






REVIEW

COVID-19 vaccination intention in the first year of the pandemic: A systematic review

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Abstract

Aims and objectives: To synthesise evidence regarding vaccination intention, identify factors contributing to vaccine hesitancy among healthcare professionals and the general populations globally.

Background: As COVID-19 vaccine becomes available worldwide, attention is being directed to community vaccine uptake, to achieve population-wide immunity. A number of factors have been reported to influence vaccine intention.

Methods: Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a systematic search of COVID-19 vaccination intention related literature published on or before 31 December 2020 from seven databases was undertaken.

Results: Thirty articles were included in this systematic review. Overall COVID-19 vaccination intention during the first year of the pandemic ranged from 27.7% to 93.3%. Findings highlighted that socio-demographic differences, perceptions of risk and susceptibility to COVID-19 and vaccine attributes influenced vaccination intention. Healthcare professionals particularly, nurses have higher vaccine hesitancy reportedly due to concerns regarding vaccine safety and efficacy and mistrust of health authorities. Negative information about COVID-19 vaccines in the social media and low confidence in the health system were associated with lower acceptability among the community. Interestingly, cumulative increase in COVID-19 caseloads of countries over time was not associated with vaccination intention.

Conclusions: The significant variability in vaccine intention rates worldwide would hamper efforts to achieve immunity against COVID-19. Nurses' concerns about vaccine safety and efficacy need to be addressed to increase vaccine acceptance and maximise their influence on vaccination decision in the community. As misinformation through social media negatively impacts vaccination uptake, authoritative and reliable information on vaccine attributes, disease risks and vaccination benefits are needed.

Relevance to clinical practice: Concerns about vaccine safety and efficacy including misinformation are important contributors to vaccine hesitancy. Addressing these factors, particularly among nurses who are considered trusted influencers of vaccination decisions in the community is an important strategy for pandemic preparedness.

KEYWORDS

coronavirus, COVID-19, vaccination, vaccine acceptance, vaccine hesitancy, vaccine uptake

1 | INTRODUCTION

The emergence of SARS-CoV-2 in the latter part of 2019 is perhaps the biggest health threat in living memory. This novel coronavirus that causes COVID-19, remains a significant threat to life (Fauci et al., 2020). The rapid spread of this disease has caused substantial burden on morbidity and mortality, particularly among older people, causing a need to quarantine and physical distance to reduce transmission. In addition, restriction measures have contributed to a major global economic downturn (Mehta, 2020). The cataclysmic impact of the COVID-19 pandemic on health and economy globally has contributed to an unprecedented pace in COVID-19 vaccine development to gain herd immunity.

Effective vaccine development usually takes an average of 10 years, but in the case of COVID-19 vaccines, 10 were developed and were being tested in clinical trials by June 2020. Of these, two received Emergency Use Authorization in December 2020 to be rolled out before the end of 2020 (Mullard, 2020). Despite this unprecedented success in vaccine development, convincing the population to accept vaccination against COVID-19 remains a major challenge (World Health Organization, 2021). Vaccination intention can be broadly defined to include willingness to be vaccinated, vaccine acceptability including desirability, vaccine demand and positive attitudes towards the given vaccine, which is contrasted to vaccine resistance, the refusal to be vaccinated (Gates et al., 2021). Of most concern to public health is the issue of vaccine hesitancy, which can be defined as indecision, reluctance or concerns regarding vaccination for oneself or loved ones or delay in the uptake of vaccines (Dubé et al., 2013). This indecision or reluctance towards COVID-19 vaccination can severely jeopardise herd immunity, which is the indirect protection conferred on vulnerable populations when a sufficiently large number of individuals who are immune to the disease within a population (Randolph & Barreiro, 2020). Therefore, as the race to COVID-19 vaccine development is reaching the finish line, attention is now focused on community vaccine uptake, to achieve population-wide immunity. Pivotal in this effort is vaccine acceptance among healthcare professionals, particularly nurses, who are at the frontline of health care to promote vaccine acceptance by the public.

A range of factors are known to influence vaccination intention, which include personal socio-demographic characteristics, individual beliefs and experiences, to broader external or organisational factors (Dube et al., 2015). Among parents from minority populations, willingness to have their children vaccinated has been influenced by concerns regarding the threat of the infection, perceived

What does this paper contribute to the wider global clinical community?

- COVID-19 vaccine intention in the first year of the pandemic was 27.7% to 93.3%. The low rate in some countries would hamper efforts to achieve herd immunity.
- Nurses and nursing assistants were found to have higher vaccine hesitancy than other healthcare professionals.
- Media misinformation, particularly from social media, remains a challenge to vaccination uptake.

susceptibility of their children and confidence of vaccine effectiveness (Frew et al., 2011). In relation to COVID-19 vaccine uptake intention, there have been several studies published in 2020 alone, focusing on the general public, healthcare workers, as well as on specific at-risk groups. The aim of this review was to assess intention to receive a COVID-19 vaccine, and to identify factors shown to be associated with vaccine acceptability. Additionally, this review also aimed to examine if the vaccination intention among nurses and other healthcare professionals were significantly different from that of the community in general. Findings from this review will contribute to understanding the challenges related to vaccine hesitancy across all population groups, and explore strategies to overcome these challenges.

2 | METHODS

This review was designed to explore COVID-19 vaccination intention of any people 18 years and above, and factors that influence uptake intention. This review was undertaken using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (see Supporting Information; Liberati et al., 2009) and followed a pre-defined protocol (PROSPERO #CRD42020224269).

2.1 | Search terms and strategies

The search strategy for this study was tailored to each database according to the indexing terms, including Medical Subject Headings (MeSH), truncations and Boolean operators. A combination of terms for the concepts of COVID-19 (SARS-CoV-2, novel coronavirus,

coronavirus), vaccine (vaccination, inoculation and immunisation) and intention (attitude, acceptance, barriers, hesitancy, perception, refusal, uptake, utilisation and willingness) were used. In total, seven databases were searched CINAHL, Cochrane Library, Google Scholar, ProQuest, PsycINFO, PubMed and Scopus. Database searches commenced from 17 December 2020, and the date of the last search was performed on 31 December 2020. The reference lists of included studies were also reviewed for inclusion, as well as recent citations of the included studies. Any alerts of studies published before 31 December 2020 were included.

2.2 | Inclusion and exclusion criteria

Studies that aimed to investigate attitude and perceptions of people towards COVID-19 vaccine were included. These included studies

that used cross-sectional, observational or qualitative approaches that focused on COVID-19 vaccination intention. In addition to the three key concepts (COVID-19, vaccine and intention), all population groups were included. Studies published in languages other than English and Arabic were excluded from this review. Pre-print references with no evidence of acceptance by peer-reviewed journals up to 31 December 2020 were excluded from this review.

2.3 | Screening

All records retrieved from the seven databases that met the inclusion criteria were downloaded using the reference management software, EndNote Version X9.0. Following removal of duplicate references, two authors (DM and YS) screened to exclude irrelevant records, firstly by title and then by abstract. Upon

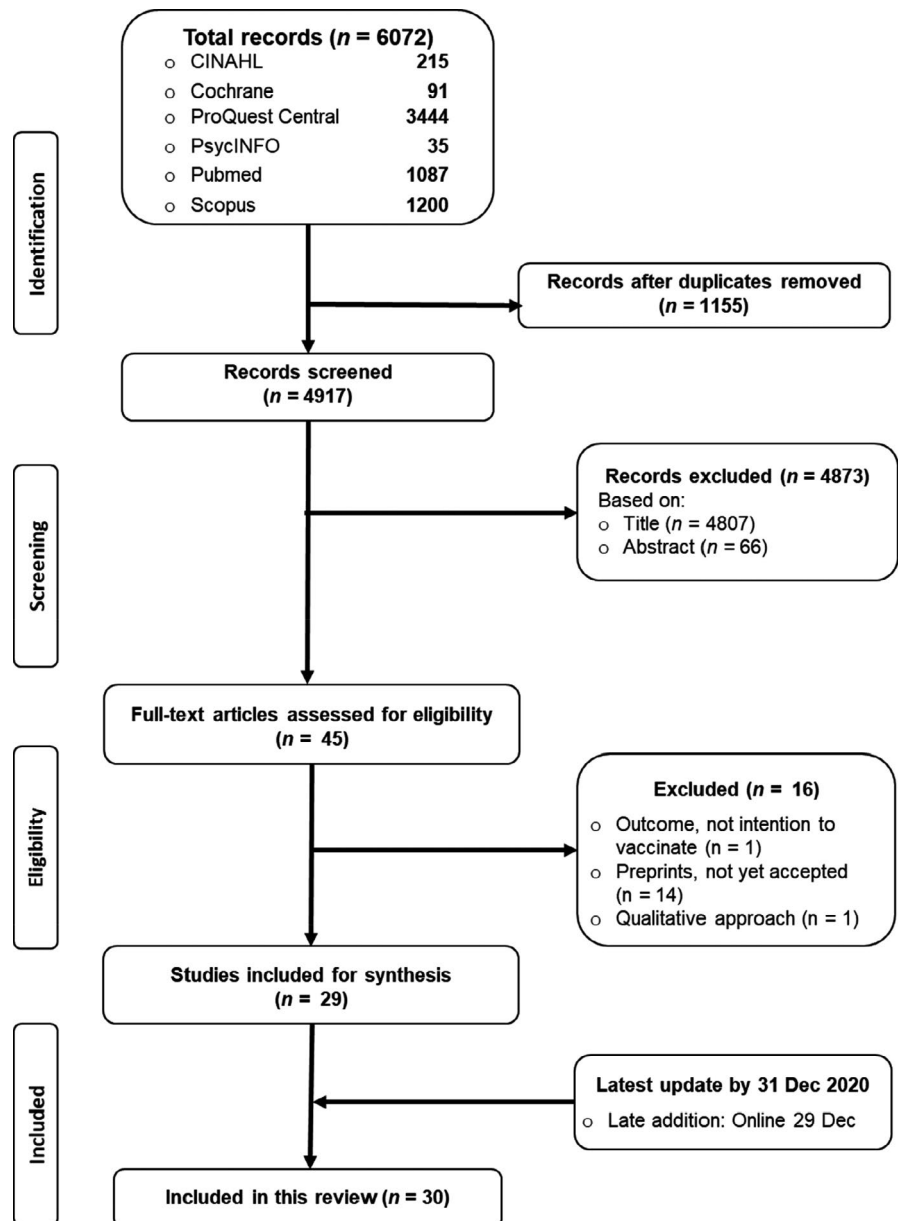


FIGURE 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart for the systematic review

TABLE 1 Summary of included studies published in 2020 on COVID-19 vaccination intention

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
1 Al-Mohaithef and Padhi (2020) Saudi Arabia	Aim To assess the prevalence of COVID-19 vaccine acceptance and their determinants among people in Saudi Arabia Study design Cross-sectional study of participants from Saudi Arabia recruited through social media and snowball sampling	Sample size n = 992 (no specified date of recruitment but stated that it was during the lockdown period) Key measures • Knowledge and perceptions towards COVID-19 • Trust in the health system • Participants willingness to accept the COVID-19 vaccine	<ul style="list-style-type: none"> • Sample characteristics: 27% (aged 18–25); 44% (26–35), 24% (36–45); 5% (above 45); 66% females; 52% married; 82% Saudi; 50% had graduate level education; 43% government employees • 65% vaccine acceptance; 7% vaccine hesitancy; 28% not sure • Higher willingness to be vaccinated among older age group, married, post-graduate degree or higher level of education, non-Saudi (migrants), government employee • Significant predictors of vaccine acceptance—aged above 45 years (2x); Married (1.8x); Trust in the health system (3x); Perceived risk of acquiring the infection (2x) 	<ul style="list-style-type: none"> • Quality Assessment Score: 89% • Limitation: low number of participants above 45 years • Date of recruitment not stated • Strength—large sample size (n = 992); representing four major cities of Saudi Arabia; included non-Saudi citizens (18%)
2 Barelo et al. (2020) Italy (69% from Lombardy and Lazio)	Aim To explore students' attitudes towards a future vaccine to prevent COVID-19 To evaluate the impact of healthcare versus non-healthcare curricula on the intention to vaccinate Study design Cross-sectional study of Italian university students recruited through university mailing lists	Sample size N = 934 (81% response rate) n = 551 healthcare students n = 383 non-healthcare students Key measures Intention to vaccinate	<ul style="list-style-type: none"> • Sample characteristics: 79.6% female; mean age 23.6 years (SD = 4.9); 58.9% healthcare students (medicine, nursing); 41.1% non-healthcare (economics, law, engineering, physics, math, human sciences) • 86.1% students reported intention to vaccinate for COVID-19 coronavirus; 13.9% would not or were not sure to vaccinate • No significant differences between healthcare/non-healthcare students' intention to vaccinate 	<ul style="list-style-type: none"> • Quality Assessment Score: 33% • Strength: good response rate

(Continues)

TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
3 Bertin et al. (2020) France	Aim To explore the relationship between COVID-19 conspiracy beliefs and attitudes towards vaccines science To examine the relationship of conspiracy beliefs with the intention to be vaccinated against COVID-19 Study design Two cross-sectional studies Participants: In Study 1: Social media users; French participants In Study 2: undergraduate university students and social media users (France)	Sample size Study 1: n = 409 (recruited 2 days after official lockdown in France to 27 March 2020) Study 2: n = 396 (not reported when recruitment occurred, but indicated it was post-Study 1) Key measures Study 1: • COVID-19 conspiracy beliefs • Attitude towards vaccination Study 2: • COVID-19 conspiracy beliefs • Chloroquine conspiracy beliefs • Conspiracy mentality questionnaire • Attitude towards chloroquine treatment • Attitude towards vaccination • Vaccination intention in 1–7 scale	Study 1: • The more participants endorsed COVID-19 conspiracy beliefs, the less likely it was that they held a positive attitude towards vaccination Study 2: • All types of conspiracy beliefs (outgroup, ingroup, pro-chloroquine) were negative predictors of both positive attitudes towards vaccination and intention to get vaccinated • All types of conspiracy beliefs positively predicted a pro-chloroquine attitude • Conspiracy mentality had the same relationship as COVID-19 and chloroquine conspiracy beliefs with vaccine attitudes, intention to be vaccinated, and pro-chloroquine attitudes • Vaccination intention scale, 22% of the sample answered below the median point, and among them, 7.3% reported that they would 'refuse vaccination without hesitation'	Quality Assessment Score: 78% Limitations: • Cross-sectional and self-report and there might be unmeasured factors not covered in the two studies • Sample size is not representative of the French population Strength: • Presented a comprehensive process of how conspiracy beliefs could be measured in relation to intention to be vaccinated
4 Bogart et al. (2020) USA	Aim To examine relationships between mistrust with COVID-19 vaccine and antiretroviral (ART) adherence among HIV-positive Black Americans Study design Cross-sectional study of participants from a parent study of Black Americans living with HIV in the community	Sample size n = 103 (recruited between May and July 2020) Key measures • A 10-item COVID-19 mistrust scale • A 3-item COVID-19 vaccine and treatment hesitancy • ART adherence assessed using Medication Events Monitoring System (MEMS)	Sample characteristics: Mean age: 50 years; only 14% employed; 77% gay or bisexual males; half were homeless or in temporary housing; and only half had good adherence to ART • Tested for COVID-19; 31%, only one was found to be positive • High levels of COVID-19 mistrust, with approximately half concerned about lack of honesty by the government • Over half showed COVID-19 vaccine or treatment hesitancy, with one-third declining vaccination • COVID-19 vaccine mistrust was associated with vaccine hesitancy, controlling for socio-demographic factors	Quality Assessment Score: 78% Limitations: small, convenience sampling; no females recruited • Study strength: homogenous group of ethnic minority group (Black Americans) of men living with HIV

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TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
5 Dodd et al. (2020) Australia	Aim To examine actions or intentions towards flu vaccine and a potential COVID-19 vaccine Study design Cross-sectional online survey in Australia	Sample size n = 4,362 Australians (April 17–21, 4 weeks after lockdown measures) Key measures • Intention to vaccinate for both flu and the potential COVID-19 vaccine	<ul style="list-style-type: none"> • For intention to vaccinate for COVID-19, 4.9% said they would not get the vaccine; 9.4% were indifferent and 85.8% expressed intention to be vaccinated • Refusal to get COVID-19 vaccination was associated with the belief that COVID-19 threat has been exaggerated • Inadequate health literacy and lower education level were significantly associated with a reluctance to be vaccinated against COVID-19 	<ul style="list-style-type: none"> • Quality Assessment Score: 44% • The article is a correspondence letter published at the Lancet, presenting snapshot of the results
6 Dong et al. (2020) China	Aim To examine how factors related to vaccine characteristics, their social normative influence and convenience of vaccination can affect the public's preference for the uptake of the COVID-19 vaccine in China Study design Cross-sectional online survey to general Chinese population via WJX (survey company)	Sample size n = 1,236 Key measures • Public preference in selecting the COVID-19 vaccine	<ul style="list-style-type: none"> • Strong public preference for high effectiveness of the vaccine, followed by long protective duration, very few adverse events and being manufactured overseas • Price was the least important attribute affecting the public preference in selecting the COVID-19 vaccine 	<ul style="list-style-type: none"> • Quality Assessment Score: 89% • Good sample size and attributes used in the study were from initial analysis

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TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
7 Dror et al. (2020) Israel	Aim To examine acceptance of COVID-19 vaccine among health care workers and the general public in Israel population Study design Cross-sectional survey	Sample size n = 1,941 Key measures • Acceptance of COVID-19 vaccine	<ul style="list-style-type: none"> Healthcare staff involved in the care of COVID-19 patients and those who considered themselves as at risk were more likely to report acceptance of COVID-19 vaccine. Doctors expressed higher vaccine acceptance than nurses Those healthcare workers not caring for COVID-19 positive patients have higher vaccine hesitancy For the general public, males and parents with kids were likely to accept the vaccine Strongest predictor for acceptance COVID-19 vaccination was current flu vaccinations- people who had flu vaccines is likely to accept COVID-19 vaccine 	<ul style="list-style-type: none"> Quality Assessment Score: 78% Good study sample size. Explored specifically healthcare workers and the general public
8 Fisher et al. (2020) USA	Aim To assess intent to be vaccinated against COVID-19 among a representative sample of adults in the United States and identify predictors of and reasons for vaccine hesitancy Study design Cross-sectional survey via Amerispeak survey company	Sample size n = 991 (16–20 April 2020) Key measures • Intent to be vaccinated against COVID-19; a yes or no question	<ul style="list-style-type: none"> Overall, 57.6% of participants intended to be vaccinated, 31.6% were not sure, and 10.8% did not intend to be vaccinated Factors independently associated with vaccine hesitancy (a response of 'no' or 'not sure') included younger age, Black race, lower educational attainment, and not having received the influenza vaccine in the prior year Reasons for vaccine hesitancy included vaccine-specific concerns, a need for more information, anti-vaccine attitudes or beliefs, and a lack of trust 	<ul style="list-style-type: none"> Quality Assessment Score: 78% Very low response rate

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TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
9 Freeman et al. (2020) United Kingdom	Aim To estimate provisional willingness to receive a COVID-19 vaccine To identify predictive socio-demographic factors Study design Cross-sectional survey via market research company	Sample size $n = 5,114$ adults (18+ years old) was conducted from 24 September to 17 October 2020 Key measures Intent to be vaccinated against COVID-19; a yes or no question	<ul style="list-style-type: none"> 71.7% were willing to be vaccinated, 16.6% were very unsure, and 11.7% were strongly hesitant 86% of variance in hesitancy was provided by beliefs about the collective importance, efficacy, side effects, and speed of development of a COVID-19 vaccine 32% of variance highlighted two higher-order explanatory factors: 'excessive mistrust' ($r = .51$), including conspiracy beliefs, negative views of doctors, and need for chaos, and 'positive healthcare experiences' ($r = -.48$), including supportive doctor interactions and good NHS care Hesitancy was associated with younger age, female gender, lower income, and ethnicity, but socio-demographic information explained little variance (9.8%) Hesitancy was associated with lower adherence to social distancing guidelines 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Good sample size and scope
10 Gagneux-Brunon et al. (2020) France	Aim To determine COVID-19, 24 vaccine acceptance rate of healthcare workers in France Study design Cross-sectional online survey	Sample size $n = 2,047$ (26 March–2 July 2020) Key measures The intention to get vaccinated against COVID-19 if the vaccine was available	<ul style="list-style-type: none"> 76.9% expressed intention to be vaccinated against COVID-19. Highest in physiotherapists (95.8%), followed by physicians (92.1%), pharmacists (88.8%), nurses (64.7%), assistant nurses (60.1%), midwives (70.3%) and other HCWs (67.4%) Older age, male, fear about COVID-19 and perceived risk were significantly associated with the hypothetical vaccine acceptance Flu vaccine update during the previous season was the main predictor of COVID-19 vaccine acceptance 	<ul style="list-style-type: none"> Quality Assessment Score: 78% Good sample size, article reported required information on methods and analysis undertaken

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TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
11 Goldman et al. (2020) United States, Canada, Israel, Japan, Spain, and Switzerland	Aim To investigate predictors associated with global caregivers' intent to vaccinate their children against COVID-19, when the vaccine becomes available Study design Cross-sectional survey of caregivers arriving with their children to 16 Paediatric Emergency Departments (ED) across six countries (United States, Canada, Israel, Japan, Spain, and Switzerland)	Sample size n = 1,541 (26 March–31 May 2020) Key measures The intention to vaccinate their children against COVID-19	<ul style="list-style-type: none"> 65% of caregivers reported that they intend to vaccinate their child against COVID-19 increased intended uptake was associated with children that were older, children with no chronic illness, when fathers completed the survey, children up-to-date on their vaccination schedule, recent history of vaccination against influenza, and caregivers concerned their child had COVID-19 at the time of survey completion in the ED The most common reason reported by caregivers intending to vaccinate was to protect their child (62%), and the most common reason reported by caregivers refusing vaccination was the vaccine's novelty (52%) 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Good study coverage. Sampling size is acceptable
12 Graffigna et al. (2020) Italy	Aim To understand how adult citizens' health engagement, perceived COVID-19 susceptibility and severity, and general vaccine-related attitudes affect the willingness to vaccinate against COVID-19 Study design Cross-sectional survey of Italian adult citizens (18 years old and above) using online survey panel provider Norstat Italia srl	Sample size n = 1,004 (early days of reopening after the lockdown/phase 2) Key measures Health engagement Vaccine attitude (VAs) Perceived severity and susceptibility to COVID-19 Willingness to vaccinate (5-point Likert Scale)	<ul style="list-style-type: none"> Health engagement is positively related to the intention to vaccinate and that this relationship is partially mediated by the general attitude towards vaccines The model appears invariant across genders and partially invariant across age groups, showing some differences in the role of perceived susceptibility 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Good analysis and methods, although was more of health engagement and intention to vaccine

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TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
13 Grech et al. (2020) Malta	Aim To examine the degree of COVID-19 vaccine hesitancy among GPs and GP trainees in Malta Study design Cross-sectional mail-out survey to medical doctors listed on the 'Malta College of Family Doctors' register	Sample size n = 123 (recruited between 25 and 29 September 2020) Key measures • Age category: GP or GP trainees; history of taking influenza vaccine A 5-item scale on the likelihood of taking the COVID-19 vaccine	<ul style="list-style-type: none"> • Of the 123 responses, 64.2% took the influenza vaccine the previous year (71.9% GP vs. 37.0% trainees) • Nearly two-thirds of GPs were likely to take the COVID-19 vaccine; less than one-third of trainees would • Long-term side effects were the most common concerns and misgivings about COVID-19 vaccine • Increasing age was a significant predictor of vaccine uptake • The likelihood of taking the influenza vaccine was associated with the likelihood of taking COVID-19 vaccine 	<ul style="list-style-type: none"> • Quality Assessment Score: 56% • Limitations: small sample size, overall response rate: 35% of invited GPs and trainees • Study strength: Assessment of specific concerns and misgivings regarding COVID-19 vaccine
14 Grüner and Krüger (2020) Germany	Aim To assess psychosocial predictors of COVID-19 vaccine uptake intention Study design Cross-sectional online survey administered by the survey research firm Qualtrics	Sample size n = 2,077 (18 May to 2 August 2020) • Participant groups: students (healthcare and non-healthcare); and healthcare professional academics and non-healthcare professors and deans Key measures • Health status; immunosuppression; smoking activities; trust of health-related information (mass media and information from government); use of complementary medicine • Willingness to vaccinate against COVID-19 and against the Flu (yes, no response)	<ul style="list-style-type: none"> • In total, 788 responses, 22.3% were 'definitely unwilling' to receive the COVID-19 vaccine under 'emergency use authorisation' • Willingness to vaccinate against COVID-19 among groups were similar: a) healthcare students (79.81%); b) healthcare professionals (83.10%); and c) non-healthcare students (85.67%) • Overall, higher willingness to vaccinate against flu than against COVID-19 • Higher willingness to vaccinate among: a) men; b) those who fear of health threats due to virus; c) trust mass media and health-related information • Lower likelihood to vaccinate among those who used homeopathy or naturopathy 	<ul style="list-style-type: none"> • Quality Assessment Score: 67% • Limitations: Not a representative sample of the community • Trust of health-related information played a key role in the decision to vaccinate

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TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
15 Guidry et al. (2020) USA	Aim To assess the psychosocial predictors of COVID-19 vaccine uptake intention under Emergency Use Authorisation (EUA) Study design Cross-sectional online survey of adults administered by the survey research firm Qualtrics	Sample size n = 788 in July 2020 Key measures • Age; gender; ethnicity; insurance status; education; political affiliation and religiosity • Constructs of Health Belief Model: Severity; susceptibility; benefits; barriers; self-efficacy • Constructs of Theory of Planned Behaviour: Attitude; subjective norms; perceived behavioural control; intention to get a future COVID-19 vaccine under EUA	<ul style="list-style-type: none"> In total, 788 responses, 22.3% were 'definitely unwilling' to receive the COVID-19 vaccine under emergency use authorisation. Overall, 60% of respondents self-reported willingness to receive future COVID-19 vaccine Predictors of intention for COVID-19 vaccine uptake were: (a) higher education; (b) having insurance; (c) higher subjective norms; (d) positive attitude towards vaccine; (e) higher perceived susceptibility; (f) higher perceived benefits; (g) lower barriers to vaccine; and (h) higher self-efficacy Concerns about rushed vaccine development reduced vaccine uptake intent, and willingness to receive vaccine under EUA 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitations: Convenience sampling Study underscores the need to correct misinformation about COVID-19 vaccine and focus on re-establishing trust in information from government agencies regarding vaccine
16 Harapan et al. (2020) Indonesia	Aim To assess the acceptance of a 50%–95% efficacious COVID-19 vaccine when available Study design Cross-sectional online survey using Google Forms distributed on the WhatsApp communication platform	Sample size Adult population (n = 1,359) collected between 25 March and 6 April 2020 Key measures • Age; gender; religion; educational attainment; income; occupation (healthcare worker or other); location (urbanicity); information received about COVID-19 • Perceived risk of vaccine; willingness to receive vaccine (Yes, no response)	<ul style="list-style-type: none"> If vaccine were 95.5% effective, 93.3% of respondents would like to be vaccinated if provided free by government. This reduced to 67% if vaccine is 50% efficacious High vaccine efficacy increases self-reported vaccine uptake by over 26% of 95% efficacious vaccine was being healthcare workers For the 95% efficacious vaccine, significant predictors were: (a) being healthcare workers; (b) perceived risk of getting infected; but less likely among the retirees 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitations: Recruitment, over less than a 2-week period; only available on the WhatsApp platform; among those who were literate

(Continues)

TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
17 Head et al. (2020) USA	<p>Aims</p> <ul style="list-style-type: none"> To assess intention to vaccinate against SARS-CoV-2 among adults? To determine response to recommendation to vaccinate by healthcare provider? To determine factors associated with vaccine intention? <p>Study design</p> <p>Cross-sectional online survey facilitated by market research firm, Dynata, data collected 4–11 May 2020</p>	<p>Sample size</p> <p>Adult population (n = 3,159)</p> <p>Key measures</p> <ul style="list-style-type: none"> Age; gender; marital status; education; race/ethnicity; dwelling location (region); employment; working in healthcare; income; political views Received flu vaccine; COVID-19 test; pre-existing condition(s); know someone with COVID-19; health beliefs (altruism, perceived COVID-19 risk of infection, threat and severity) Likelihood of getting vaccine: with or without provider recommendation 	<ul style="list-style-type: none"> High (mean: 5.23 of 7-point scale) vaccine intentions, increased to 5.47 with provider recommendation Low intent: associated with less education and working in healthcare High intent: associated with liberal political views; high altruism; increased worry; and perceived threat to physical health 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitations: Not representative of adults in the USA; and mismatch in wordings of outcome measures Inconsistent finding about lower vaccine uptake intention among healthcare workers, likely due to the inclusion of non-clinical staff in the sample
18 Kabamba Nzaji et al. (2020) Republic of Congo	<p>Aim</p> <p>To assess the acceptability of COVID-19 vaccine among healthcare workers (HCWs)</p> <p>Study design</p> <p>Cross-sectional survey—self-administered</p>	<p>Sample size</p> <p>Healthcare workers (n = 613) collected between 20 March and 30 April 2020 (from 23 hospitals in Congo)</p> <p>Key measures</p> <ul style="list-style-type: none"> Age; gender; marital status; occupation; years of HCW experience; place of residence; information received about COVID-19 intention to vaccinate against COVID-19 (Yes, No response) 	<ul style="list-style-type: none"> Low (27.7%) intention to vaccinate against COVID-19 if available Significant predictors associated with vaccine acceptance were: (a) being a male HCW; (b) being a doctor; (c) having a positive attitude towards COVID-19 	<ul style="list-style-type: none"> Quality Assessment Score: 89% High vaccine hesitancy among healthcare workers in Congo is a serious concern, underscoring a need to tailor strategies to address this emerging issue
19 Kreps et al. (2020) USA	<p>Aim</p> <p>To examine factors associated with likelihood of receiving hypothetical COVID-19 vaccine (Vaccine A, B, or none)</p> <p>Study design</p> <p>Cross-sectional online survey, recruited from contacting 3,708 US adults through the Lucid platform</p>	<p>Sample size</p> <p>Adult population (n = 1,971) collected on 9 July 2020</p> <p>Key measures</p> <ul style="list-style-type: none"> Respondents were asked to choose Vaccine A, Vaccine B or None. Attributes of each vaccine were then randomly assigned Attributes presented were as follows: efficacy; protection duration; risk of severe side effects; government authorisation; country of vaccine origin; sources of recommendation (Trump, Biden, CDC, WHO) willingness to receive vaccine 	<ul style="list-style-type: none"> Of the respondents, 79% selected either Vaccine A or B, 21% chose neither Choosing a vaccine was associated with: increased efficacy and increased protection duration; decreased major adverse effects FDA emergency use authorisation is associated with lower probability of choosing a vaccine (compare with full FDA approval) Endorsement by CDC, WHO and President Trump were associated with high probabilities of choosing a vaccine 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Vaccine-related attributes and political characteristics were associated with probabilities of choosing hypothetical COVID-19 vaccine

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TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
20 La Vecchia et al. (2020) Italy	Aim To examine intention to be vaccinated against COVID-19 Study design Cross-sectional online survey, recruited using Computer Assisted Web Interviews (CAWI)	Sample size National survey of Italian population (n = 1,055) recruited between 16 and 28 September 2020 Key measures • Five questions on influenza vaccine uptake and a potential COVID-19 vaccine uptake • Age, sex, occupation category, influenza vaccine uptake history, vaccination advice by GP, and potential COVID-19 vaccine uptake	<ul style="list-style-type: none"> • Of the respondents, 54% would take a potential COVID-19 vaccine • Acceptance of COVID-19 vaccine increased among those: (a) above age 55 years • Less favourable attitude towards COVID-19 vaccination among less qualified workers (44.8%) compared to more qualified workers (51.6%) 	<ul style="list-style-type: none"> • Quality Assessment Score: 63% • Limitation: Only descriptive and bivariate analyses undertaken, despite the large sample size and the number of variables measured
21 Lazarus et al. (2020) Total: 19 countries (China, Nigeria, South Korea, India, Poland, Mexico, South Africa, Germany, Canada, Ecuador, France, Russia, Italy, United Kingdom, Brazil, Sweden, Spain, Singapore, United States of America)	Aim To determine potential acceptance of COVID-19 vaccination Study design Cross-sectional survey of vaccine acceptance across 19 countries (recruitment procedure not reported). No report of any translation of questionnaire procedure	Sample size Survey of 19 countries (n = 13,426) recruited between June 2020 Key measures Age category, sex, income level, education level, vaccination acceptance level, acceptance level with employer's recommendation	<ul style="list-style-type: none"> • Overall vaccine acceptance rate, 71.5% • Higher rates among Asian nations with high trust levels of national governments (Singapore, South Korea, China) • Older age groups were more likely to take vaccine, and employers' recommendation also increased vaccination acceptance • Higher income groups were also more likely to accept vaccination 	<ul style="list-style-type: none"> • Quality Assessment Score: 78% • Implication: Clear and consistent communication from the government would increase public confidence in vaccination • Limitations: survey undertaken at a brief snapshot in time prior to vaccine availability, and highly dynamic changes in COVID-19 infection rates and threats

(Continues)

TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
22 Malik et al. (2020) USA	Aim <ul style="list-style-type: none"> to predict COVID-19 vaccine acceptance to identify the most vulnerable populations, and to understand risk perceptions about the COVID-19 pandemic, acceptance of a COVID-19 vaccine, and trust in sources of information Study design Cross-sectional online survey via CloudResearch, an online survey platform	Sample size n = 672 USA adults surveyed in May 2020 Key measures <ul style="list-style-type: none"> Demographic information 'If a vaccine becomes available and is recommended for me, I would get it' (5-point Likert Scale: 1 = strongly disagree to 5 strongly agree) The 10-item Perceived Risk Scale Cronbach's $\alpha = 0.72$ Influenza vaccination in the previous 8 months Confidence in and reliability of media sources (5-point Likert Scale) 	<ul style="list-style-type: none"> 67% of respondents would accept a COVID-19 vaccine if recommended for them Males, older adults, Asians, and college and/or graduate degree holders were more likely to accept the vaccine Unemployed and Black Americans reported lower COVID-19 vaccine acceptance Risk perception scores higher in those who would accept a COVID-19 vaccine Respondents reported highest confidence in healthcare professionals (75%); their own physician (70%), CDC (64%) state health departments (62%), and local health departments (61%) Respondents reported health professionals (75%) and health officials (70%) as the most reliable sources on information on COVID-19; 21% reported social media as a reliable source of information 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitation: the study sample are better educated than the general US population and there are ethnic differences (e.g. less Hispanics than the general population and more Asians than the general US population) The inclusion of respondents who were neutral in the disagree response may not truly reflect disagreement and including these respondents may have resulted in some loss of statistical outcomes (or inflated the negative responses?)
23 Palamenghi et al. (2020) Italy	Aim To understand citizens' perceptions and behaviours about preventive behaviours and willingness to vaccinate for COVID-19 Study design Two cross-sectional online surveys through Norstat Italia, srl (professional survey company)	Sample size Sample 1: n = 968 Italian citizens, surveyed during the early days after the initial spread of the SARS-COV-2 virus in Italy Sample 2: n = 1,004 Italian citizens, surveyed during the early days of the Italian reopening after lockdown Key measures <ul style="list-style-type: none"> age, gender, smoking status and other socio-economic variables Two questions surveying participants' attitude towards general vaccines' effectiveness and trust towards science (5-point Likert scale) In the second sample, an additional question was added: 'Willingness to vaccinate for COVID-19 'if a vaccine was found' on a scale ranging from 1 (not likely at all) to 5 (absolutely likely) 	<ul style="list-style-type: none"> 59% of respondents in Phase 2 (during the early days of the Italian reopening after lockdown) reported to be likely to vaccinate for COVID-19 Middle-aged group (35–59) were less willing to vaccinate compared to the 18- to 34-year group ($p < .001$) and the over-60 group ($p < .001$) Attitude towards vaccine efficacy and trust towards scientific research decreased between Phase 1 and Phase 2 Willingness to vaccinate was positively correlated with both trust in scientific research and general attitude towards vaccines' efficacy 	<ul style="list-style-type: none"> Quality Assessment Score: 44% Despite the authors stating the samples were representative of Italian citizens, these were independent samples and so the differences between Phase 1 and Phase 2 may have been due to sample differences. A table comparing the demographic characteristics for both samples would have been helpful The authors could have reported analyses by gender and socio-economic variables but did not provide this data

(Continues)

TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
24 Pogue et al. (2020) USA	Aim To understand the attitudes towards and obstacles facing COVID-19 vaccination Research design Cross-sectional online survey administered by Qualtrics	Sample Online survey of $n = 316$ adults Date of survey unclear but likely August–September 2020 Key measures <ul style="list-style-type: none"> • Attitude towards COVID-19 and a potential vaccine (including intent to vaccinate, the seriousness of the pandemic facing the USA, time spent in clinical testing, vaccine efficacy, location of vaccine development, types of vaccine) • Vaccination history • Understanding of Vaccine Immunity • Sociodemographic characteristics (age, race/ethnicity, sex, household income, political ideology) 	<ul style="list-style-type: none"> • 68.57% of respondents supportive of being vaccinated • the greater the perceived impact of COVID-19 on America, the more receptive the respondent was to receiving a potential COVID-19 vaccine • Respondents who were unwilling to be vaccinated cited concerns about vaccine safety (45.45%) and lack of trust in the source that encouraged to be vaccinated (13.54%). 15.45% reported that more testing would be needed before accepting the vaccine • Confidence in an American-developed vaccine was significantly higher than a European vaccine or one developed in another location • Using SEM, household income and political ideology showed no relationship with attitudes towards the COVID-19 vaccine however, when examined individually, household income, education and satisfaction with health insurance significantly correlated with intent to vaccinate 	<ul style="list-style-type: none"> • Quality Assessment Score: 67% • Limitation: authors note the timing of the survey occurred during a push for accelerated vaccine deployment announced by the CDC, and a major vaccine trial being paused due to safety concerns
25 Reiter et al. (2020) USA	Aim To determine acceptability of a COVID-19 vaccine Research design Cross-sectional online survey administered through survey company, SSRS	Sample: Convenience sample of $n = 2,006$ US adults in May 2020 Key measures COVID-19 vaccination willingness (5-point Likert ranging from definitely not/definitely will) Knowledge, Attitudes, Beliefs: 14-items Self-efficacy: 2-items Demographic and Health-Related Characteristics: gender, age, race/ethnicity, marital status, education level, household income, political leaning, religiosity, sexual identity, urbanicity, region of residence, health insurance, underlying medical condition, ever tested for/history of COVID	<ul style="list-style-type: none"> • 69% of respondents willing to get a COVID-19 vaccination • More likely to be willing to get a COVID-19 vaccine if: were moderate or liberal in their political leaning, had private health insurance, reported a personal history of COVID-19 infection, or healthcare provider recommendation, higher levels of perceived likelihood of getting a COVID-19 infection in the or perceived effectiveness of a COVID-19 vaccine • less likely to be willing to get a COVID-19 vaccine if they were female non-Latinx black, higher level of perceived potential harms of a COVID-19 vaccine 	<ul style="list-style-type: none"> • Quality Assessment Score: 89% • Limitation: convenience sample from an opt-in survey panel; Incentives provided which may have influenced participation; no data on non-respondents; study based on assumption vaccine was free—acceptability may be lower if with out-of-pocket expenses

(Continues)

TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
26 Sherman et al. (2020) UK	Aim To investigate factors associated with intention to be vaccinated against COVID-19 Research design Cross-sectional online survey administered through survey company, Prolific	Sample: Convenience sample of $n = 1,500$ UK adults recruited between 14 and 17 July 2020 Key measures Personal and clinical characteristics: sex, age, religion, highest qualification, employment, key worker, household income, vulnerable others in home, influenza vaccination previous winter general beliefs and attitudes relating to vaccination, COVID-19 illness, COVID-19 vaccination vaccination intention (when a vaccine becomes available) (primary outcome)	<ul style="list-style-type: none"> 64% reported being very likely to be vaccinated against COVID-19 Increased likelihood of vaccination: older age; vaccinated for influenza previous winter; perceiving greater risk of COVID-19 to others; more positive general COVID-19 beliefs and attitudes (strongest predictor); weaker beliefs that vaccination would cause side effects; greater perceived information sufficiency; lower endorsement that only people who are more at risk of serious illness should be vaccinated 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitation: online research panel—convenience sample may not have been representative of the general population
27 Szilagyi et al. (2020) USA	Aim To track the likelihood of COVID-19 vaccine uptake, from March to December 2020 Research design Longitudinal online survey recruited using address-based sampling	Sample Beginning 10 March 2020, the entire 'Understanding America Study (UAS) panel with approximately 9,000 US non-institutionalised adults were invited to participate in biweekly tracking surveys about COVID-19; consenting respondents are invited on a rolling basis (590 invited daily) to complete the survey Key measures Age, sex, age, ethnicity, highest educational qualification, likelihood of vaccine uptake	<ul style="list-style-type: none"> Of the 9,000 UAS panel, 8,167 (91%) consented to participate in the biweekly tracking surveys, with 75%–97% response rate varying across each 2-week period Between April to December, vaccination intention dropped from 74% to 56% During November–December period, the likelihood of getting COVID-19 vaccination was: <ul style="list-style-type: none"> lower among: (a) women; and (b) Black higher among those: (a) 65 years and older and (b) with at least a bachelor's degree 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitations: (a) Only English and Spanish-speaking surveys were distributed; and (b) small sample sizes for other minority groups

(Continues)

TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
28 Wang et al. (2020) Hong Kong, China	Aim To examine the impact of the COVID-19 pandemic on change of influenza vaccination acceptance and identify factors associated with acceptance of potential COVID-19 vaccination Research design Cross-sectional online survey	Sample N = 806 nurses recruited by email through membership of Association of Hong Kong Nursing Staff between 26 February and 31 March 2020 Key measures vaccination-related intentions and behaviours (previous seasonal influenza vaccination; intention to accept seasonal influenza vaccination in current year; intention to accept COVID-19 vaccination when available) work-related factors (high-risk and non-risk setting; public/private sector; encountered suspected/confirmed COVID-19; perception of likelihood of being infected) demographics (age, gender, having chronic condition)	<ul style="list-style-type: none"> 40.0% nurses reported intention to accept COVID-19 vaccination More likely to accept vaccine if: male; having chronic condition; working in private sector; encounter with suspected or confirmed COVID-19 patients; accepted seasonal influenza vaccination in 2019 Reasons for not intending to accept COVID-9 vaccination: (a) suspicion on efficacy, effectiveness or safety of the new vaccine (b) believing COVID-19 vaccination is unnecessary, and (c) no time to take it 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitation: low response rate (5.2%)
29 Williams et al. (2020) UK	Aim (a) To identify and understand the barriers and facilitators to receiving a future COVID-19 vaccine; (b) to provide recommendations for the design of interventions aimed at maximising uptake of the vaccine among the public Study design Cross-sectional online survey	Sample N = 527 UK adults recruited between 1 and 10 April 2020. Participants were recruited through two ongoing projects examining vaccination behaviour more broadly Key measures Perceptions of COVID-19 COVID-19 vaccination intention Influence of COVID-19 on future vaccination behaviour	<ul style="list-style-type: none"> 58% would definitely want to receive a vaccine for COVID-19; 27% would probably want to receive it COVID-19 vaccination was positively associated with the belief that the COVID-19 outbreak is going to continue for a long time, and negatively associated with the belief that the media has over-exaggerated the risks of catching COVID-19 No gender or socio-economic differences (38%) stated that COVID-19 will make them more likely to receive the annual flu vaccination in the future 	<ul style="list-style-type: none"> Quality Assessment Score: 75% Limitation: results may not be generalisable to the UK population as sample drawn from two key populations already participating in research (older population and chronic respiratory disease) who would be at higher risk of COVID-19; did not account for the influence of participants' socio-demographic characteristics

(Continues)

TABLE 1 (Continued)

Author, year and country	Aim/research question and study design	Sample and key measures	Results	Comments
30 Zhang et al. (2020) China	Aim To investigate parental acceptability of free COVID-19 vaccination for children under the age of 18 years Study design Secondary analysis of cross-sectional closed online survey	Sample N = 1,052 parents of at least one child <18 years of age Key measures Sociodemographic characteristics: parental history of seasonal influenza vaccination, and whether they had a family member with a history of COVID-19 Parental acceptability of free COVID-19 vaccination for children under 18 years Perceptions related to COVID-19 vaccination Influence of social media	<ul style="list-style-type: none"> 72.6% of parents would accept vaccination for their children Higher parental acceptability of COVID-19 vaccination: positive attitudes towards COVID-19 vaccination: perceiving that a family member would support them in having their children take up COVID-19 vaccination, and perceived behavioural control to have the children receive COVID-19 vaccination higher exposure to positive information related to COVID-19 vaccination was associated with higher parental acceptability of COVID-19 vaccination 	<ul style="list-style-type: none"> Quality Assessment Score: 89% Limitations: recruitment in one city; did not include parents in other occupations; no data on non-respondents

completion of this process, the full text of the remaining references was sourced and screened for inclusion in this systematic review (Figure 1).

2.4 | Data extraction

We developed and pilot tested a data extraction form, which was tested by three authors (BE, JM and YS). Following testing and agreement of the included fields (author, year, country, aim, study design, sample size, key measures, results and comments), the same three authors undertook data extraction for all 30 studies. Data were also sourced from the Worldometer (COVID-19 Coronavirus Pandemic 2020, 2020), from March to December 2020, to extract the 'total COVID-19 cases per 1 million population' daily information of the relevant country, at the commencement and completion of data collection for each of the studies.

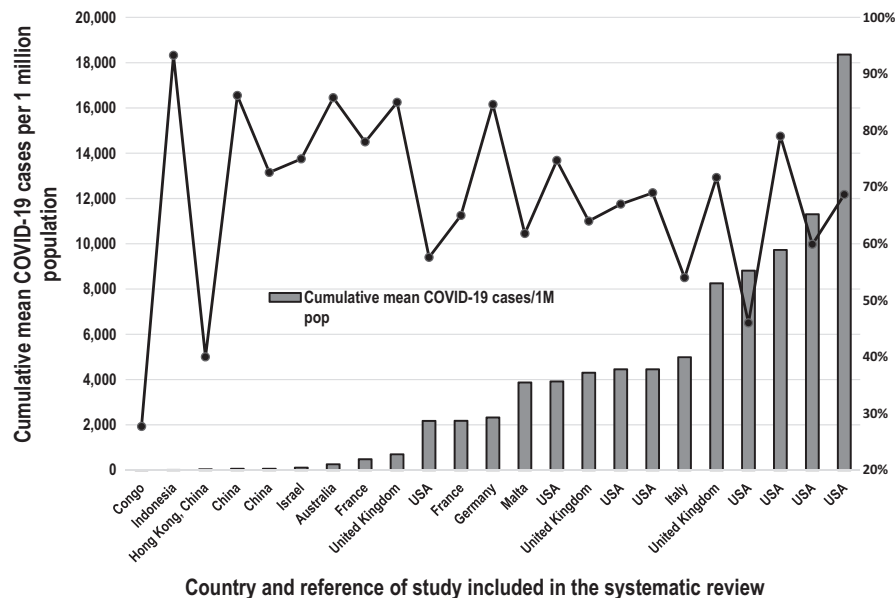
2.4.1 | Risk of bias

The Joanna Briggs Institute critical appraisal tools for quasi-experimental design (The Joanna Briggs Institute, 2017) were used to conduct quality assessment and to assess for risk of bias. Each study was assessed independently by two authors (RA and DM). In cases of disagreement on any of the criteria, the assessment of a third author (BE) was sought. The results of the quality assessments of all 30 studies are summarised in Table 1. The assessment score of each study was aggregated, using quality appraisal categories previously reported (Goldsmith et al., 2007; Villarosa et al., 2019). In total, 16 of 30 (54%) studies were rated to be above 80% (high quality), 10 of 30 (33%) studies were within the range of 60%–79% (moderate quality), and 3 of 30 (13%) studies were appraised as poor quality (30%–59%).

2.5 | Data analysis

Characteristics of all studies were summarised, including country of study, sample, period of data collection, levels of COVID-19 vaccination intention and key factors influencing this intention. Due to the heterogeneity in measurement of vaccination intention, synthesis of this outcome measure was included in the results section. The process of grouping similar textual description and similar data types were undertaken to provide a valid and meaningful narrative that address the review aims. COVID-19 spread in each country, as indicated by the total confirmed COVID-19 cases per 1 million population, retrieved from the Worldometer live update (COVID-19 Coronavirus Pandemic 2020). A mean value of total COVID-19 cases at two time points was used, at commencement and at completion of data collection in each study.

FIGURE 2 Cumulative mean number of COVID-19 cases per 1 million population and overall percentages vaccination intention



3 | RESULTS

3.1 | Characteristics of included studies

Data collection in 14 of the 30 included studies was administered by a commercial survey panel provider (Dong et al., 2020; Fisher et al., 2020; Freeman et al., 2020; Graffigna et al., 2020; Grüner & Krüger, 2020; Guidry et al., 2020; Head et al., 2020; Kreps et al., 2020; La Vecchia et al., 2020; Malik et al., 2020; Palamenghi et al., 2020; Pogue et al., 2020; Reiter et al., 2020). Following the completion of the search and screening process, 30 studies met the criteria for inclusion in this review (Figure 1) and are summarised in Table 1. None of these were published in Arabic. Of the 30 studies, nine were undertaken in the United States (Bogart et al., 2020; Fisher et al., 2020; Guidry et al., 2020; Head et al., 2020; Kreps et al., 2020; Malik et al., 2020; Pogue et al., 2020; Reiter et al., 2020; Szilagyi et al., 2020), four in Italy (Barello et al., 2020; Graffigna et al., 2020; La Vecchia et al., 2020; Palamenghi et al., 2020), three in the United Kingdom (Freeman et al., 2020; Sherman et al., 2020; Williams et al., 2020), two in France (Bertin et al., 2020; Gagneux-Brunon et al., 2020), two in mainland China (Dong et al., 2020; Zhang et al., 2020) and one each from Australia (Dodd et al., 2020), Congo (Kabamba Nzaji et al., 2020), Germany (Grüner & Krüger, 2020), Hong Kong (Wang et al., 2020), Indonesia (Harapan et al., 2020), Israel (Dror et al., 2020), Malta (Grech et al., 2020) and Saudi Arabia (Al-Mohaithef & Padhi, 2020). Two studies surveyed respondents across six (Goldman et al., 2020) to 19 countries (Lazarus et al., 2020). Except for one study that surveyed respondents at 16-time points (Szilagyi et al., 2020), the remaining 29 studies used a cross-sectional survey design. Time periods of surveys varied from early during the COVID-19 pandemic up to April 2020 (Bertin et al., 2020; Dodd et al., 2020; Dror et al., 2020; Fisher et al., 2020; Harapan et al., 2020; Kabamba Nzaji et al., 2020; Wang et al., 2020; Williams et al., 2020), from May to August 2020 (Bogart et al., 2020; Dong et al., 2020; Gagneux-Brunon et al., 2020; Grüner & Krüger, 2020; Guidry et al., 2020; Head et al., 2020;

Kreps et al., 2020; Lazarus et al., 2020; Malik et al., 2020; Reiter et al., 2020; Sherman et al., 2020), and from September to December (Freeman et al., 2020; Grech et al., 2020; La Vecchia et al., 2020; Pogue et al., 2020; Zhang et al., 2020). Four studies did not include the time period of data collection (Al-Mohaithef & Padhi, 2020; Barello et al., 2020; Graffigna et al., 2020; Palamenghi et al., 2020).

Two-thirds (20 of 30) of the included studies focused on the general public living in each of the respective countries (Al-Mohaithef & Padhi, 2020; Bertin et al., 2020; Dodd et al., 2020; Dong et al., 2020; Fisher et al., 2020; Freeman et al., 2020; Graffigna et al., 2020; Guidry et al., 2020; Harapan et al., 2020; Head et al., 2020; Kabamba Nzaji et al., 2020; Kreps et al., 2020; La Vecchia et al., 2020; Lazarus et al., 2020; Malik et al., 2020; Palamenghi et al., 2020; Pogue et al., 2020; Reiter et al., 2020; Sherman et al., 2020; Szilagyi et al., 2020). Three focused on students in higher education (Barello et al., 2020; Bertin et al., 2020; Grüner & Krüger, 2020), and two collected data exclusively from parents or caregivers, and focused on their intended uptake of vaccine for their children against COVID-19 (Goldman et al., 2020; Zhang et al., 2020). One on HIV-positive Black Americans (Bogart et al., 2020), and another on older adults or patients with chronic respiratory disease (Williams et al., 2020).

3.2 | COVID-19 vaccination intention and variability in intention assessment

Except for one study that assessed preference for the types of hypothetical COVID-19 vaccines (Dong et al., 2020), the remaining 29 studies measured vaccination intention using a range of approaches. Six studies used a two (e.g. 'Yes' or 'No') category response format (Dror et al., 2020; Gagneux-Brunon et al., 2020; Goldman et al., 2020; Grüner & Krüger, 2020; Harapan et al., 2020; Kabamba Nzaji et al., 2020), five studies used a three (e.g. 'Yes', 'No' or 'Unsure') category response format (Al-Mohaithef & Padhi, 2020; Barello et al., 2020; Dodd et al., 2020; Fisher et al., 2020; Wang et al., 2020), and

one study used a four ('Yes', 'Probably Yes', 'Probably No', 'No') category response format (La Vecchia et al., 2020). The remaining 17 studies used a 5- to 11-point Likert response format.

In total, 11 studies that used the 5-point Likert response format, eight collapsed the first two positive categories of a 5-point Likert response format to indicate vaccination intention (Grech et al., 2020; Lazarus et al., 2020; Malik et al., 2020; Palamenghi et al., 2020; Pogue et al., 2020; Reiter et al., 2020; Szilagyi et al., 2020; Zhang et al., 2020), two computed an average score to indicate vaccination intention percentages (Bogart et al., 2020; Freeman et al., 2020), and one reported the scores of all five categories (Graffigna et al., 2020). Two studies that used a 6-point Likert response format also did not collapse category scores and reported scores for all six categories (Guidry et al., 2020; Williams et al., 2020), and three studies used a 7-point Likert response format and computed an average score to indicate vaccination intention percentages (Bertin et al., 2020; Head et al., 2020; Kreps et al., 2020). One study used an 11-point Likert scale and aggregated the first 3 categories to indicate vaccination intention (Sherman et al., 2020).

Overall vaccination intention percentages for COVID-19 ranged from as low as 27.7% (Kabamba Nzaji et al., 2020) to 93.3% (Harapan et al., 2020). In the one USA study that examined national trends in acceptability of COVID-19 vaccine from April to November 2020, there was an overall decline in vaccination intention over time, from 74% to 56% (Szilagyi et al., 2020).

3.3 | Factors influencing COVID-19 vaccination intention

Studies included in this review also identified factors influencing COVID-19 vaccine uptake intention, which were categorised into five categories: (a) socio-demographic differences; (b) health literacy and COVID-19 information sources; (c) perceived risk or perceived susceptibility of COVID-19; (d) vaccine attributes, and speed of vaccine development; and (e) regional increase in cumulative COVID-19 caseloads over time.

3.3.1 | Socio-demographic differences in vaccination intention

Of the 30 studies, 12 found that those in older age groups were more likely to express willingness to be vaccinated against COVID-19 (Al-Mohaithef & Padhi, 2020; Fisher et al., 2020; Freeman et al., 2020; Gagneux-Brunon et al., 2020; Grech et al., 2020; Kabamba Nzaji et al., 2020; La Vecchia et al., 2020; Lazarus et al., 2020; Malik et al., 2020; Palamenghi et al., 2020; Sherman et al., 2020; Szilagyi et al., 2020), in contrast, three studies found higher vaccine acceptance among those in the younger age group (Guidry et al., 2020; Harapan et al., 2020; Kreps et al., 2020). In relation to gender, 11 studies found that men were more likely to express acceptance of COVID-19 vaccine compared to women (Dror et al., 2020; Freeman et al., 2020;

Gagneux-Brunon et al., 2020; Grüner & Krüger, 2020; Guidry et al., 2020; Kabamba Nzaji et al., 2020; Kreps et al., 2020; Malik et al., 2020; Reiter et al., 2020; Szilagyi et al., 2020; Wang et al., 2020). This was also the case if fathers were the designated respondents to a caregiver survey, about their intention to accept COVID-19 vaccine for their child (Goldman et al., 2020). Among racial and ethnic groups, lower COVID-19 vaccination intention was reported among Black Americans and those of ethnic minority backgrounds (Fisher et al., 2020; Freeman et al., 2020; Guidry et al., 2020; Kreps et al., 2020; Malik et al., 2020; Reiter et al., 2020; Szilagyi et al., 2020). In contrast, two USA studies reported that those of Asian descent had higher intention to COVID-19 vaccination compared to other racial and ethnic minority groups (Malik et al., 2020; Szilagyi et al., 2020). In another study that sampled populations from 19 countries (Lazarus et al., 2020), respondents living in China reported the highest positive COVID-19 acceptance percentage (88.6%).

Among studies that assessed educational attainment, 10 reported COVID-19 vaccination intention was lower among those with lower education levels (Al-Mohaithef & Padhi, 2020; Dodd et al., 2020; Fisher et al., 2020; Freeman et al., 2020; Guidry et al., 2020; Head et al., 2020; Kreps et al., 2020; La Vecchia et al., 2020; Malik et al., 2020; Szilagyi et al., 2020). Political affiliations were also found to be associated with vaccination intention in three studies, with higher acceptance of COVID-19 vaccine among those with moderate or liberal political leanings (Head et al., 2020; Kreps et al., 2020; Reiter et al., 2020), although one study did not show any group difference between vaccine uptake and political affiliation (Guidry et al., 2020).

3.3.2 | Healthcare workers, nurses and vaccination intention

Nine of the 30 studies included or exclusively focused on healthcare workers (HCWs). Of these, two reported no difference between those in healthcare and the non-healthcare groups (Barello et al., 2020; Grüner & Krüger, 2020). Although one study reported lower intent to be vaccinated among HCWs compared to the general public (Head et al., 2020), another study reported higher vaccination intention among HCWs (Harapan et al., 2020). Within HCW groups, physicians were consistently reported to have higher intention to be vaccinated against COVID-19 compared to trainees or other HCWs, including nurses (Dror et al., 2020; Gagneux-Brunon et al., 2020; Grech et al., 2020; Kabamba Nzaji et al., 2020). In the study that exclusively surveyed nurses, only 40% reported an intention to accept COVID-19 vaccination (Wang et al., 2020).

3.3.3 | Beliefs and COVID-19 information sources related to vaccination intention

While inadequate health literacy has been shown to be related to COVID-19 vaccination hesitancy (Dodd et al., 2020; Sherman et al.,

2020), high exposure to negative information about COVID-19 vaccines in the media, particularly social media, was associated with lower acceptability of COVID-19 vaccination (Bertin et al., 2020; Grüner & Krüger, 2020; Malik et al., 2020; Zhang et al., 2020). Specifically, those with conspiracy beliefs about the vaccine (Bertin et al., 2020; Freeman et al., 2020), and those who reported vaccine mistrust (Bogart et al., 2020; Guidry et al., 2020), expressed reluctance to be vaccinated against COVID-19.

In contrast, those with high trust in their nation's health system (Al-Mohaithef & Padhi, 2020), or trust in health-related information from government bodies (Grüner & Krüger, 2020; Lazarus et al., 2020), were more likely to report willingness to be vaccinated. One USA study reported that endorsements from the Centers for Disease Control and Prevention and World Health Organization were associated with higher vaccination intention (Kreps et al., 2020). Trust in information from scientific research (Palamenghi et al., 2020) and recommendation from their healthcare provider were also associated with willingness to vaccinate against COVID-19 (Head et al., 2020; Reiter et al., 2020).

Although one study reported that HCWs had higher acceptance of the COVID-19 vaccine (Harapan et al., 2020), other studies did not find higher vaccination intention among those working in the healthcare industry (Barello et al., 2020; Grüner & Krüger, 2020; Kabamba Nzaji et al., 2020). Of concern, certain health professional groups, including nurses and assistant nurses, consistently reported lower COVID-19 vaccine acceptance, when compared to the adult population, or other health professional groups (Dror et al., 2020; Gagneux-Brunon et al., 2020; Kabamba Nzaji et al., 2020; Wang et al., 2020). Two studies showed that medical doctors were more likely to express willingness to be vaccinated against COVID-19 compared to medical trainees or other HCWs (Grech et al., 2020; Kabamba Nzaji et al., 2020).

3.3.4 | Perceived risk and susceptibility to COVID-19 and vaccination intention, including among vulnerable groups and HCWs

Vaccine acceptance was higher among those who perceived themselves to be at greater risk or threat (e.g. HCWs who were exposed to COVID-19 patients) of acquiring the infection (Al-Mohaithef & Padhi, 2020; Dror et al., 2020; Grüner & Krüger, 2020; Harapan et al., 2020; Reiter et al., 2020; Wang et al., 2020; Williams et al., 2020). Additionally, those who perceived themselves to be vulnerable or at greater susceptibility to COVID-19 (e.g. older age groups or those with chronic health conditions), were also more likely to indicate increased vaccine acceptance (Guidry et al., 2020; Head et al., 2020; Malik et al., 2020; Sherman et al., 2020; Wang et al., 2020). Seven studies included vaccine intention among HCWs (Dror et al., 2020; Gagneux-Brunon et al., 2020; Harapan et al., 2020; Head et al., 2020; Kabamba Nzaji et al., 2020; Wang et al., 2020) which ranged from 28% to 96%. Nurses were shown to have lower vaccine intention (28%–65%) in half of these studies (Dror et al., 2020;

Gagneux-Brunon et al., 2020; Wang et al., 2020) because of lower perception of personal risk, concerns regarding the vaccine and time constraints.

3.3.5 | Vaccine attributes, speed of vaccine development and vaccination intention

Seven studies reported higher acceptance of the COVID-19 vaccine if respondents had had influenza vaccine in the past (Dror et al., 2020; Fisher et al., 2020; Gagneux-Brunon et al., 2020; Goldman et al., 2020; Grech et al., 2020; Sherman et al., 2020; Wang et al., 2020). Among those from healthcare backgrounds, two studies reported that they were more likely to receive the influenza vaccine than the COVID-19 vaccine (Dror et al., 2020; Grüner & Krüger, 2020); however, there was no group difference in COVID-19 vaccination intention between healthcare professionals and the general population (Grüner & Krüger, 2020). In two studies, concerns about vaccine novelty and the speed of COVID-19 vaccine development were reasons given for vaccine hesitancy (Freeman et al., 2020; Goldman et al., 2020).

In relation to personal preference of hypothetical types of available COVID-19 vaccines and vaccination intention, respondents from eight studies indicated effectiveness of vaccine was an important factor influencing vaccine selection or vaccination intention (Dong et al., 2020; Freeman et al., 2020; Harapan et al., 2020; Kreps et al., 2020; Palamenghi et al., 2020; Pogue et al., 2020; Reiter et al., 2020; Wang et al., 2020), as was a vaccine with long duration of disease protection (Dong et al., 2020; Kreps et al., 2020; Pogue et al., 2020). Vaccine safety, that is a vaccine with no or few adverse effects, was also a strong determinant influencing willingness to be vaccinated (Dong et al., 2020; Freeman et al., 2020; Kreps et al., 2020; Pogue et al., 2020; Reiter et al., 2020; Sherman et al., 2020; Wang et al., 2020). Furthermore, COVID-19 vaccines that were developed or manufactured in America or Europe received higher preference ratings compared to those developed in China or Russia (Dong et al., 2020; Kreps et al., 2020; Pogue et al., 2020). Interestingly, in one study, cost of the vaccine was found to be the least important factor in respondents' vaccine selection (Dong et al., 2020).

3.3.6 | Regional increase in cumulative COVID-19 caseloads over time and vaccination intention

Figure 2 plots the estimated cumulative mean caseloads of COVID-19 cases per 1 million people in the country retrieved from the Worldometer live update (COVID-19 Coronavirus Pandemic 2020, 2020), on the day when survey data were collected, against the overall reported COVID-19 vaccination intention in 23 studies included in this review. Studies that (a) did not specify a data collection period (Al-Mohaithef & Padhi, 2020; Barello et al., 2020; Graffigna et al., 2020; Palamenghi et al., 2020); (b) included multiple countries (Goldman et al., 2020; Lazarus et al., 2020); and (c)

recorded trend over time in a single country (Szilagyi et al., 2020); were excluded in this plot (Figure 2). The time series pattern showed low estimated R of -0.00042 , indicating no relationship between cumulative increase in COVID-19 caseloads and respondents' vaccination intention. The same and consistent pattern was also found in the study by Lazarus et al. (2020), which collected data from 19 countries in June 2020. Low correlation ($R = -.0004$) was found between vaccination intention in each country and the cumulative mean COVID-19 caseloads per 1 million people during the period of data collection in June 2020.

4 | DISCUSSION

As world leaders and public health officials focus on securing sufficient COVID-19 vaccines and an effective vaccine roll-out strategy for their population, this review underscores another urgent challenge—to address the variability in COVID-19 acceptance across socio-demographic groups, and addressing barriers to vaccine acceptance. Findings of this review on COVID-19 vaccination intention are consistent with previously reported seasonal influenza vaccination uptake which showed that being older, ethnically White, and having higher educational attainment were associated with higher vaccine acceptance (Okoli et al., 2019). Similarly, the finding that men were more receptive to the COVID-19 vaccine is consistent with previous investigation on gender differences and vaccine uptake (Flanagan et al., 2017). Some of the reasons postulated were lower level of social support for women and being less open to healthcare recommendations and preventive measures (Jiménez-García et al., 2010). In contrast to those who underestimated the severity of the disease or showed mistrust in authorities, those who had previously received vaccination for seasonal influenza, and/or expressed higher concern and belief in their susceptibility to the disease were understandably more willing to vaccinate against COVID-19 (Graffigna et al., 2020).

Vaccine attributes were also found to be crucial in the decision to vaccinate, including effectiveness of the vaccine, long duration of protective effects and optimum safety profile which were also consistent with previous findings, for example, in the study conducted on the H1N1 vaccine during the 2009 influenza A pandemic (Frew et al., 2011). Confidence in the quality of the vaccine was reported to be strengthened by recommendations from reliable sources such as nurses and physicians highlighting the role of HCWs in building public trust. Another important factor that influenced vaccine hesitancy found in this review was the speed of vaccine development which was not surprising considering the novelty of the COVID-19 virus and the new technologies used, raising uncertainties about the adequacy of research and testing, adversely impacting on perceived efficacy and safety of vaccines (Freeman et al., 2020).

Of concern, this review also highlighted a decline in vaccination intention over a 10-month span in 2020, which was borne out in two studies, one conducted in the USA (Szilagyi et al., 2020) and the other in Italy (Palamenghi et al., 2020). This decline occurred during a period when confirmed COVID-19 cases in both countries

were consistently among the 10 highest in the world (COVID-19 Coronavirus Pandemic, 2020, 2020). Nevertheless, this trend is consistent with findings of another study conducted during the 2009–2010 H1N1 pandemic (Gidengil et al., 2012). Postulated reasons for this paradoxical trend of decline in vaccination intention over time could be (a) an overestimation of perceived risk in an unusual event (COVID-19 pandemic), which declines as more comprehensive understanding of the threat emerges (Gidengil et al., 2012); (b) messaging fatigue, a status of weariness and desensitisation, due to repeated exposure to information about COVID-19 (Koh et al., 2020); and (c) infodemic, an oversupply of information making it difficult to distinguish between reliable information and misinformation (Zarocostas, 2020). Findings from this review support a need to address the issue of potential 'crisis of public confidence' against COVID-19 vaccination, and to address specific concerns of subpopulation groups, with vaccination messages that are group- and context-specific, to restore confidence in COVID-19 vaccines (Larson et al., 2011). Although the WHO has established a new information platform to share information tailored for specific target groups since the declaration of the COVID-19 pandemic (Zarocostas, 2020), findings from this review indicate more work is needed. This need is particularly important, as it has been shown empirically, that undecided or vaccine hesitant groups were more likely to be influenced by the views from minority but well-organised anti-vaccination groups, compared to those from pro-vaccination groups (Johnson et al., 2020). One strategy that has been promoted is psychological inoculation, also known as pre-bunking, an approach of presenting anti-conspiracy arguments to counter misinformation about COVID-19 vaccination, before the general public is exposed to misinformation on vaccination conspiracy theories (van der Linden et al., 2020). Nevertheless, the effectiveness of this strategy against COVID-19 vaccination intention has yet to be reported.

In addition to highlighting the issues of vaccine intention in different population groups, this review has also highlighted the need for standardisation in measuring vaccine uptake. Differences in terminology used to refer to vaccine intention, heterogeneity in measurement of vaccine acceptance and collapsing responses often into dichotomous categories limit the capacity to undertake precise quantitative comparisons among studies that measured the same construct of vaccination intention. A standardised measure of this construct will enhance accuracy to identify target areas to improve vaccination uptake.

4.1 | Limitations

We only included full-text articles of studies published up until December 2020 and we excluded pre-print articles that had not yet been peer reviewed. Given the very high rate of COVID-19 research publications—estimated at 137 publications per day compared to 6 papers per day during the 2009/2010 H1N1 pandemic (Yeo-Teh & Tang, 2021), it may be that including papers available in pre-print but not peer-reviewed at the time of our search may have resulted in different conclusions being drawn. We also only included papers

published in English because of the lack of resources to undertake translation which may limit the generalisability of these findings.

5 | CONCLUSIONS

This review identified significant variability in vaccine intention rates across countries, ranging from 27.7% to 93.3%, which in some countries would hamper efforts to achieve herd immunity. Nevertheless, factors shown to be associated with vaccine acceptability included being older, male, having higher levels of education, previous receipt of influenza vaccination, perceiving oneself to be at greater risk of exposure or greater susceptibility to COVID-19, and having high levels of trust in health-related information from government bodies and healthcare providers. In contrast, high exposure to negative information about COVID-19 vaccines, particularly in social media, and certain health professional groups including nurses and nursing assistants were associated with lower vaccine acceptability. This review did not support COVID-19 caseload as a factor associated with vaccination intention rather, it has highlighted a decline in vaccination intention during a period when COVID-19 have been increasing. More research is needed to understand why nurses have lower rates of vaccine acceptability particularly as they are at higher risk of exposure to COVID-19 and will be prioritised to receive the vaccine. Addressing methodological issues of measuring vaccine acceptance would be an important step towards an improved evaluation of vaccine intention. Intensive population education programs, in concert with vaccination promotion efforts from health, social and political organisations to address the barriers reported in this review are needed to improve vaccination acceptance.

6 | RELEVANCE TO CLINICAL PRACTICE

An important finding of this review was the number of studies showing lower vaccine acceptance among healthcare professionals, particularly among nurses. This is consistent with previous studies that showed that nurses had more concerns with vaccine efficacy and safety, and mistrust in health authorities (Wilson et al., 2020). Given that nurses are considered the most trusted professionals in the community (Milton, 2018), more focus should be given to address their vaccine hesitancy concerns, to enable them to provide informed and authoritative recommendations to the public.

CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTION

Study conception and design: RA and DM; Data, investigation and methodology: RA, DM, ARV and YS; Data extraction: BE, JM and YS; Performance of the data analysis: YS, BE, JM, ARV, DM and RA; Manuscript draft: RA, DM, YS, BE, JM and ARV; Critical revisions to the paper for important intellectual content: RA, DM, YS, BE, JM and

ARV; Supervision of the conduct of the research and the research team: YS.

DATA AVAILABILITY STATEMENT

Data are in the table and figures included in the article (Table 1).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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