Willingness to obtain COVID-19 vaccination in general population: A systematic review and meta-analysis

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Background The effectiveness of vaccination campaigns in the midst of a pandemic depends on both the vaccine’s effectiveness and the general population’s willingness to be vaccinated. To estimate the proportion of the general population willing to get COVID-19 vaccination and to identify factors, ie, the number of COVID-19 cases and deaths, and WHO Regions contributing to the willingness rate, we conducted a systematic review and meta-analysis compliant with PRISMA 2020 guidelines.

Methods A search of the existing relevant literature was conducted by means of Cochrane Library, Medline, Embase, Registers, and other sources in order to identify studies published between November 2019 and April 2021. A total of 19 studies from 11 countries that satisfied the inclusion criteria (ie, studies exclusively on the general population, and participants aged 16 years and above) were retrieved. Data extraction and quality assessment were conducted. Heterogeneity was quantified using the I² statistic, and publication bias was assessed using funnel plots and the Egger’s test. A meta-analysis and a meta-regression analysis were conducted using STATA 16.1 software.

Results The pooled rate of willingness to receive a COVID-19 vaccine among the general population was calculated to be 60.1% (95% confidence interval (CI) = 51.5, 68.4). Meta-analyses showed, on the one hand, that the highest pooled willingness to get vaccinated was 73% (95% CI = 62.3, 84.1) in the studies of countries with 1000-4000 COVID-19 cases per million population and, on the other, that the same measure was 71% (95% CI = 53.2, 89.1) in countries reporting >400 COVID-19 deaths per million population. The acceptance rates also varied in different WHO regions of the world. The meta-regression analysis showed that a COVID-19 death rate of >400 per million population or higher was significantly associated (P = 0.02) with the willingness rate.

Conclusions The overall willingness among the general global population to get a COVID-19 vaccine is moderately high; however, the existence of hesitancy might be a major obstacle to the global efforts to control the current pandemic. Understanding the critical factors influencing the acceptance of pandemic vaccines may help health authorities to manage emerging public health threats better.

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In the midst of the COVID-19 pandemic, the world has been left with a large number of infections and deaths. In May 2020, the 73rd World Health Assembly issued a resolution that recognized the role of extensive immunization as a global public-health strategy or preventing, containing, and stopping the transmission of SARS-CoV-2 [1]. Safe and effective vaccines are a game-changing tool, and those that protect against Covid-19 are becoming available [2]. However, the critical challenge is distributing vaccines in a way that achieves high vaccination coverage rates and eventually herd immunity.

The reluctance of people to receive safe and recommended available vaccines, known as vaccine hesitancy, had already been a growing concern before the COVID-19 pandemic started [3]. Promoting immunization requires identifying the number of people who are willing and unwilling to be vaccinated, the reasons why they are willing or unwilling to do so, and the most trusted sources of information on which they base their decision-making. Furthermore, to maximize the vaccine’s benefits, a large portion of the population must be vaccinated within a short period of time. Vaccination campaigns that successfully encourage the population to get vaccinated can help reduce the rates of morbidity and mortality related to the emerging disease [4]. Therefore, it is crucial to know how widespread the acceptance of vaccines and the intention to be vaccinated are, which helps to implement effective strategies to improve vaccination coverage rates.

Several studies have identified factors associated with the willingness to receive vaccination against COVID-19 [5-7]. A recent study conducted in Taiwan attributed the low level of such willingness to the small number of cases and deaths reported in the media [7]. Furthermore, it appears that this willingness varies widely in different countries. For example, whereas some previous studies have observed willingness rates lower than 40% in Jordan, Kuwait, Hong Kong, the UK, and Saudi Arabia [8-11], many others done in different countries have reported high acceptance rates [12-14]. Therefore, as vaccine hesitancy is a common, highly variable global phenomenon, there is a need to identify the causes of the high variability in all countries to understand better the hesitancy specific to COVID-19 immunization that could, on a global scale, potentially delay both the ability to get the pandemic under control and subsequent efforts to achieve societal and economic recovery.

Vaccine hesitancy has been listed by the World Health Organization (WHO) as one of the top ten threats to global health in 2019, along with antimicrobial resistance, air pollution and climate change [15]. Consequently, eliminating or reducing public hesitancy and skepticism in the face of vaccination campaigns is a critical factor for policymakers concerned with addressing such threats. They must have a good understanding of the willingness of the population, especially those individuals who are likely to refuse or delay vaccination. To lessen the global effects of the pandemic and to reduce its health and socio-economic impacts, we need, to a large extent, to rely on preventive measures [16,17]. Thus, tremendous effort on the part of the scientific community and the pharmaceutical industry, with the help of government subsidies, has been directed at the development of efficacious and safe vaccines against SARS-CoV-2 [18]. This diligence and determination is evidenced by the quick approval of several vaccines for emergency use.

However, despite the work that has gone into producing successful COVID-19 vaccines, a major barrier to their deployment might be the lack of widespread willingness to receive the approved and prospective COVID-19 vaccines [19]. At present there are a few systematic review and scoping review on COVID-19 hesitancy [20-23], however, those review include the sole dependence on one or two databases in the search, ie, Pubmed, or web of science and demanded the need for more extensive search criteria systematic review. In addition, they also lack important methodological/patient information for which they were not able to perform meta-analysis and meta regression. Therefore, this study aimed to provide such a synthesis of the willingness to be immunized against COVID-19 among the general population and to identify the key factors (ie, the number of COVID-19 cases and deaths, and WHO regions) contributing to the willingness rate.

**METHODS**

The study protocol was registered with the National Institute for Health Research International Prospective Register of Scientific Reviews (PROSPERO; #CRD42021254943) prior to data extraction.

**Search strategy and study selection**

A search of the relevant literature was conducted using Cochrane Library, Medline, Embase, Registers, from inception to 19 February 2021 and a manual search on Google Scholar was performed to identify additional relevant studies to April 2021. Therefore, this review identified studies published between November 2019 and April 2021 that have assessed the prevalence of willingness to get COVID-19 vaccination. Regarding the search syntax employed, Entree controlled vocabulary included terms such as ‘population,’ ‘sars-cov-2 vac-
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VIEWPOINTS
RESEARCH THEME 1: COVID-19 PANDEMIC

The MeSH controlled vocabulary included “population,” “Vaccination,” “COVID-19 Vaccines,” “Attitude,” “Vaccination refusal.” English synonyms and controlled vocabulary were systematically used as items of search syntax while exploring the databases to minimize the likelihood of missing relevant studies. Some studies were also identified using Google Scholar.

The study identification, selection procedure, and critical appraisal of the research studies were conducted according to the checklist provided in the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement of 2020 [24]. As for the inclusion criteria, we sought to focus exclusively on studies on members of the general population aged 16 years old and above. The outcome measure of interest was the overall proportion of adults reporting a willingness to get vaccinated against COVID-19. However, studies that included specific segments of the general population like health care workers, parents, and children were excluded. Furthermore, review articles and studies that had been written in any language other than English were also excluded. The process that was followed to identify the studies to include in this meta-analysis is described in Figure 1.

Quality assessment and data extraction

Quality assessment was performed with the help of the quality assessment tool developed by the Joanna Briggs Institute (JBI) for use in studies reporting prevalence data [25]. The tool consists of 9 items with four possible responses (yes, no, unclear, and not applicable). In order to determine whether each study under consideration was of sufficient quality, a study with a total score of 7 and above was considered to be of an acceptably high quality and so was included in our systematic review. The quality of the studies and their risk of bias were assessed by two reviewers independently; if any disagreement occurred, it was resolved with the evaluation of a third reviewer.

Abstraction of all data was performed independently by two reviewers using a data extraction form. Data were extracted on the following study characteristics: author name and country, sample size, research participant gender, sampling method, COVID-19 vaccine acceptance rate, male and female acceptance rates, response rate, and duration of data collection. Further, cumulative numbers of cases and deaths collected from online website by University of Oxford [26].

Statistical analysis

The statistical analysis was conducted using STATA 16.1 software (StataCorp, College Station, TX, USA). The outcome was analyzed to evaluate the proportion of general population willing to get a COVID-19 vaccine using
a pool of event rates with a 95% confidence interval (CI), a $P$ value, and a fitted model based on the results of a heterogeneity test incorporated into a random effects model. We transformed the proportions with the Freeman-Tukey double arcsine method before pooling the data [27]. The presence of heterogeneity across studies was evaluated by using the $I^2$ statistic. An $I^2$ value of 0%-25% indicates insignificant heterogeneity, 26%-50% indicates low heterogeneity, 51–75% indicates moderate heterogeneity, and >75% indicates considerable heterogeneity [28]. Heterogeneity was further evaluated using Cochran’s Q-statistics with a significance level of $P < 0.10$ [28]. All the results of the meta-analysis were displayed on a forest plot. Egger’s tests were performed to assess publication bias, and funnel plots were constructed to visualize possible asymmetry [29,30]. In order to determine the acceptance rate of vaccination against COVID-19, a subgroup analysis was carried out based on the location where the study was conducted, the number of COVID-19 cases relative to the country’s population, the number of COVID-19 deaths relative to the country’s population, and the numbers of cases and deaths by WHO region. A random effects meta-regression model was used to assess the contributions of each of the potential risk factors.

RESULTS

Of the 1512 studies that were identified from 3 databases and one register, 260 of them were removed as duplicates. The titles and abstracts of 1252 studies were screened, of which 66 met the inclusion criteria and were read in their entirety as part of our systematic review. After the full text had been read, 49 research papers were excluded as they did not satisfy the inclusion criteria. In addition to the remaining 17 studies, two others were identified via Google Scholar. Therefore, this systematic review and meta-analysis were conducted on 19 studies (Figure 1). Furthermore, the quality of the studies included in our research was assessed using JBI quality scores (Table S1 in the Online Supplementary Document).

Study characteristics

The characteristics of the studies included in this review are summarized in Table 1. All the studies adopted a cross-sectional design. They surveyed adults in the general population aged ≥18 years, except for one study with participants aged ≥16 years [10]. Stratified per country, a total of 22 surveys were found. Their sampling methods included snowball sampling (n = 8) [5,8,9,13,31-33], convenience sampling (n = 4) [10,14], stratified random sampling (n = 6) [34-38], quota sampling (n = 4) [6,11,12,39], and multistage probability sampling (n = 1) [40]. The sample sizes ranged from 154 [10] to 5114 [12] participants. The dates that the surveys were administered covered the period from March 2020 [36,38] until December 2020 [10]. Based on the regions into which the WHO divides its member countries, eleven studies were conducted in the European region (EUR) [11,12,14,31-35,37,39], six were conducted in the Eastern Mediterranean Region (EMR) [5,8-10], three were conducted in the Region of the Americas (AMR) [6,38,40], and two were conducted in the Western Pacific Region (WPR) [13,36]. The highest presentation of the male and female was in the study of Freeman et al. [12], whereas the lowest presentation of the male and female was in Sallam et al. [10].

The willingness of survey respondents to receive a COVID-19 vaccine was evaluated in 22 studies [5,6,8-14,31-39,40], and the results showed a rate of willingness ranging from 23.6% (95% CI = 20.7, 26.7) [10] (a study conducted in Kuwait) to 92% (95% CI = 90.0, 93.5) [14] (a study conducted in Italy). Stratified per country and survey end date, the highest number of COVID-19 cases per million population (34 546.03 cases) was reported in the study conducted in Kuwait by Sallam et al. [10], whereas the lowest number (0.10 cases) was observed in the USA by Mallik et al. [38]. Likewise, stratified per country and survey end date, the highest number of COVID-19 deaths per million population (643.27 deaths) was reported in the study conducted in the UK by Freeman et al. [12], whereas the lowest number (<0.01 deaths) again comes from the study by Mallik et al. [38].

Overall prevalence of COVID-19 vaccination willingness

Calculated according to a random effects model, the pooled proportion of the willingness to receive a COVID-19 vaccine for data on a total of 33 844 participants from 22 survey was 60.1% (95% CI = 51.5, 68.4) with a high degree of heterogeneity ($I^2 = 99.6$%; $P < 0.01$; $r^2 = 0.17$) (Figure 2). Figure 3 shows the funnel plot of these 22 studies to be symmetrical, and the Egger’s test ($P = 0.67$) showed no evidence of publication bias. Furthermore, to identify the causes of heterogeneity and point prevalence, 20 studies [5,6,9-14,31-36,38,39,40] were included in the subgroup analysis since these studies provided their survey dates.
### Table 1. Showing main characteristics of the studies included in systematic review, meta analysis and meta regression

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>WHO Regions</th>
<th>Sample size</th>
<th>Age</th>
<th>Female (%)</th>
<th>Male (%)</th>
<th>Sampling Method</th>
<th>COVID-19 Vaccine Acceptance (n)</th>
<th>Response rate (%)</th>
<th>Data collection start date</th>
<th>Data collection end date</th>
<th>COVID-19 cases per 1 million population</th>
<th>COVID-19 Deaths per 1 million population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akarsu, et al. [33]</td>
<td>Turkey</td>
<td>EUR</td>
<td>759</td>
<td>18 and above</td>
<td>63</td>
<td>37</td>
<td>Snowball sampling</td>
<td>377</td>
<td>NR</td>
<td>June 10, 2020</td>
<td>July 10, 2020</td>
<td>2501.39</td>
<td>63.11</td>
</tr>
<tr>
<td>Al-Mohaithef, et al. [8]</td>
<td>Saudi Arabia</td>
<td>EMR</td>
<td>992</td>
<td>18 and above</td>
<td>66</td>
<td>34</td>
<td>Snowball sampling</td>
<td>642</td>
<td>99.2</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Biasio et al. [14]</td>
<td>Italy</td>
<td>EUR</td>
<td>885</td>
<td>18 and above</td>
<td>50</td>
<td>50</td>
<td>Convenient sampling</td>
<td>814</td>
<td>NR</td>
<td>June 52020</td>
<td>June 132020</td>
<td>3914.06</td>
<td>567.32</td>
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<tr>
<td>Feleszko, et al. [39]</td>
<td>Poland</td>
<td>EUR</td>
<td>1066</td>
<td>18 and above</td>
<td>50</td>
<td>50</td>
<td>Quota sampling</td>
<td>394</td>
<td>NR</td>
<td>June 02, 2020</td>
<td>June 09, 2020</td>
<td>728.20</td>
<td>31.26</td>
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<tr>
<td>Freeman, et al. [12]</td>
<td>UK</td>
<td>EUR</td>
<td>5114</td>
<td>18 and above</td>
<td>51</td>
<td>50</td>
<td>Quota sampling</td>
<td>3666</td>
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<td>October 17, 2020</td>
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<tr>
<td>Gabriele Prati [32]</td>
<td>Italy</td>
<td>EUR</td>
<td>624</td>
<td>18 and above</td>
<td>54</td>
<td>50</td>
<td>Snowball sampling</td>
<td>474</td>
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<td>April 30, 2020</td>
<td>1828.82</td>
<td>217.57</td>
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<td>Grillienga et al. [37]</td>
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<td>EUR</td>
<td>1004</td>
<td>18 and above</td>
<td>51</td>
<td>49</td>
<td>Stratified sampling</td>
<td>588</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
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<tr>
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<td>Greece</td>
<td>EUR</td>
<td>1004</td>
<td>18 and above</td>
<td>49</td>
<td>51</td>
<td>Stratified random sampling</td>
<td>579</td>
<td>33.5</td>
<td>April 28, 2020</td>
<td>May 03, 2020</td>
<td>251.94</td>
<td>13.82</td>
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<tr>
<td>Latkin, et al. [40]</td>
<td>US</td>
<td>AMR</td>
<td>1043</td>
<td>18 and above</td>
<td>70</td>
<td>30</td>
<td>Multistage probability sampling</td>
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<td>May 18, 2020</td>
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<tr>
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<td>AMR</td>
<td>672</td>
<td>18 and above</td>
<td>57</td>
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<td>Stratified sampling</td>
<td>450</td>
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<td>March 01, 2020</td>
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<td>Salali et al. [31]</td>
<td>UK</td>
<td>EUR</td>
<td>1088</td>
<td>18 and above</td>
<td>68</td>
<td>32</td>
<td>Snowball sampling</td>
<td>892</td>
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<td>May 01, 2020</td>
<td>May 27, 2020</td>
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<td>404.41</td>
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<td>Salali et al. [31]</td>
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<td>EUR</td>
<td>3936</td>
<td>18 and above</td>
<td>63</td>
<td>37</td>
<td>Snowball sampling</td>
<td>2637</td>
<td>66</td>
<td>May 01, 2020</td>
<td>May 30, 2020</td>
<td>1451.19</td>
<td>38.63</td>
</tr>
<tr>
<td>Schwarzinger, et al.[34]</td>
<td>France</td>
<td>EUR</td>
<td>1942</td>
<td>18 and above</td>
<td>51</td>
<td>49</td>
<td>Stratified random sampling</td>
<td>1382</td>
<td>97.1</td>
<td>June 22, 2020</td>
<td>July 03, 2020</td>
<td>3053.57</td>
<td>442.48</td>
</tr>
</tbody>
</table>

NR – not reported

*a-include other gender, 19 studies stratified by per country survey n=22 survey.
Prevalence related to COVID-19 cases per million population.

Figure 4 shows the pooled rate of willingness to be vaccinated against COVID-19 based on the number of COVID-19 cases per million population in each country during data collection. The pooled prevalence was highest, 73% (95% CI = 62.3, 84.1), for the 6 studies [14,31-34] where the number of COVID-19 cases was between 1000 and 4000 per million population, with a high degree of heterogeneity ($I^2 = 98.5\%$; $P < 0.01$; $\tau^2 = 0.02$) (Figure 4).

Prevalence related to COVID-19 deaths per million population.

Figure 5 shows the pooled vaccine acceptance rate based on the number of COVID-19 deaths per million population in each country during data collection. The pooled prevalence of 4 studies [11,12,14,34] having COVID-19 deaths >400 and above per 1 million was highest, 71% (95% CI = 53.2, 89.1) with high heterogeneity (Figure 5).

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**Figure 4.** Pooled willingness rate of COVID-19 vaccine based on the number of COVID-19 cases within each country (19 studies stratified by per country survey n = 22 survey).

**Figure 5.** Pooled willingness rate of COVID-19 vaccine based on the number of COVID-19 deaths within each country (19 studies stratified by per country survey n = 22 survey).
COVID-19 prevalence by WHO regions

Ten of the studies we reviewed [11,12,14,31-35,39] presented prevalence rates of the willingness to receive a COVID-19 vaccine for the European region. In these studies, the willingness rates ranged from 37% (95% CI = 31.1, 43.0) [39] to 92% (95% CI=85.1, 99.2) [14]. The pooled prevalence across the ten studies was 64%. The result of the test for heterogeneity was 98.1% \( P < 0.01; \tau^2 = 0.04 \), with a degree of inconsistency (Figure 6). Two other studies [13,36] presented such prevalence rates for the Western Pacific region (Figure 6). Both studies were conducted in China. In these studies, the pooled prevalence was 87% (95% CI=80.3, 95.1). The degree of heterogeneity for this region was 85.8% \( P < 0.01; \tau^2 = 0.04 \), with a degree of inconsistency.

Meta-regression

A meta-regression analysis was performed to identify the factors behind the high heterogeneity associated with the pooled prevalence of COVID-19 vaccine acceptance among the general population (Table 2). By combining the possible explanatory variables in a single model, we found that COVID-19 deaths per million population and WHO regions significantly affected the willingness rate. In particular, in contrast to the studies conducted in the EMR, significantly high prevalence estimates were found in the studies conducted in the WPR (\( P = 0.05 \)) and AMR (\( P = 0.03 \)). Based on the results of the meta-regression analysis, the combination of COVID-19 deaths per million population, COVID-19 cases per million population, and WHO regions showed that 21.96% of the residual variation between studies was due to heterogeneity \( P < 0.01 \).

**DISCUSSION**

This systematic review and meta-analysis evaluated the prevalence of the willingness to get COVID-19 vaccination during the ongoing pandemic. A comprehensive search for relevant studies yielded 19 studies [5,6,8-14,31-39,40] from 11 countries. Our finding of a 60.1% acceptance rate suggests a moderate to high level of willingness among the general population. On the other hand, this finding also indicates that a hesitancy to get vaccinated against COVID-19 exists, which may be attributed to several reasons. It has been shown that the causes of this resistance include concerns about safety, in particular the fear that a vaccine produced in a
rush is too dangerous; the belief that the vaccine is useless because of the perception that COVID-19 is harmless; a general lack of trust; doubts about the efficiency of the vaccine; the belief in pre-existing immunity; and doubts about the provenance of the vaccine [41].

We also identified several factors responsible for the high heterogeneity among existing studies on the proportion of people who are willing to get a COVID-19 vaccine. From the subgroup analysis performed in this study, we found that the highest pooled vaccination acceptance rate was 73%, which was observed in countries having 1000-4000 COVID-19 cases per million population, and the highest pooled acceptance rate was 71% in countries with at least >400 COVID-19 deaths per million population. Furthermore, the high willingness rates of 64% and 84% were found in the EUR and WPR studies. The meta-regression analysis demonstrated that the willingness rate is associated with a high number of COVID-19 deaths per million population; however, the number of COVID-19 cases per million population was not a significant moderator when controlled for gender. During the current public health emergency, promoting and increasing the uptake of a vaccine released for emergency use by the target population is a difficult challenge for public health authorities which should be addressed carefully. Otherwise, it may impede efforts to manage this highly infectious disease.

Prior studies have reported a hesitancy to get vaccinated in countries that consistently report low numbers of COVID-19 cases and deaths. A possible reason for this is if individuals who feel that the risks of catching disease is not very severe may be less willing to face any perceived risks resulting from vaccination [42]. However, our study found that a low acceptance rate of COVID-19 vaccination was seen in studies with a high number of cases (>4000 COVID-19 cases per 1 million people), whereas a high acceptance rate was high deaths (>400 COVID-19 deaths per 1 million). The lowest acceptance of willingness among countries like Kuwait, Saudi Arabia, and Jordan reported the lowest rates of willingness despite the burdensome spread of COVID-19. This finding has been attributed to the low level of trust in the government and the low levels of education found in these countries [10]. On the other hand, the moderate number of COVID-19 deaths could also potentially explain this lack of willingness.

The willingness rates in the studies conducted in the UK [11,12,31] and the US can best be described as fluctuating at different points in time. It was observed, however, by Qunaibi et al. that several surveys conducted in the last third of 2020 have shown a decrease in vaccination acceptance compared with previous surveys [43]. A systematic review by Lin and colleagues [44] showed that the acceptance rates were decreasing over time in many countries, and that common factors were perceived risk, concerns over vaccine safety and effectiveness, doctors’ recommendations, and inoculation history.

Using the WHO regions groupings of its member countries, we found a high prevalence of acceptance in the EUR (64%) and the WPR (87%). Based on our assessment, EUR countries exhibited a moderate rate of willingness, with the exception of Greece [35] and Poland [39]. The European willingness rates ranged from 37% in Poland to 92% in Italy. It seems that Polish people are more hesitant to get a COVID-19 vaccine compared to other European populations because of a societal opposition towards vaccination seen especially among elderly people who are hard to convince to get vaccination [39]. A similar variability across countries was observed in 2009 regarding the acceptance of the H1N1 vaccine during the influenza pandemic, with the willingness rate ranging between 8% and 67% [45]. Poland again reported very low acceptance rates, coming second to last in Europe [46]. Low willingness rates decrease vaccination rates, which eventually worsens the situation and negatively affects the population’s health and the country’s economy. This assertion is lent credence by the fact that vaccine hesitancy has been shown to hinder efforts to control and lessen the negative consequences of the COVID-19 pandemic, at least in certain countries or regions [47]. Therefore, there is an urgent need for awareness-raising campaigns to be designed and implemented by public health officials aiming to increase acceptance of COVID-19 vaccines among the general population.

The WPR had the highest acceptance rate among all WHO regions, even though it is only marginal statistically significant. It has been suggested that the reason for this high degree of willingness despite consistently low numbers of COVID-19 cases and deaths in the region was the increased threat of COVID-19 infection, which tended to outweigh other factors (eg, lacking confidence in the vaccine) that have been reported as barriers to accepting COVID-19 vaccination [48]. On the other hand, countries throughout the world face severe problems related to providing an adequate supply of vaccines for their populations, ensuring the fair distribution of the vaccines, and addressing the uncertainty about the long-term efficacy of the vaccines as they work to implement their COVID-19 vaccination programs [49].

During the H1N1 influenza pandemic, Bish and colleagues reported that the perceived susceptibility to the disease and the perceived severity of the disease were essential predictors of protective behaviors such as vaccination [50]. Our results support this finding as we observed that a large number of COVID-19 deaths was
associated with a high degree of COVID-19 vaccination acceptance. These findings are of utmost importance to efforts to develop strategies in order to modify people’s perceptions of their own risk in a way that will further encourage the general population to obtain vaccination during public health emergencies.

In this systematic review and meta-analysis, we searched different databases using various strategies and selected good quality research reports based on the evaluation and agreement of three reviewers. To ensure that our evidence was robust, we included the number of COVID-19 cases and deaths in various countries relative to each country's population at the time of the data collection in our subgroup analysis. However, the present study has some limitations. Our study was limited by the response bias and the social desirability bias that were inherent in the original studies. Study lacks data from other WHO region like Africa region (AFR) and Southeast Asian Region (SEAR), which demand the need for extensive review from all the region for generalizability of results. Furthermore, all the studies included in this review were cross-sectional studies, making causal inferences impossible. This review only includes published papers. We were not able to include other important sources published in social media like Facebook [51]. Lastly, the multivariate analysis assumed that there existed linearity in the variables, which may not be the case. For example, ecological bias may have been a confounding factor. Despite the heterogeneity in the data and the small sample sizes in some subgroup analyses, a meta-analysis remains a valuable method for the formal exploration of data, providing a more transparent, formalized, and robust assessment of the consistency of the effect being examined.

CONCLUSIONS

This study suggests that the prevalence of the willingness to be vaccinated against COVID-19 is 60.1% (95% CI: 51.5, 68.4) across different populations around the world. This means vaccine hesitancy exists among the general global population, which could be a serious problem for efforts to control the current pandemic. Considerable variability was found among countries and regions of the world regarding this willingness. The general populations of the countries of the EMR showed low acceptance rates, whereas in the WPR, where the outbreak was first reported, the degree of willingness was the highest, even though it is only marginally statistically significant. Therefore, national health authorities should publicly announce the number of COVID-19 deaths as doing so could increase the public awareness of the severity of the crisis, which, in turn, could lead to an increase in vaccine acceptance. There is a need for specific strategies that address the factors behind the public’s reluctance to be vaccinated during a pandemic in order to increase the overall rate of vaccine uptake and help health authorities to manage the emerging public health concern better.

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Additional material
Online Supplementary Document

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