 2021; Mo et al., 2021; Okorodudu & Okorodudu, 2021; Palamenghi et al., 2020; Pogue et al., 2020; Shacham et al., 2021; Wong et al., 2020) confidence in effectiveness of vaccination was reported as an important factor in accepting the Covid-19 vaccine.

Concerns about Covid-19 and previous infection: A total of 6 studies; (Gagneux-Brunon et al., 2021; Pastorino et al., 2021; Pogue et al., 2020; Priori et al., 2021; Qattan et al., 2021; Verger et al., 2021) reported concerns about Covid-19 as an important factor in vaccine acceptance. Also in 4 studies; (Rhodes et al., 2021; Sallam et al., 2021b; Vallée et al., 2021; Wang, Wong, et al., 2021) previous infection was reported as an important factor in vaccine acceptance.

The Underlying diseases: Altogether, in 7 studies; (García & Cerda, 2020; Ledda et al., 2021; Nzaji et al., 2020; Shekhar et al., 2021; Thaker, 2021; Wang, Wong, et al., 2021; Wong et al., 2020) the underlying diseases were reported as the cause of vaccine acceptance. However, in the studies of Campochiaro et al. (Campochiaro et al., 2021), the underlying diseases were reported as an important factor in vaccine rejection. Also, Gagneux-Brunon et al. (Gagneux-Brunon et al., 2021) and Sallam et al. (Sallam et al., 2021b) did not detect a significant association between underlying diseases and acceptance rate of the Covid-19 vaccine ($p > 0.05$). Based on these results, the relationship between the underlying diseases and the acceptance of the vaccine is not definite and depends on the study conditions.

Vaccination history: Generally, in 5 studies; (Chu & Liu, 2021; Pastorino et al., 2021; Sallam et al., 2021b; Urrunaga-Pastor et al., 2021; Verger et al., 2021), positive vaccination history was reported as an important factor in vaccine acceptance. Additionally, in 9 studies; (Gagneux-Brunon et al., 2021; Gerussi et al., 2021; Hursh et al., 2020; Kose et al., 2021; Machida et al., 2021; Ruiz & Bell, 2021; Vallée et al., 2021; Wang, Wong, et al., 2021; Zigrone et al., 2021), positive influenza vaccination was reported as an important factor in accepting the Covid-19 vaccine.

Other factors in the study of Pastorino et al. (2021) understanding of prevention criteria, in the study of Turcu-Stiolică et al. (2021) higher quality of life, Pogue et al. (2020) personal relationships with Covid-19 patients, Olagoke et al. (2021) religious belief, Mo et al. (2021) social media, Sallam et al. (2021b) social media dependency, Ilesanmi et al. (Ilesanmi et al., 2021) media and cultural beliefs, Priori et al. (2021) in musculoskeletal patients, Abdallah et al. (Abdallah & Lee, 2021) estimated and descriptive norms, Dinga et al. (2021) knowledge about the pharmaceutical industry, Thaker et al. (Thaker, 2021) not smoking were mentioned as factors in vaccine acceptance.

Discussion

Vaccination is considered as one of the most prominent public health intervention in the last century. Although unaffordability or inaccessibility to COVID-19 vaccines has been the major problem since the beginning of the pandemic, vaccine hesitancy has become a novel challenge across the world (Rosselli et al., 2016). Despite the capability to prevent or end the ongoing pandemic, vaccine hesitancy has caused failure to control public health and has brought about a new challenge in fighting against this virus (Dror et al., 2020). However, vaccine acceptance varies depending on the population, time, socioeconomic status, ethnicity, attitude, beliefs and many other factors (Larson et al., 2014). Hence, we have performed a systematic review and meta-analysis to find out the approximate rate of vaccine hesitancy and associated factors for thinking out measures to improve vaccine acceptance in order to save more lives.

We included 82 cross-sectional surveys conducted in different countries of the world on 660,604 participants. The quality scores of the included studies ranged from satisfactory to good. Our meta-analysis revealed that the pooled estimate of COVID-19 vaccine acceptance was 63.9% (95% CI: 59.1–68.4) in the world. Another survey by Jeffrey V. Lazarus et al. on 13,426 participants in 19 countries showed that 71.5% of the participants were willing to receive the COVID-19 vaccines (Lazarus et al., 2021). Although it appears that trust in the influenza vaccine is higher and some surveys report higher reluctance to being vaccinated against COVID-19, compared with usual vaccines in many countries (Grochowska et al., 2021; Richardson et al., 2020).

Our study illustrated the acceptance rate of COVID-19 vaccine in different parts of the world in a subgroup analysis according to different continents (Asia, Europe, Africa, Australia and the United States), with the highest percentage related to Australian continent, 76.4% (95% CI: 79.8–72.6%). Cheryl Lin et al. reported substantial variations in COVID-19 vaccine receptivity between different countries, different states and subgroups. According to their study, some Asian countries had higher acceptance, 88.6–91.3% in China and 79.8% in South Korea, which could be due to higher trust in central governments. On the other hand, Russia had the lowest vaccine acceptance rate (54.9%) (Lin et al., 2021). These variations can be reflective of different trust levels in information from government sources.

The study findings showed no difference in acceptance rates between males and females. Our results were in contrast with the study conducted by Cheryl Lin et al. who stated that males were more likely to be vaccinated than females (Lin et al., 2021). On the contrary, Jeffrey V. Lazarus et al. suggested that men were slightly less likely to respond positively to vaccines than women (Lazarus et al., 2020). In general, it seems that men have more acceptance of COVID-19 vaccines, which might be due to lower level of concern about acquiring the infection following vaccination, and the fear of side effects, compared to women (Nery Jr et al., 2022). Moreover, as men are less apt to take protective and hygienic measures, they tend to receive COVID-19 vaccines to be free of adhering to preventive measures. Being a male as a positive predictor for COVID-19 vaccine acceptance can also be

explained by the high rates of COVID-19-related morbidity and mortality among them and also their more positive perceptions about the vaccines safety and efficacy as opposed to women.

Our study was indicative of higher vaccine acceptance in young age groups (20–40 years old) and the elderly (over 60 years old), compared to other age groups. Another study by Jeffrey V. Lazarus which considered a cut-off of 50 years for evaluating age-related acceptance, showed older age as a significant factor in Canada, Poland, Sweden, and the UK. Conversely, in the same study, Younger Chinese individuals were more likely to receive vaccine (Zeballos Rivas et al., 2021). However, these findings are in contrast with the existing facts, as it seems that older people and the retired individuals are more hesitant to get vaccinated. The potential reasons include lower social media usage, lower knowledge about vaccines and their benefits, and lower perception of the risks (Momplaisir et al., 2021). On the other hand, as a different point of view, older adults must be more interested in being vaccinated because they are more vulnerable to COVID-19-related consequences (Nery Jr et al., 2022).

Overall, racial and ethnic groups have been considerable factors in vaccine acceptance; ethnic minorities are less likely to be vaccinated against COVID-19; Black race and mixed ethnicity have been more hesitant towards the vaccine. However, our results showed no difference in acceptance rates between whites and blacks. White ethnic groups were more likely to accept vaccination, while Cheryl Lin et al. demonstrated higher receptivity of COVID-19 vaccine in White Americans and more hesitancy and lack of confidence to vaccination among the Black (Lin et al., 2021). This disparity in vaccine acceptance among races can be explained by beliefs against vaccines, and also political environment which fosters racial injustice (Bono et al., 2021). This implies that although a COVID-19 vaccine can reduce the race mortality gap from SARS-CoV-2 infection, fear in the Black would be a barrier to vaccine acceptance.

In general, low education levels are associated with vaccine rejection. In a study by Suzanna Awang Bono et al., participants from undergraduate and postgraduate levels were more willing to be vaccinated compared to those who had completed primary and secondary education, particularly among undergraduate degree holders (Wang, Jing, et al., 2020). The higher vaccine acceptance rate in educated individuals is the direct reflection of valuing professionals' recommendations to get vaccinated immediately (Shrestha et al., 2022). It seems that the field of education can be a determining factor; for example, it seems that medical students would show lower rates of hesitancy and more positive attitudes toward COVID-19 vaccines.

Basically, not being employed in a full time job or being retired are expected to be associated with refusal of the vaccine, while those with professional private jobs seem to be more likely to accept vaccination (Elsayed et al., 2021; Thanapluetiwigong et al., 2021). Our study also verified this fact that vaccination acceptance is higher among employed individuals, especially health care workers (HCWs). The reasons might be self-protection and tendency to protect family, friends, and patients and higher perception for risk of infection. Although our study did not separate vaccine acceptance in various subgroups of the healthcare workers, it is interesting that a survey conducted by Rahul Shekhar et al. acknowledged that direct patient care

providers (DPCP) had higher vaccine acceptance (49%), while administrative staff working in hospital without direct patient contact had the lowest vaccine acceptance among HCWs (Shekhar et al., 2021). Amiel A. Dror also came to the same conclusion (Dror et al., 2020). Another reason for more vaccine acceptance in the employed population would be their interaction with more people, making them more vulnerable to various infections.

The marital status also affects the response to vaccine acceptance, being single or widowed can be associated with hesitancy, while married individuals are more likely to accept the vaccine (Bhopal & Nielsen, 2021). However, our study was indicative of no difference between single and married individuals in receiving COVID-19 vaccines. It seems that married people have more tendency to get vaccinated due to their intimate contact with their partners or children and their concern for transmitting the infection.

It is reasonable that the rate of vaccine hesitancy would be higher in lower income population (Torrelee, 2020). According to our study, it seems that vaccine acceptance is higher in people with higher incomes. In a study by Suzanna Awang Bono et al., it was found that people with lower-middle, higher-middle, and high income had higher acceptance of being vaccinated compared to those with low income (Wang, Wong, et al., 2021). Therefore, making the vaccine price more affordable for the public can be a solution to vaccine hesitancy.

One of the main factors engaged in COVID-19 vaccine hesitancy is the fear of side effects. The adverse reactions of the vaccine vary from local to systemic events. Local reactions such as pain and induration, and some of the systemic reactions like fatigue, chills, fever, myalgia and arthralgia are not problematic, but allergic reactions especially anaphylaxis, long-term neurological consequences such as Guillain-Barré Syndrome, and recently, thrombo-embolic events especially following receiving the AstraZeneca vaccine have been the dominant factors for decreasing vaccine acceptance. The concerns about COVID vaccines safety are expected to be stronger than other vaccines, since people believe that such a vaccine that is produced in a rush and released immediately can be too dangerous (Kaplan et al., 2021). Moreover, rumors about the presence of active virus in the vaccines and also religious prohibitions have been other reasons of vaccine hesitancy (Troiano & Nardi, 2021). In our survey, 17 studies had reported the fear of side effects as an important factor in COVID-19 vaccine hesitancy.

Another reason for vaccine hesitancy is the uncertainty about COVID-19 vaccines efficacy. Acceptance of a COVID-19 vaccine is highly influenced by the efficacy of the vaccine. Fifteen studies among the pooled data of our study showed confidence in efficacy as an important factor in accepting the COVID-19 vaccine. In a survey conducted by Harapan et al., it was revealed that vaccine acceptance would be 93.3% if the vaccine was 95% effective, while willingness to get vaccinated dropped to 67.0% if vaccine efficacy was 50% (Harapan et al., 2020). Accordingly, Kaplan et al., stated that vaccine acceptance improves when vaccine efficacy exceeds 70% (Schwarzinger et al., 2021). Furthermore, there is still misbeliefs about the futility of the vaccine because of the harmless nature of COVID-19 or this virus being merely a lie (Batty et al., 2021). The mentioned issues verify the fact that misinformation about COVID-19 vaccines are major

provokers for vaccine rejection, thus helping the population gain their trust can increase vaccine acceptance.

Other factors that have not been evaluated in our study, but seem to be highly relevant to vaccine hesitancy is the manufacturer country of the vaccine; it is believed that vaccine acceptance is higher for COVID-19 vaccines produced in the USA, while distrust in vaccines is higher for those developed in China or Russia (Schwarzinger et al., 2021) In addition, mental health can be another associated factor; individuals with lower cognitive function seem to be more vaccine-hesitant (Batty et al., 2021).

This study has some limitation. Firstly, vaccine acceptance was assessed differently across included studies. Our study may not show the individual's action or behavior to receiving the vaccine, as most of the studies included evaluated people's attitudes or intentions to evaluate behavior, not their real behavior. According to theory of planned behavior, behavioral intention occurs after the developing attitude and then behavior is occurred. Some studies didn't assess vaccine acceptance directly and evaluated vaccine hesitancy. Therefore, we subtracted 100% from the frequency of the vaccine hesitancy to obtain the vaccine acceptance. Secondly, some studies didn't have an adequate sample size to capture the actual rate of the vaccine acceptance. Thirdly, studies were conducted at different times. Some of them performed when the COVID-19 vaccination was not yet available in that country and the potential complications were unclear. So, it is recommended that the vaccination acceptance rate assess in regular because the hesitancy rates are likely to vary as the situation evolves.

Conclusion

Unfortunately, despite becoming available, SARS-CoV-2 vaccines are still confronted with a hesitancy, which could be a global health threat. Working out solutions to this universal problem is highly critical. Transparency in reporting the exact and true number of newly diagnosed COVID-19 cases and mortality can increase the intention of community to receive the vaccines. Moreover, increasing the public trust in medical professionals can be a great benefit.

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Author's contributions FR and MK and AS contributed to the design, MK and FR and MR participated in most of the study steps. FR and MK and ZM prepared the manuscript. FR and MK and ZM assisted in designing the study, and helped in the, interpretation of the study. All authors have read and approved the content of the manuscript.

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Data Availability Datasets are available through the corresponding author upon reasonable request.

Declarations

Conflict of Interests The authors declare that they have no conflict of interest.

Ethics Approval and Consent to Participate Ethics approval was received from the ethics committee of deputy of research and technology, Kermanshah University of Medical Sciences (IR.KUMS.REC.1400.201).

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References

- Abdallah, D. A., & Lee, C. M. (2021). Social norms and vaccine uptake: College students' COVID vaccination intentions, attitudes, and estimated peer norms and comparisons with influenza vaccine. *Vaccine*, *39*, 2060–2067.
- Adebisi, Y. A., Alaran, A. J., Bolarinwa, O. A., Akande-Sholabi, W. & Lucero-Prisno, D. E. (2021). When it is available, will we take it? Social media users' perception of hypothetical COVID-19 vaccine in Nigeria. *The Pan African Medical Journal*, *38*.
- Ahmed, N. J., Alkhawaja, F. Z., Alrawili, A. S., & Almalki, Z. S. (2021). Public knowledge and attitudes toward COVID-19 Vaccination: A cross-sectional study. *Medical Science*, *25*, 279–284.
- Akarsu, B., Canbay Özdemir, D., Ayhan Baser, D., Aksoy, H., Fidancı, İ, & Cankurtaran, M. (2021). 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*, *75*, e13891.
- Alabdulla, M., Reagu, S. M., Al-Khal, A., Elzain, M., & Jones, R. M. (2021). COVID-19 vaccine hesitancy and attitudes in Qatar: A national cross-sectional survey of a migrant-majority population. *Influenza and Other Respiratory Viruses*, *15*, 361–370.
- Allen, J. D., Abuelezam, N. N., Rose, R., & Fontenot, H. B. (2021). Factors associated with the intention to obtain a COVID-19 vaccine among a racially/ethnically diverse sample of women in the USA. *Translational Behavioral Medicine*, *11*, 785–792.
- Alvarado-Socarras, J. L., Vesga-Varela, A. L., Quintero-Lesmes, D. C., Fama-Pereira, M. M., Serano-Diaz, N. C., Vasco, M., Carballo-Zarate, V., Zambrano, L. I., Paniz-Mondolfi, A., & Rodriguez-Morales, A. J. (2021). Perception of COVID-19 vaccination amongst physicians in Colombia. *Vaccines*, *9*, 287.
- Barello, S., Nania, T., Dellafiore, F., Graffigna, G., & Caruso, R. (2020). 'Vaccine hesitancy' among university students in Italy during the COVID-19 pandemic. *European Journal of Epidemiology*, *35*, 781–783.
- Batty, G. D., Deary, I. J., Fawns-Ritchie, C., Gale, C. R. & Altschul, D. (2021). Pre-pandemic cognitive function and COVID-19 vaccine hesitancy: cohort study. *Brain, Behavior, and Immunity*, *96*, 100–105.
- Begg, C. B. & Mazumdar, M. (1994). Operating characteristics of a rank correlation test for publication bias. *Biometrics*, *50*, 1088–1101.
- Bell, S., Clarke, R., Mounier-Jack, S., Walker, J. L., & Paterson, P. (2020). Parents' and guardians' views on the acceptability of a future COVID-19 vaccine: A multi-methods study in England. *Vaccine*, *38*, 7789–7798.
- Bhagavathula, A. S., Massey, P. M., & Khubchandani, J. (2022). COVID-19 testing demand amidst Omicron variant surge: Mass hysteria or population health need? *Brain, Behavior, and Immunity*, *101*, 394.
- Bhopal, S., & Nielsen, M. (2021). Vaccine hesitancy in low-and middle-income countries: Potential implications for the COVID-19 response. *Archives of Disease in Childhood*, *106*, 113–114.
- Bono, S. A., De Moura, F., Villela, E., Siau, C. S., Chen, W. S., Pengpid, S., Hasan, M. T., Sessou, P., Ditekemena, J. D., Amodan, B. O., & Hosseinipour, M. C. (2021). Factors affecting COVID-19 vaccine acceptance: An international survey among Low-and Middle-Income Countries. *Vaccines*, *9*, 515.

- Campochiaro, C., Trignani, G., Tomelleri, A., Cascinu, S., & Dagna, L. (2021). Potential acceptance of COVID-19 vaccine in rheumatological patients: A monocentric comparative survey. *Annals of the Rheumatic Diseases, 80*, 816–817.
- Cascini, F., Pantovic, A., Al-Ajlouni, Y., Failla, G., & Ricciardi, W. (2021). Attitudes, acceptance and hesitancy among the general population worldwide to receive the COVID-19 vaccines and their contributing factors: A systematic review. *EClinicalMedicine, 40*, 101113.
- Chen, M., Li, Y., Chen, J., Wen, Z., Feng, F., Zou, H., Fu, C., Chen, L., Shu, Y., & Sun, C. (2021). An online survey of the attitude and willingness of Chinese adults to receive COVID-19 vaccination. *Human Vaccines & Immunotherapeutics, 17*, 2279–2288.
- Chu, H. & Liu, S. (2021). Integrating health behavior theories to predict American's intention to receive a COVID-19 vaccine. *Patient Education and Counseling, 104*, 1878–1886.
- Di Gennaro, F., Murri, R., Segala, F. V., Cerruti, L., Abdulle, A., Saracino, A., Bavaro, D. F., & Fantoni, M. (2021). Attitudes towards Anti-SARS-CoV2 vaccination among healthcare workers: Results from a national survey in Italy. *Viruses, 13*, 371.
- Dijkshoorn, A. B., Van Stralen, H. E., Sloots, M., Schagen, S. B., Visser-Meily, J. M. & Schepers, V. P. (2021). Prevalence of cognitive impairment and change in patients with breast cancer: a systematic review of longitudinal studies. *Psycho-Oncology, 30*, 635–648.
- Dinga, J. N., Sinda, L. K., & Titanji, V. P. (2021). Assessment of vaccine hesitancy to a COVID-19 vaccine in Cameroonian adults and its global implication. *Vaccines, 9*, 175.
- Ditekemena, J. D., Nkamba, D. M., Mavoko, A. M., Hypolite, M., Siewe Fodjo, J. N., Luhata, C., Obimpeh, M., Van Hees, S., Nachega, J. B., & Colebunders, R. (2021). COVID-19 vaccine acceptance in the Democratic Republic of Congo: A cross-sectional survey. *Vaccines, 9*, 153.
- Dror, A. A., Eisenbach, N., Taiber, S., Morozov, N. G., Mizrachi, M., Zigran, A., Srouji, S., & Sela, E. (2020). Vaccine hesitancy: The next challenge in the fight against COVID-19. *European Journal of Epidemiology, 35*, 775–779.
- Elsayed, M., El-Abasiri, R. A., Abdeer, K. T., Kamal, M. A., Htay, M. N. N., Abler, B. & Marzo, R. R. (2021). Factors influencing decision making regarding the acceptance of the COVID-19 vaccination in Egypt: A cross-sectional study in an urban, well-educated sample. *Vaccines, 10*, 20.
- Gagneux-Brunon, A., Detoc, M., Bruel, S., Tardy, B., Rozaire, O., Frappe, P., & Botelho-Nevers, E. (2021). Intention to get vaccinations against COVID-19 in French healthcare workers during the first pandemic wave: A cross-sectional survey. *Journal of Hospital Infection, 108*, 168–173.
- García, L. Y., & Cerda, A. A. (2020). Contingent assessment of the COVID-19 vaccine. *Vaccine, 38*, 5424–5429.
- Gerussi, V., Peghin, M., Palese, A., Bressan, V., Visintini, E., Bontempo, G., Graziano, E., De Martino, M., Isola, M., & Tascini, C. (2021). Vaccine hesitancy among Italian patients recovered from COVID-19 infection towards influenza and Sars-Cov-2 vaccination. *Vaccines, 9*, 172.
- Graffigna, G., Palamenghi, L., Boccia, S., & Barello, S. (2020). Relationship between citizens' health engagement and intention to take the COVID-19 vaccine in Italy: A mediation analysis. *Vaccines, 8*, 576.
- Grech, V. & Gauci, C. (2020). Vaccine hesitancy in the University of Malta Faculties of Health Sciences, Dentistry and Medicine vis-à-vis influenza and novel COVID-19 vaccination. *Early Human Development, 12*, 105258.
- Grech, V., Bonnici, J. & Zammit, D. (2020a). Vaccine hesitancy in Maltese family physicians and their trainees vis-a-vis influenza and novel COVID-19 vaccination. *Early Human Development, 12*, 105259.
- Grech, V., Gauci, C. & Agius, S. (2020b). Vaccine hesitancy among Maltese healthcare workers toward influenza and novel COVID-19 vaccination. *Early Human development, 12*, 105213.
- Green, M. S., Abdullah, R., Vered, S., & Nitzan, D. (2021). A study of ethnic, gender and educational differences in attitudes toward COVID-19 vaccines in Israel—implications for vaccination implementation policies. *Israel Journal of Health Policy Research, 10*, 1–12.
- Grochowska, M., Ratajczak, A., Zdunek, G., Adamiec, A., Waszkiewicz, P., & Feleszko, W. (2021). A comparison of the level of acceptance and hesitancy towards the Influenza Vaccine and the Forthcoming COVID-19 Vaccine in the Medical Community. *Vaccines, 9*, 475.
- Grüner, S. & Krüger, F. (2020). The intention to be vaccinated against COVID-19: stated preferences before vaccines were available. *Applied Economics Letters, 1*–5.
- Harapan, H., Wagner, A. L., Yufika, A., Winardi, W., Anwar, S., Gan, A. K., Setiawan, A. M., Rajamoorthy, Y., Sofyan, H. & Mudatsir, M. (2020). Acceptance of a COVID-19 vaccine in Southeast Asia: a cross-sectional study in Indonesia. *Frontiers in Public Health, 8*.

- Head, K. J., Kasting, M. L., Sturm, L. A., Hartsock, J. A., & Zimet, G. D. (2020). A national survey assessing SARS-CoV-2 vaccination intentions: Implications for future public health communication efforts. *Science Communication*, *42*, 698–723.
- Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., & Gu, X. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*, *395*, 497–506.
- Hursh, S. R., Strickland, J. C., Schwartz, L. P., & Reed, D. D. (2020). Quantifying the impact of public perceptions on vaccine acceptance using behavioral economics. *Frontiers in Public Health*, *8*, 877.
- Hussain, A., Mahawar, K., Xia, Z., Yang, W., & Shamsi, E.-H. (2020). RETRACTED: Obesity and mortality of COVID-19. Meta-Analysis. *Obesity Research & Clinical Practice*, *14*, 295–300.
- Ilesanmi, O., Afolabi, A., & Uchendu, O. (2021). The prospective COVID-19 vaccine: Willingness to pay and perception of community members in Ibadan. Nigeria. *PeerJ*, *9*, e11153.
- Kaplan, R. M. & Milstein, A. (2021). Influence of a COVID-19 vaccine's effectiveness and safety profile on vaccination acceptance. *Proceedings of the National Academy of Sciences*, 118.
- Kaplan, A. K., Sahin, M. K., Parildar, H. & Adadan Guvenc, I. (2021). The willingness to accept the COVID-19 vaccine and affecting factors among healthcare professionals: A cross-sectional study in Turkey. *International Journal of Clinical Practice*, e14226.
- Kelkar, A. H., Blake, J. A., Cherabuddi, K., Cornett, H., Mckee, B. L. & Cogle, C. R. (2021). Vaccine enthusiasm and hesitancy in cancer patients and the impact of a Webinar. Healthcare, 2021. Multi-disciplinary Digital Publishing Institute, 351.
- Khubchandani, J., Sharma, S., Price, J. H., Wiblehauser, M. J., Sharma, M., & Webb, F. J. (2021). COVID-19 vaccination hesitancy in the United States: A rapid national assessment. *Journal of Community Health*, *46*, 270–277.
- Kociolek, L. K., Elhadary, J., Jhaveri, R., Patel, A. B., Stahulak, B. & Cartland, J. (2021). Coronavirus disease 2019 vaccine hesitancy among children's hospital staff: A single-center survey. *Infection Control & Hospital Epidemiology*, 1–3.
- Kose, S., Mandiracioglu, A., Sahin, S., Kaynar, T., Karbus, O., & Ozbel, Y. (2021). Vaccine hesitancy of the COVID-19 by health care personnel. *International Journal of Clinical Practice*, *75*, e13917.
- Kwok, K. O., Li, K.-K., Wei, W. I., Tang, A., Wong, S. Y. S., & Lee, S. S. (2021). Influenza vaccine uptake, COVID-19 vaccination intention and vaccine hesitancy among nurses: A survey. *International Journal of Nursing Studies*, *114*, 103854.
- Larson, H. J., Jarrett, C., Eckersberger, E., Smith, D. M., & Paterson, P. (2014). Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: A systematic review of published literature, 2007–2012. *Vaccine*, *32*, 2150–2159.
- Latkin, C., Dayton, L. A., Yi, G., Konstantopoulos, A., Park, J., Maulsby, C., & Kong, X. (2021a). COVID-19 vaccine intentions in the United States, a social-ecological framework. *Vaccine*, *39*, 2288–2294.
- Latkin, C. A., Dayton, L., Yi, G., Colon, B., & Kong, X. (2021b). Mask usage, social distancing, racial, and gender correlates of COVID-19 vaccine intentions among adults in the US. *PLoS ONE*, *16*, e0246970.
- Latkin, C. A., Dayton, L., Yi, G., Konstantopoulos, A. & Boodram, B. (2021c). Trust in a COVID-19 vaccine in the US: A social-ecological perspective. *Social Science & Medicine (1982)*, *270*, 113684.
- Lazarus, J. V., Wyka, K., Rauh, L., Rabin, K., Ratzan, S., Gostin, L. O., Larson, H. J., & El-Mohandes, A. (2020). Hesitant or not? The association of age, gender, and education with potential acceptance of a COVID-19 vaccine: A country-level analysis. *Journal of Health Communication*, *25*, 799–807.
- Lazarus, J. V., Ratzan, S. C., Palayew, A., Gostin, L. O., Larson, H. J., Rabin, K., Kimball, S., & El-Mohandes, A. (2021). A global survey of potential acceptance of a COVID-19 vaccine. *Nature Medicine*, *27*, 225–228.
- Ledda, C., Costantino, C., Cuccia, M., Maltezou, H. C., & Rapisarda, V. (2021). Attitudes of healthcare personnel towards vaccinations before and during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, *18*, 2703.
- Lin, Y., Hu, Z., Zhao, Q., Alias, H., Danaee, M., & Wong, L. P. (2020). Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China. *PLoS Neglected Tropical Diseases*, *14*, e0008961.
- Lin, C., Tu, P., & Beitsch, L. M. (2021). Confidence and receptivity for COVID-19 vaccines: A rapid systematic review. *Vaccines*, *9*, 16.

- Lueck, J. A., & Spiers, A. (2020). Which beliefs predict intention to get vaccinated against COVID-19? A mixed-methods reasoned action approach applied to health communication. *Journal of Health Communication, 25*, 790–798.
- Macdonald, N. E. (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*, 4161–4164.
- Machida, M., Nakamura, I., Kojima, T., Saito, R., Nakaya, T., Hanibuchi, T., Takamiya, T., Odagiri, Y., Fukushima, N., & Kikuchi, H. (2021). Acceptance of a COVID-19 Vaccine in Japan during the COVID-19 Pandemic. *Vaccines, 9*, 210.
- Malik, A. A., Mcfadden, S. M., Elharake, J., & Omer, S. B. (2020). Determinants of COVID-19 vaccine acceptance in the US. *EclinicalMedicine, 26*, 100495.
- Mercadante, A. R., & Law, A. V. (2021). Will they, or Won't they? Examining patients' vaccine intention for flu and COVID-19 using the Health Belief Model. *Research in Social and Administrative Pharmacy, 17*, 1596–1605.
- Meyer, M. N., Gjorgjieva, T., & Rosica, D. (2021). Trends in health care worker intentions to receive a COVID-19 vaccine and reasons for hesitancy. *JAMA Network Open, 4*, e215344–e215344.
- Mo, P.K.-H., Luo, S., Wang, S., Zhao, J., Zhang, G., Li, L., Li, L., Xie, L., & Lau, J. T. (2021). Intention to receive the COVID-19 vaccination in China: Application of the diffusion of innovations theory and the moderating role of openness to experience. *Vaccines, 9*, 129.
- Momplaisir, F., Haynes, N., Nkwihoreze, H., Nelson, M., Werner, R. M. & Jemmott, J. (2021). Understanding drivers of COVID-19 vaccine hesitancy among Blacks. *Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 73*, 1784–1789.
- Mouchtouri, V. A., Agathagelidou, E., Kofonikolas, K., Rousou, X., Dadouli, K., Pinaka, O., Agathocleous, E., Anagnostopoulou, L., Chatziligou, C., & Christoforidou, E. P. (2020). Nationwide survey in Greece about knowledge, risk perceptions, and preventive behaviors for COVID-19 during the general lockdown in April 2020. *International Journal of Environmental Research and Public Health, 17*, 8854.
- Murphy, J., Vallières, F., Bentall, R. P., Shevlin, M., McBride, O., Hartman, T. K., Mckay, R., Bennett, K., Mason, L., & Gibson-Miller, J. (2021). Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. *Nature Communications, 12*, 1–15.
- Napolitano, F., Di Giuseppe, G., Montemurro, M. V., Molinari, A. M., Donnarumma, G., Arnese, A., Pavia, M., & Angelillo, I. F. (2021). Seroprevalence of SARS-CoV-2 antibodies in adults and healthcare workers in Southern Italy. *International Journal of Environmental Research and Public Health, 18*, 4761.
- Nehme, M., Stringhini, S., Guessous, I. & Team, S.-P. S. (2020). Perceptions of immunity and vaccination certificates among the general population: a nested study within a serosurvey of anti-SARS-CoV-2 antibodies (SEROCoV-POP). *Swiss Medical Weekly, 150*.
- Nery Jr, N., Ticona, J. P. A., Cardoso, C. W., Prates, A. P. P. B., Vieira, H. C. A., Salvador De Almeida, A., Souza, M. M. D. S., Borba Dos Reis, O., Pellizzaro, M. & Portilho, M. M. (2022). COVID-19 vaccine hesitancy and associated factors according to sex: A population-based survey in Salvador, Brazil. *Plos one, 17*, e0262649.
- Noor, F. M., & Islam, M. (2020). Prevalence and associated risk factors of mortality among COVID-19 patients: A meta-analysis. *Journal of Community Health, 45*, 1270–1282.
- Nzaji, M. K., Ngombe, L. K., Mwamba, G. N., Ndala, D. B. B., Miema, J. M., Lungoyo, C. L., Mwimba, B. L., Bene, A. C. M., & Musenga, E. M. (2020). Acceptability of vaccination against COVID-19 among healthcare workers in the Democratic Republic of the Congo. *Pragmatic and Observational Research, 11*, 103.
- Okorodudu, D. O., & Okorodudu, D. E. (2021). An issue of trust—vaccinating Black patients against COVID-19. *The Lancet Respiratory Medicine, 9*, 228–229.
- Olagoke, A. A., Olagoke, O. O., & Hughes, A. M. (2021). Intention to vaccinate against the novel 2019 coronavirus disease: The role of health locus of control and religiosity. *Journal of Religion and Health, 60*, 65–80.
- Padureanu, V., Bogdan, M., Subtirelu, M.-S., Padureanu, R., Turcu-Stiolică, A., Petrescu, F., Dumitrescu, F. & Mititelu-Tartau, L. (2020). Perceptions of COVID-19 vaccination among healthcare professionals in Romania. *Stress, 22*, 25.
- Page, M. J., Mckenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A. & Brennan, S. E. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Bmj, 372*.

- Palamenghi, L., Barello, S., Boccia, S., & Graffigna, G. (2020). Mistrust in biomedical research and vaccine hesitancy: The forefront challenge in the battle against COVID-19 in Italy. *European Journal of Epidemiology*, *35*, 785–788.
- Papagiannis, D., Rachiotis, G., Malli, F., Papatheanasiou, I. V., Kotsiou, O., Fradelos, E. C., Giannakopoulos, K., & Gourgoulis, K. I. (2021). Acceptability of COVID-19 vaccination among Greek health professionals. *Vaccines*, *9*, 200.
- Pastorino, R., Villani, L., Mariani, M., Ricciardi, W., Graffigna, G., & Boccia, S. (2021). Impact of COVID-19 pandemic on flu and COVID-19 vaccination intentions among university students. *Vaccines*, *9*, 70.
- Petravič, L., Arh, R., Gabrovec, T., Jazbec, L., Rupčič, N., Starešinič, N., Zorman, L., Pretnar, A., Srakar, A., & Zwitter, M. (2021). Factors affecting attitudes towards COVID-19 vaccination: An online survey in Slovenia. *Vaccines*, *9*, 247.
- Pierantoni, L., Lenzi, J., Lanari, M., De Rose, C., Morello, R., Di Mauro, A., Vecchio, A. L., Valentini, P., & Buonsenso, D. (2020). Nationwide COVID-19 survey of Italian parents reveals useful information on attitudes to school attendance, medical support, vaccines and drug trials. *Acta Paediatrica (Oslo, Norway: 1992)*.
- Pogue, K., Jensen, J. L., Stancil, C. K., Ferguson, D. G., Hughes, S. J., Mello, E. J., Burgess, R., Berges, B. K., Quaye, A., & Poole, B. D. (2020). Influences on attitudes regarding potential COVID-19 vaccination in the United States. *Vaccines*, *8*, 582.
- Prati, G. (2020). Intention to receive a vaccine against SARS-CoV-2 in Italy and its association with trust, worry and beliefs about the origin of the virus. *Health Education Research*, *35*, 505–511.
- Priori, R., Pellegrino, G., Colafrancesco, S., Alessandri, C., Ceccarelli, F., Di Franco, M., Riccieri, V., Scrivo, R., Scavalli, A. S., & Spinelli, F. R. (2021). SARS-CoV-2 vaccine hesitancy among patients with rheumatic and musculoskeletal diseases: A message for rheumatologists. *Annals of the Rheumatic Diseases*, *80*, 953–954.
- Qattan, A., Alshareef, N., Alsharqi, O., Al Rahahleh, N., Chirwa, G. C., & Al-Hanawi, M. K. (2021). Acceptability of a COVID-19 vaccine among healthcare workers in the Kingdom of Saudi Arabia. *Frontiers in Medicine*, *8*, 83.
- Rabi, R., Maraqa, B., Nazzal, Z., & Zink, T. (2021). Factors affecting nurses' intention to accept the COVID-19 vaccine: A cross-sectional study. *Public Health Nursing*, *38*, 781–788.
- Rhodes, A., Hoq, M., Measey, M.-A., & Danchin, M. (2021). Intention to vaccinate against COVID-19 in Australia. *The Lancet Infectious Diseases*, *21*, e110.
- Richardson, S., Hirsch, J. S., Narasimhan, M., Crawford, J. M., McGinn, T., Davidson, K. W., Barnaby, D. P., Becker, L. B., Chelico, J. D., & Cohen, S. L. (2020). Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA*, *323*, 2052–2059.
- Robertson, E., Reeve, K. S., Niedzwiedz, C. L., Moore, J., Blake, M., Green, M., Katikireddi, S. V., & Benzeval, M. J. (2021). Predictors of COVID-19 vaccine hesitancy in the UK household longitudinal study. *Brain, Behavior, and Immunity*, *94*, 41–50.
- Rosselli, R., Martini, M., & Bragazzi, N. L. (2016). The old and the new: vaccine hesitancy in the era of the Web 2.0. Challenges and opportunities. *Journal of Preventive Medicine and Hygiene*, *57*, E47.
- Ruiz, J. B., & Bell, R. A. (2021). Predictors of intention to vaccinate against COVID-19: Results of a nationwide survey. *Vaccine*, *39*, 1080–1086.
- Saied, S. M., Saied, E. M., Kabbash, I. A., & Abdo, S. A. E. F. (2021). Vaccine hesitancy: Beliefs and barriers associated with COVID-19 vaccination among Egyptian medical students. *Journal of Medical Virology*, *93*, 4280–4291.
- Salali, G. D., & Uysal, M. S. (2020). COVID-19 vaccine hesitancy is associated with beliefs on the origin of the novel coronavirus in the UK and Turkey. *Psychological Medicine*, 1–3.
- Sallam, M., Dababseh, D., Eid, H., Al-Mahzoum, K., Al-Haidar, A., Taim, D., Yaseen, A., Ababneh, N. A., Bakri, F. G., & Mahafzah, A. (2021a). High rates of COVID-19 vaccine hesitancy and its association with conspiracy beliefs: A study in Jordan and Kuwait among other Arab countries. *Vaccines*, *9*, 42.
- Sallam, M., Dababseh, D., Eid, H., Hasan, H., Taim, D., Al-Mahzoum, K., Al-Haidar, A., Yaseen, A., Ababneh, N. A., & Assaf, A. (2021b). Low covid-19 vaccine acceptance is correlated with conspiracy beliefs among university students in Jordan. *International Journal of Environmental Research and Public Health*, *18*, 2407.

- Salmon, D. A., Dudley, M. Z., Brewer, J., Kan, L., Gerber, J. E., Budigan, H., Proveaux, T. M., Bernier, R., Rimal, R., & Schwartz, B. (2021). COVID-19 vaccination attitudes, values and intentions among United States adults prior to emergency use authorization. *Vaccine*, *39*, 2698–2711.
- Schradang, W. A., Trent, S. A., Paxton, J. H., Rodriguez, R. M., Swanson, M. B., Mohr, N. M., Talan, D. A. & Network, P. C. E. D. (2021). Vaccination rates and acceptance of SARS-CoV-2 vaccination among US emergency department health care personnel. *Academic Emergency Medicine*.
- Schwarzinger, M., Watson, V., Arwidson, P., Alla, F., & Luchini, S. (2021). COVID-19 vaccine hesitancy in a representative working-age population in France: A survey experiment based on vaccine characteristics. *The Lancet Public Health*, *6*, e210–e221.
- Seale, H., Heywood, A. E., Leask, J., Sheel, M., Durrheim, D. N., Bolsewicz, K., & Kaur, R. (2021). Examining Australian public perceptions and behaviors towards a future COVID-19 vaccine. *BMC Infectious Diseases*, *21*, 1–9.
- Shacham, M., Greenblatt-Kimron, L., Hamama-Raz, Y., Martin, L. R., Peleg, O., Ben-Ezra, M., & Mijiritsky, E. (2021). Increased COVID-19 vaccination hesitancy and health awareness amid COVID-19 vaccinations programs in Israel. *International Journal of Environmental Research and Public Health*, *18*, 3804.
- Sharun, K., Rahman, C. F., Haritha, C., Jose, B., Tiwari, R. & Dhama, K. (2020). Covid-19 vaccine acceptance: Beliefs and barriers associated with vaccination among the general population in india. *Journal of Experimental Biology and Agricultural Sciences*, *8*.
- Shekhar, R., Sheikh, A. B., Upadhyay, S., Singh, M., Kottewar, S., Mir, H., Barrett, E., & Pal, S. (2021). COVID-19 vaccine acceptance among health care workers in the United States. *Vaccines*, *9*, 119.
- Sherman, S. M., Smith, L. E., Sim, J., Amlôt, R., Cutts, M., Dasch, H., Rubin, G. J., & Sevdalis, N. (2021). COVID-19 vaccination intention in the UK: Results from the COVID-19 vaccination acceptability study (CoVAccS), a nationally representative cross-sectional survey. *Human Vaccines & Immunotherapeutics*, *17*, 1612–1621.
- Shrestha, R., Meyer, J. P., Sheno, S., Khati, A., Altice, F. L., Mistler, C., Aoun-Barakat, L., Virata, M., Olivares, M. & Wickersham, J. A. (2022). COVID-19 Vaccine Hesitancy and Associated Factors among People with HIV in the United States: Findings from a National Survey. *Vaccines*, *10*, 424.
- Sun, S., Lin, D., & Operario, D. (2021). Interest in COVID-19 vaccine trials participation among young adults in China: Willingness, reasons for hesitancy, and demographic and psychosocial determinants. *Preventive Medicine Reports*, *22*, 101350.
- Szmyd, B., Bartoszek, A., Karuga, F. F., Staniecka, K., Błaszczuk, M., & Radek, M. (2021a). Medical students and SARS-CoV-2 vaccination: Attitude and behaviors. *Vaccines*, *9*, 128.
- Szmyd, B., Karuga, F. F., Bartoszek, A., Staniecka, K., Siwecka, N., Bartoszek, A., Błaszczuk, M., & Radek, M. (2021b). Attitude and behaviors towards SARS-CoV-2 vaccination among healthcare workers: A cross-sectional study from Poland. *Vaccines*, *9*, 218.
- Taylor, S., Landry, C. A., Paluszek, M. M., Groenewoud, R., Rachor, G. S., & Asmundson, G. J. (2020). A proactive approach for managing COVID-19: The importance of understanding the motivational roots of vaccination hesitancy for SARS-CoV2. *Frontiers in Psychology*, *11*, 2890.
- Thaker, J. (2021). The persistence of vaccine hesitancy: COVID-19 vaccination intention in New Zealand. *Journal of Health Communication*, *26*, 104–111.
- Thanapluetiwigong, S., Chansirikarnjana, S., Sriwannopas, O., Assavapokee, T. & Ittasakul, P. (2021). Factors associated with COVID-19 Vaccine Hesitancy in Thai Seniors. *Patient preference and adherence*, *15*, 2389.
- Torreele, E. (2020). The rush to create a covid-19 vaccine may do more harm than good. *Bmj*, *370*.
- Toubasi, A. A., Abuanezh, R. B., Tawileh, H. B. A., Aldebei, R. H., & Alryalat, S. A. S. (2021). A meta-analysis: The mortality and severity of COVID-19 among patients with mental disorders. *Psychiatry Research*, *299*, 113856.
- Troiano, G. & Nardi, A. (2021). Vaccine hesitancy in the era of COVID-19. *Public Health*, *194*, 245–251.
- Trueblood, J. S., Sussman, A. B. & O'leary, D. (2021). The Role of Risk Preferences in Responses to Messaging About COVID-19 Vaccine Take-Up. *Social Psychological and Personality Science*, 1948550621999622.
- Turcu-Stiolică, A., Bogdan, M., Subtirelu, M.-S., Meca, A.-D., Taerel, A.-E., Iaru, I., Kamusheva, M., & Petrova, G. (2021). Influence of COVID-19 on health-related quality of life and the perception of being vaccinated to prevent COVID-19: An approach for community pharmacists from Romania and Bulgaria. *Journal of Clinical Medicine*, *10*, 864.

- Urrunaga-Pastor, D., Bendezu-Quispe, G., Herrera-Añazco, P., Uyen-Cateriano, A., Toro-Huamanchumo, C. J., Rodriguez-Morales, A. J., Hernandez, A. V., & Benites-Zapata, V. A. (2021). Cross-sectional analysis of COVID-19 vaccine intention, perceptions and hesitancy across Latin America and the Caribbean. *Travel Medicine and Infectious Disease*, *41*, 102059.
- Vallée, A., Fourn, E., Majerholm, C., Touche, P., & Zucman, D. (2021). COVID-19 vaccine hesitancy among French people living with HIV. *Vaccines*, *9*, 302.
- Verger, P., Scronias, D., Dauby, N., Adedzi, K. A., Gobert, C., Bergeat, M., Gagneur, A., & Dubé, E. (2021). Attitudes of healthcare workers towards COVID-19 vaccination: A survey in France and French-speaking parts of Belgium and Canada, 2020. *Eurosurveillance*, *26*, 2002047.
- Volpp, K. G., Loewenstein, G., & Buttenheim, A. M. (2021). Behaviorally informed strategies for a national COVID-19 vaccine promotion program. *JAMA*, *325*, 125–126.
- Wang, J., Jing, R., Lai, X., Zhang, H., Lyu, Y., Knoll, M. D., & Fang, H. (2020a). Acceptance of COVID-19 Vaccination during the COVID-19 Pandemic in China. *Vaccines*, *8*, 482.
- Wang, K., Wong, E. L. Y., Ho, K. F., Cheung, A. W. L., Chan, E. Y. Y., Yeoh, E. K., & Wong, S. Y. S. (2020b). Intention of nurses to accept coronavirus disease 2019 vaccination and change of intention to accept seasonal influenza vaccination during the coronavirus disease 2019 pandemic: A cross-sectional survey. *Vaccine*, *38*, 7049–7056.
- Wang, J., Lu, X., Lai, X., Lyu, Y., Zhang, H., Fenghuang, Y., Jing, R., Li, L., Yu, W., & Fang, H. (2021a). The changing acceptance of COVID-19 vaccination in different epidemic phases in China: A longitudinal study. *Vaccines*, *9*, 191.
- Wang, K., Wong, E.L.-Y., Ho, K.-F., Cheung, A.W.-L., Yau, P.S.-Y., Dong, D., Wong, S.Y.-S., & Yeoh, E.-K. (2021b). 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*, *9*, 62.
- Williams, L., Flowers, P., Mcleod, J., Young, D., & Rollins, L. (2021). Social patterning and stability of intention to accept a COVID-19 vaccine in Scotland: Will those most at risk accept a vaccine? *Vaccines*, *9*, 17.
- Woko, C., Siegel, L., & Hornik, R. (2020). An investigation of low COVID-19 vaccination intentions among Black Americans: The role of behavioral beliefs and trust in COVID-19 information sources. *Journal of Health Communication*, *25*, 819–826.
- Wong, L. P., Alias, H., Wong, P.-F., Lee, H. Y., & Abubakar, S. (2020). 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*, *16*, 2204–2214.
- Wong, M. C., Wong, E. L., Huang, J., Cheung, A. W., Law, K., Chong, M. K., Ng, R. W., Lai, C. K., Boon, S. S., & Lau, J. T. (2021). Acceptance of the COVID-19 vaccine based on the health belief model: A population-based survey in Hong Kong. *Vaccine*, *39*, 1148–1156.
- Yang, S., Cao, P., Du, P., Wu, Z., Zhuang, Z., Yang, L., Yu, X., Zhou, Q., Feng, X. & Wang, X. (2020). Early estimation of the case fatality rate of COVID-19 in mainland China: a data-driven analysis. *Annals of Translational Medicine*, *8*.
- Zeballos Rivas, D. R., Lopez Jaldin, M. L., Nina Canaviri, B., Portugal Escalante, L. F., Alanes Fernández, A. M., & Aguilar Ticona, J. P. (2021). Social media exposure, risk perception, preventive behaviors and attitudes during the COVID-19 epidemic in La Paz, Bolivia: A cross sectional study. *PLoS ONE*, *16*, e0245859.
- Zigron, A., Dror, A. A., Morozov, N., Shani, T., Haj Khalil, T., Eisenbach, N., Rayan, D., Daoud, A., Kablan, F., & Sela, E. (2021). COVID-19 vaccine acceptance among dental professionals based on employment status during the pandemic. *Frontiers in Medicine*, *8*, 13.

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