Review

Determination of Novel Coronavirus Disease (COVID-19) Vaccine Hesitancy Using a Systematic Review Approach Based on the Scientific Articles in *PubMed* Database

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Abstract

OBJECTIVE: Publications on vaccine hesitancy and the novel coronavirus disease 2019 in the scientific literature are increasing every day. An examination of their content will help to eliminate the existing negativity related to vaccine hesitancy through scientific methods. Hence, a systematic approach to the prevention of vaccine hesitancy worldwide can be developed. This article aims to survey how vaccine hesitancy is addressed in the PubMed articles about "vaccine hesitancy" over the novel coronavirus disease, for which the MeSH criteria have been published; to understand their recommendations for the prevention of vaccine hesitancy; to evaluate any related research described as "cross-sectional," "case-control," and "cohort" according to Strengthening the Reporting of Observational Studies in Epidemiology criteria; and to contribute to the current literature on the subject.

MATERIAL AND METHODS: This study is planned to use a systematic review format and STROBE checklist was used to evaluate the articles accessed from *PubMed* database. Microsoft Excel was used as the data calculation tool.

RESULTS: Sixty-five (81.3%) of the 80 articles investigated in the scope of this study mention "vaccine." While 64 articles (80%) discuss the determination of vaccine hesitancy, 57 (71.3%) articles address its prevention. The keyword "COVID-19" is used in 61 articles (79.2%). The second most frequently used keyword is "vaccine hesitancy" (n = 37, 48.1%), followed by "vaccine" (n = 25, 32.5%). Twenty-nine (48%) of the reviewed articles originate from the WHO American Continents. The second most represented region of research is the European Region (n = 21, 35%), followed by the South East Asian Region (n = 5, 8%).

CONCLUSION: This study illustrates the recent situation for the coronavirus disease 2019 vaccine and reveals the presence of a vaccine hesitancy. Vaccine hesitancy is a risk factor that could prevent herd immunity. The systematic review of scientific articles should continue with improvements in order to tackle the problem as exemplified by the present study. Other checklists as well as STROBE checklist are recommended to be used in similar studies to have more objective conclusions.

KEYWORDS: COVID-19, novel coronavirus disease, vaccine, vaccine hesitancy, vaccine refusal
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INTRODUCTION

Outbreaks of communicable diseases have always been among the major problems challenging humanity throughout history. The Wuhan Municipal Health Commission of China reported a cluster of cases of pneumonia in Wuhan, Hubei Province, on December 31, 2019, which then spread rapidly to all countries. The novel coronavirus disease (COVID-19) was declared a pandemic by the World Health Organization (WHO) on March 11, 2020.[1] The disease has had a devastating impact especially in the social, economic, and health dimensions, from the date of its onset to the present day. Although, medical treatments for COVID-19 have been improving, the most important prevention mechanisms known today are behavioral approaches and vaccine application, to which world countries have started to give approval.[2,3]

Vaccinations against outbreaks of life-threatening contagious diseases have been one of the greatest public health achievements in history. Individuals are immune to infectious diseases thanks to the availability of vaccines. Vaccine-preventable diseases can be dangerous in the absence of vaccination, resulting in disability or death.[4] Vaccinations help children and adults develop immunity to the disease by working with the body's natural defense systems to reduce the risks of infection.[5] In terms of public health, the vaccine's success in reducing disease-related mortality ranks second after the use of safe drinking water.[6] Although vaccines carry some risks, most countries have shaped their public health policies accordingly and promulgated mandatory child vaccination laws to inhibit the spread of preventable diseases.[7]

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While vaccination studies aiming at protection against COVID-19 have gained momentum, they have also ushered in a series of discussions in society about vaccination. The most hotly debated topic is "vaccine hesitancy/refusal." Fighting the existing vaccine hesitancy/refusal has been extremely important in achieving success against COVID-19 through vaccination. Vaccine hesitancy implies a refusal or delay in the acceptance of vaccination despite the availability of vaccination services. Vaccine hesitancy is complex and it may be specific or vary, depending on the time, place, and the vaccine. Vaccine hesitancy is influenced by such factors as indifference, suitability, and trust.[8]

Recent research has revealed that 49%-70% of the United States population plan to receive the COVID-19 vaccine when available. This number of participants is probably below the threshold necessary for homogeneous herd immunity and will leave many people vulnerable to the disease even if a vaccine is available.[9] The WHO proposes a preventive strategy to prepare for maximum effectiveness upon the availability of a vaccine, to overcome vaccine hesitancies and build confidence the vaccine.[10] The publications reflected in scientific literature on vaccine hesitancy and COVID-19 are increasing on a daily basis. Examining the content of these publications will contribute toward eliminating the existing negativity related to vaccines and overcoming vaccine hesitancy through scientific methods. Hence, a systematic approach to the prevention of vaccine hesitancy in the world can be developed.

Based on the rationale described above, this study attempts to investigate and analyze how hesitancy related to the COVID-19 vaccine is reflected in the scientific literature. We systematically analyzed a group of PubMed articles about COVID-19 vaccine hesitancy from March 11, 2020 onward, which were selected through the keywords defined by using MeSH criteria. We used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) criteria to evaluate the cross-sectional, case-control, and cohort studies.

MATERIAL AND METHODS

This research, characterized as a systematic review, has been conducted online. PubMed database publications from 2020 to 2021 form the research universe.

In the first stage, to access articles for review, the MeSH of COVID-19 Virus Disease, COVID-19 Virus Disease, COVID-19 Virus Diseases, Disease, COVID-19 Virus, Virus Disease, COVID-19 Virus Disease, COVID-19 Virus Infection, 2019- nCoV Infection, 2019-nCoV Infection, 2019- nCoV, Coronavirus Disease 19, 2019 Novel Coronavirus Disease, 2019-nCoV Disease, 2019 Novel Coronavirus Infection, Coronavirus Disease 2019, Disease 2019, Coronavirus, SARS Coronavirus 2 Infection, SARS-CoV-2 Infection, Infection, SARS-CoV-2, SARS CoV 2 Infection, SARS-CoV-2 Infections, COVID-19 Pandemic, COVID 19 Pandemic, COVID-19 Pandemics, Pandemic, Vaccine hesitancy, COVID-19, Refusal, Vaccination, Vaccination Refusals, Vaccine Refusal, Vaccine, Refusals, Vaccine Refusals have been used. On January 19, 2021, 189 articles were published in the PubMed database compatible with MeSH.

A total of 275 articles were reached when the first and second stages were completed. Nineteen of them were intersected, and 173 articles were eliminated because they did not meet the research criteria. 173 excluded articles were not related to COVID-19, vaccination or vaccine hesitancy. The remaining 83 articles were included in the research.[9,10,11,12-86] One of the articles was not written in English,[18] and 2 articles were inaccessible due to paid access requirement.[33,79] As a result, the scope of this review comprises 80 articles.

The research flow chart is presented in Figure 1.

Applicable Research Terms, Criteria, and Indicators

- **Vaccine:** A product that stimulates a person's immune system to produce immunity against a specific disease, thereby protecting the person from that disease.[87]
- **Vaccination:** A simple, safe, and effective way to protect people from harmful diseases before contact. It uses the body's natural defense to create resistance to certain infections and strengthens the immune system.[88]
- **Vaccine Refusal:** Wilful avoidance of getting vaccinated, and refusal of all vaccines.[89]
- **Vaccine Hesitancy:** It is a delay or refusal in acceptance of vaccines despite the availability of vaccination services. It includes such factors as indifference, convenience, and trust.[90]
- **Immunization:** A process by which a person becomes protected against a disease through vaccination.
- **Novel Coronavirus Disease (COVID-19):** It first emerged in late December 2019 in Wuhan, China, and is a contagious disease that causes symptoms such as fever, cough, and shortness of breath in infected people.[91]
- **STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) criteria**: The guidelines created to assist the author in high-quality presentation of the observational study. These guides consist of 22 sub-items that the author must fulfill before submitting the article to a journal.[92]

Study Variables

The articles reviewed in this study included variables like the name of the journal in which the article is published, the journal's effect value, the presence of the journal's web page, the journal's frequency of publication, the article's category in the journal, the article keywords, the acceptance and publication dates of the article, the number of pages, authors, and sources for the article, the institutional affiliation of the

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MAIN POINTS

- This study has revealed mainly the presence of vaccine hesitancy. However, vaccine refusal has been highlighted only in one manuscript.

- The manuscripts explored discuss the current attitudes and opinions toward the coronavirus disease 2019 (COVID-19) vaccine.

- The research derives its strength from offering answers to many additional research questions, from vaccine marketing strategies to vaccine safety and recommendations, and from basic motivation to the barriers to COVID-19 vaccination.
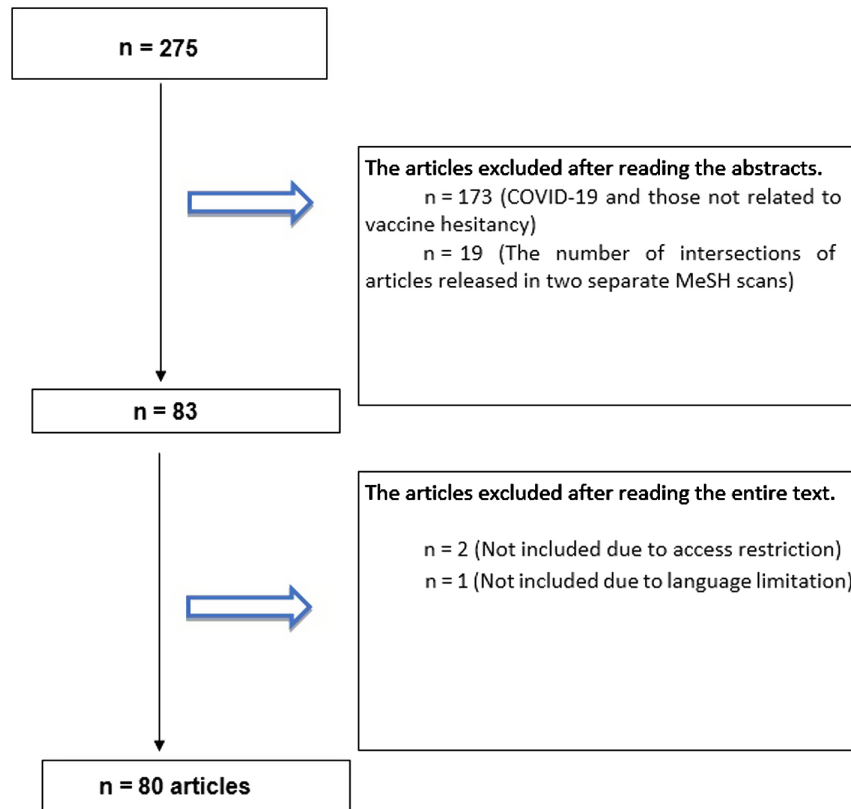
Figure 1. Flowchart of the study.

first author of the article, the WHO region where the article research was conducted, status of permission from the ethics committee, conflict of interest, if any, that the article's authors have, state of a structured abstract, state of a structured "Material and Methods" section, and the topics covered in the article's content.

Data Collection Method, Tools, and Data Analysis

The online data collection form was devised by 9 interns serving the Elective Public Health Internship at the Hacettepe University School of Medicine. The 83 articles used as research data were accessed from the PubMed database. The STROBE checklist was used to evaluate the studies. Microsoft Excel was used as a data calculation tool. In the analyses, descriptive statistics were defined as numbers and percentages, while distribution statistics consisted of mean, standard deviation, median, smallest and greatest value. The findings were tabulated using these data.

Ethical Issues

The study was conducted using online resources. All articles were open access. Therefore, no permission was required from the board or the ethics committee. No names of institutions or individuals were mentioned in the content.

Findings

Of the 80 articles reviewed, 73 articles (91.2%) have an accessible journal web page, and 58 articles (72.5%) appear in an at least monthly journal. Eighty articles reached in the scope of this study were published in 50 separate journals. The impact values of 2 of them have not been assessed. When the impact values of 48 articles were analyzed, we

found the smallest value as 0.72, the highest value as 45.54, and their average as 5.973, and standard deviation as 9.446 (Table 1).

Of the 80 articles reviewed, 44 (55%) fall into the category of original article, followed by the second most frequent article category, commentary (n = 15, 18.7%), and the third most frequent category, review (n = 7, 8.7%) (Table 1).

Table 1. Article Categories Within the Journal (PubMed, January 18, 2021; Time: 23:20 Hours)

Category	Number	Percentage
Original Article	44	55
Commentary	15	18.7
Review	7	8.7
Editorial	4	5
Short Report	2	2.5
Viewpoint	2	2.5
Analysis	1	1.2
News	1	1.3
Practice Guidelines	1	1.3
Letter to the Editor	1	1.3
Perspective	1	1.3
Essay	1	1.2
Total	80	100

Table 2. Research Articles by Study Types (PubMed, January 18, 2021; Time: 23:20 Hours)

Type of Research	Number	Percentage
Not a research article	32	40
Descriptive	29	36.3
Cross-sectional	14	17.5
Intervention (education, training, medicine, rehabilitation, behavior)	3	3.7
Systematic review	2	2.5
Total	80	100

Forty-eight (60%) of the reviewed articles are research articles. Thirty (37.5%) of the research articles are descriptive. Cross-sectional research articles are the second most frequent type (n = 14, 17.5%), followed by intervention research (n = 3, 3.7%). Systematic reviews form the least frequent article group included in the research (Table 2).

Of the 80 articles, 65 (81.3%) mention reasons for vaccine hesitancy, 64 (80%) identify vaccine hesitancy, and 57 (71.3%) address the prevention of vaccine hesitancy (Table 3).

Fourteen articles evaluated according to the STROBE checklist are based on a cross-sectional research design. There are no cohort and case control studies. Of the 14 investigated articles, 12 (85.7%) discuss limitations of the study, taking into account the sources of potential bias or imprecision. In 9 (64.2%) of the 14 articles, sources of funding and the roles of the funders of studies are stated (Table 4).

All of the 14 articles evaluated according to STROBE checklist provide in the abstract an informative and balanced summary of the study and its findings. Thirteen of the investigated articles summarize key results with reference to study objectives; 12 of the articles discuss the generalizability (external validity) of the study results (Table 4).

Most of the studies were conducted in the United States and Europe and some also in Southeast Asia. The target groups of the studies vary. Most of the studies involve individuals or healthcare professionals living in the selected regions. Many of the articles agree that healthcare professionals' views on COVID-19 vaccines are extremely important, as their role at the forefront during the pandemic period is

Table 3. The Inclusion of Vaccine Hesitancy-Related Issues in the Articles (PubMed, January 18, 2021; Time: 23:20 Hours)

Topics included in the article content	Number	Percentage
Reasons for vaccine hesitancy	65	81.3
Status of vaccine hesitancy	64	80.0
Prevention of vaccine hesitancy	57	71.3

of great significance. Most of the research participants are women. Most of the studies question the thoughts of the research group against a potential future COVID-19 vaccine by organizing online surveys, and try to obtain a justification of these opinions. Although it is expected that once developed, the vaccine, which is one of the most important elements in the fight against this pandemic, will be widely accepted by the society, the results show that vaccine hesitation exists at a level that threatens social immunity, despite the ongoing pandemic. One of the sources of hesitation dominating the articles examined in general is the insufficient confidence in the effectiveness of the vaccine. Hesitancy against a potential COVID-19 vaccine can also stem from fear of the side effects of the vaccine. From this point of view, it can be thought that the perceived risk of the vaccine's side effects among the general population is far above the side effects that may actually occur. Another reason for vaccine hesitation is that during the pandemic period, COVID-19 vaccination studies progress unusually quickly and without sufficient public information. The other results strikingly reveal that vaccine hesitancy was higher in women. Participants with a history of chronic illness may be more likely to accept the COVID-19 vaccine because of their higher risk of morbidity and mortality if they become infected. The suggestions of 14 articles, in fact, are all the same: to continue more comprehensive and evidence-based scientific studies on the detection of vaccine hesitation, to identify barriers that may cause vaccine hesitancy and lack of vaccine uptake-and thereby insufficient social immunization, which is one of the greatest tools for ending this pandemic. To ensure that the changeable factors are considered as all societies, the future vaccination programs should implemented within these principles (Table 5).

DISCUSSION

Vaccine hesitancy is defined by WHO as "delay or refusal to accept vaccines despite the availability of vaccine services."[89] WHO has declared that vaccine hesitancy is one of the top 10 threats to global health in 2019.[96] Individuals who are hesitant about vaccination may accept vaccination but remain concerned about it, some may reject or delay some vaccinations but accept others; some people may refuse all vaccinations.[90] This study mainly has revealed the presence of vaccine hesitancy by examining a group of articles accessed from the PubMed database (Table 3). Various causes of the recent vaccine hesitancy include distrust in vaccination, low education level, low income level, and concerns about side effects based on unscientific and false beliefs because the vaccine has been developed in a noticeably short time.[23,50,51,56,80] An incorrect pool of information on social media can lead to the spread of vaccine hesitancy in the community. Laying out these causes on scientific grounds before vaccination is highly valuable to remove any obstacles in the way of achieving the desired level of vaccination in the community.

The articles analyzed based on data collection forms include at least one of these subjects, namely, causes of vaccine hesitancy, detection of vaccine hesitancy, and prevention of vaccine hesitancy. The causes and detection of vaccine hesitancy occupy a more prominent place in the

Table 4. The Features of Articles According to STROBE Checklist (PubMed, January 18, 2021; Time: 23:20 Hours)

Category	N			Yes	No	Not Decided
Title and abstract	1					
		A	Indicate the study's design with a commonly used term in the title or the abstract.	14		
		B	Provide in the abstract an informative and balanced summary of what was done and what was found.	14		
Introduction						
Background/ rationale	2		Explain the scientific background and rationale for the investigation being reported.	14		
Objectives	3		State the specific objectives, including any pre-specified hypotheses.	12	1	1
Methods						
Study design	4		Present key elements of study design early in the paper.	14		
Setting	5		Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	13	1	
Participants	6					
		A	*Cohort study*-Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up. *Case-control study*-Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. *Cross-sectional study*-Give the eligibility criteria, and the sources and methods of selection of participants.	12 (cross-sectional study)	2 (1 cross-sectional and 1 case control)	
		B	*Cohort study*-For matched studies, give matching criteria and number of exposed and unexposed. *Case-control study*-For matched studies, give matching criteria and the number of controls per case.	1 (case control)		
Variables	7		Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	8	3	3
Data sources/ Measurement	8		For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	13	1	
Bias	9		Describe any efforts to address potential sources of bias.	9	4	1
Study size	10		Explain how the study size was arrived at.	9	5	
Quantitative variables	11		Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why.	10	2	2
Statistical methods	12					
		A	Describe all statistical methods, including those used to control for confounding.	9	2	3
		B	Describe any methods used to examine subgroups and interactions.	7	3	4
		C	Explain how missing data were addressed.	2	7	5
		D	*Cohort study*-If applicable, explain how loss to follow-up was addressed. *Case-control study*-If applicable, explain how matching of cases and controls was addressed. *Cross-sectional study*-If applicable, describe analytical methods taking account of sampling strategy.	11	1	2
		E	Describe any sensitivity analyses	2	5	7

(Continued)

Table 4. The Features of Articles According to STROBE Checklist (PubMed, January 18, 2021; Time: 23:20 Hours) (Continued)

Category	N			Yes	No	Not Decided
Results						
Participants	13					
		A	Report numbers of individuals at each stage of study-e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed.	8	6	
		B	Give reasons for non-participation at each stage.	4	10	
		C	Consider use of a flow diagram	2	11	1
Descriptive data	14					
		A	Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders.	11	3	
		B	Indicate number of participants with missing data for each variable of interest.	5	9	
		C	*Cohort study*-Summarize follow-up time (e.g., average and total amount).			
Outcome data	15					
			Cohort study-Report numbers of outcome events or summary measures over time.			
			Case-control study-Report numbers in each exposure category, or summary measures of exposure.			
			Cross-sectional study-Report numbers of outcome events or summary measures.	14		
Main results	16					
		A	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% CI). Make clear which confounders were adjusted for and why they were included.	13	1	
		B	Report category boundaries when continuous variables were categorized.	6	3	5
		C	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.		6	8
Other analyses	17		Report other analyses done-e.g., analyses of subgroups and interactions, and sensitivity analyses.	5	5	4
Discussion						
Key results	18		Summarize key results with reference to study objectives.	13	1	
Limitations	19		Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12	2	
Interpretation	20		Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	13	1	
Generalizability	21		Discuss the generalizability (external validity) of the study results.	12	2	
Other information						
Funding	22		Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based.	9	5	

Table 5. Basic Information About the Articles Reviewed in the Scope of the STROBE Checklist (PubMed, January 18, 2021 at 23:20 Hours)

Article Reference	Type of Research	Place of Research	Target Group	Average Age and Gender Distribution of Research Participants	Aim	Findings/Conclusion	Suggestion
Unroe KT et al 2020[144]	Cross-sectional	Indiana, USA	23 232 medical personnel were targeted. 8 243 people responded to the survey.	Of the respondents, 87% are female and 13% are male. The average age is not indicated.	The aim is to group the medical personnel working in Indiana according to age, gender, origin, duty/assignment in nursing home, whether they have previously been infected or not and to conduct a survey on willingness to receive the COVID 19 vaccine.	Of the respondents, 45% stated that they would get the vaccine once it was publicly available, 44% said that they might be vaccinated in the future. Besides, a rate of 69% has appeared for those willing to get vaccination.	When deciding to get the COVID-19 vaccine, the medical staff weigh both the possible risks if any for the residents they examine, and their personal beliefs and concerns. With special trainings for health personnel and outreach efforts, the existing concern and hesitancy should be reduced.
Sherman SM et al 2020[138]	Cross-sectional	UK	1500 people over 18 years old were targeted. A total of 1494 people responded to the survey.	The average age of the respondents is 46. 51% of the respondents are female and 49% are male.	The aim of the study is to discuss the relationship between sociodemographic factors, the respondent's intention of vaccination and her/his previous influenza vaccinations in a demographically representative sample of adult population in the UK.	Of the respondents, 64% are highly likely to get vaccination against COVID-19, 27% are unsure, and 9% are very unlikely to get vaccination. The study reports the influence of personal characteristics on the thoughts and beliefs against the influenza vaccine and vaccination in general.	Since the research conducted on 1500 people has been completed during the current pandemic, more extensive vaccination intent studies should be carried out in later.
Wang K et al 2020[92]	Cross-sectional	Hong Kong, China	Nurses working in public or private service institutions, in inpatient or outpatient services, or outreach services were found eligible for this study. A total of 856 nurses filled out the online survey.	87.5% of the participants are women and 12.5% are men. The average age is not indicated.	The study investigated the impact of the COVID-19 pandemic on the change in influenza vaccine acceptance, and the factors associated with the acceptance of the potential COVID-19 vaccination.	40% of the nurses intend to accept COVID-19 vaccination. The intentions to accept COVID-19 vaccination are higher among men, patients with chronic diseases, employees in private service delivery, those who have met suspected or confirmed COVID-19 patients, and those who accepted seasonal influenza vaccination in 2019. On the other hand, nurses who accepted the influenza vaccine in 2019 are less likely to refuse the COVID-19 vaccine this year.	With low levels of COVID-19 acceptance intentions and high hesitancy over both influenza and COVID-19 vaccination, an evidence-based planning is needed for improving the uptake of both vaccines before administration.

Table 5. Basic Information About the Articles Reviewed in the Scope of the STROBE Checklist (PubMed, January 18, 2021 at 23:20 Hours) (Continued)

Article Reference	Type of Research	Place of Research	Target Group	Average Age and Gender Distribution of Research Participants	Aim	Findings/Conclusion	Suggestion
Taylor S et al 2020[98]	Cross-sectional	USA, Canada	The target group consists of American and Canadian adults.	A total of 43% of the sample are female, 57% are male. The average age of the sample is 53.	Objectives of the study: 1) Understanding the prevalence of vaccine hesitancy for the SARS-COV2 vaccine, (2) uncovering the motivational roots of this hesitancy, and (3) identifying the most promising incentives to increase the likelihood of vaccination when a vaccine is available.	In response to the question of whether participants would be vaccinated against SARS-COV2 when a vaccine became publicly available, 25% of Americans and 20% of Canadians said "no." Significantly more Americans than Canadians said they would not be vaccinated. The greatest correlation is between the "no" answer to the vaccine and the distrust in the SARS-COV2 vaccine's potential benefits.	To maximize vaccine intake, health officials should assure the public that they have strictly followed all predetermined guidelines for developing vaccines and the vaccine development process has not been haphazard.
M, et al 2020[119]	Cross-sectional	Saudi Arabia	The target group included people living in major cities of Saudi Arabia (Riyadh, Dammam, Jeddah, Abha), and other small cities. 992 people participated in the study.	Of the participants, 65.8% are female and 34.2% are male. The average age is not indicated.	The study aims to evaluate the prevalence and determinants of COVID-19 vaccine acceptance among people in Saudi Arabia.	Of the respondents, 642 showed interest in accepting the COVID-19 vaccine. The request to accept future COVID-19 vaccination is higher among the participants who are seniors, married, holders of master's or higher educational degrees (68.8%), non-Saudis (69.1%), and government sector employees (68.9%).	Addressing sociodemographic determinants of COVID-19 vaccination can help increase the uptake of the global vaccination program to overcome future outbreaks. It is important to provide health trainings for the implementation of the targeted COVID-19 vaccine program.
Kwok KO et al 2020[120]	Cross-sectional	Hong Kong, China	In cooperation with the Hong Kong Nursing Personnel Association, the members of this association (registered nurses, nursing interns working in public or private medical facilities) were included in the survey.	The average age of the sample is 40.79. Of the participants, 90% are female and 10% are male.	The aim of the study is to predict the influenza vaccination behaviors of nurses and their intentions to have COVID-19 vaccination when available, and to examine the 5C psychological precursors impacting their intentions (e.g., trust, peace of mind, restrictions, calculation and collective responsibility).	The influenza vaccine intake rate and the rate of those who agree to get COVID-19 vaccine are 49% and 63%, respectively. Influenza vaccination is associated with working in public hospitals and having all 5C structures, while stronger intention to be vaccinated for COVID-19 is related to younger age and higher trust. The rate of COVID-19 vaccination among nurses is insufficient to ensure herd immunity.	Health officials should organize a vaccination program for nurses, especially elderly nurses, to get COVID-19 vaccination. When implementing a nationwide vaccination program, greater emphasis should be placed on psychological elements. The health safety of health care practitioners, the most valuable resource for every country, must be guaranteed in the COVID-19 pandemic.

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Table 5. Basic Information About the Articles Reviewed in the Scope of the STROBE Checklist (PubMed, January 18, 2021 at 23:20 Hours) (Continued)

Article Reference	Type of Research	Place of Research	Target Group	Average Age and Gender Distribution of Research Participants	Aim	Findings/Conclusion	Suggestion
Sallam M et al 2021[149]	Cross-sectional	Jordan and Kuwait	The online survey targeted people over 16 years of age speaking Arabic and residing in Jordan and those living in other Arabic-speaking countries. 3414 people participated in the survey.	The proportion of female respondents is 67.3%, the proportion of male respondents is 32.7%. The average age of the respondents is 31.	The survey aims to evaluate society's attitude towards possible COVID-19 vaccinations in Jordan, Kuwait, and other Arab countries. Furthermore, it analyzes the relationship between COVID-19 vaccine adoption and beliefs of conspiracy.	Of the respondents, 29.4% accepted the vaccine. The vaccine acceptance rates among men and women are 38.2% and 27.4% respectively. The vaccine acceptance rate among postgraduate students from the respondents is 40.4%, while it is below 30% among the remaining group. At the same time, the higher income rate is associated with a higher admission rate. Approximately 40% of the respondents believed that COVID-19 was a disease fabricated to force everyone to be vaccinated, and more than a quarter of the respondents stated a belief there is a chip hidden in COVID-19 vaccine. In addition, 23.4% stated that COVID-19 vaccines would cause infertility.	Associating conspiracy beliefs about possible vaccinations and the origin of the virus with vaccine hesitancy should be stimulating, and politicians, governments and different media should warn their platforms about the harmful effects of the spread of misinformation.
Barello S et al 2020[106]	Cross-sectional	Italy	The target group included Italian university students. 1152 students were contacted for the survey. The number of interviewee students is 934.	Of the respondents, 79.6% are female and 20.4% are male. The average age of the respondents is 23.6.	The study aims to evaluate students' attitudes towards possible COVID-19 vaccination and the impact of university curriculum on vaccination demand.	Of the 735 students interviewed, 633 (86.1%) would prefer to be vaccinated, while 102 students (13.9%) were unsure or did reject. In this sample, more than 1 one out of 10 students showed hesitancy/rejection for the possible COVID-19 vaccination.	The design of multidisciplinary training strategies through inclusion of psychosocial factors that cause vaccine hesitancy can be helpful in supporting students' perspective on COVID-19 vaccine, health participation, and awareness.

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Table 5. Basic Information About the Articles Reviewed in the Scope of the STROBE Checklist (PubMed, January 18, 2021 at 23:20 Hours) (Continued)

Article Reference	Type of Research	Place of Research	Target Group	Average Age and Gender Distribution of Research Participants	Aim	Findings/Conclusion	Suggestion
Goldman RD et al 2020[115]	Cross-sectional	USA, Canada, Israel, Japan, Spain, Switzerland	The survey was conducted with 1552 parents	The median age was 39.9. The gender ratio of the respondents is not indicated.	The article aims to understand whether parents want their children to get the COVID-19 vaccine or not.	Of the parents surveyed, 65.2% said they were planning to vaccinate their children, 33% stated they would not vaccinate their children.	A close look at parents' reaction to a newly released vaccine and their reflections on the vaccination of their children may help us understand the underlying reason of vaccine hesitancy.
Gagneux-Brunon et al 2020[124]	Cross-sectional	France	The target group consisted of French health practitioners. A total of 2047 people responded to the survey; 1421 people participated in the online survey from 626 sites.	Of the participants, 74% were female and 26% were male. The average age is not indicated.	The study aims to investigate the acceptability of COVID-19 and influenza vaccines by French health practitioners and identify the underlying causes of acceptance/hesitancy.	The rate of vaccine hesitancy was identified as 25.9%. Of the respondents, 48.1% expressed fears about the COVID-19 vaccine. Doctors (92.1%) and pharmacists (88.8%) agreed to be vaccinated at a higher rate, while the rate of acceptance was lower among nurses (64.7%).	If the rate of influenza is reduced by influenza vaccinations, COVID-19 tests will not be performed unnecessarily. In consideration of the hesitancies over both vaccines, the right path should be followed in the fight against vaccination.
Sun, S. et al 2020[125]	Cross-sectional	China	The target group are university students in China. A total of 1992 people participated in the survey.	The average age of participants is 20.38. Of the participants, 69.77% are women and 30.23% are men.	The study aims to investigate the willingness of Chinese university students to participate in vaccine experiments with the rapid development of COVID-19 vaccines.	Most respondents (64%) stated that they were willing to be vaccinated. Their concern about the vaccine is described in the following words: "Its side effects include disability, death, and COVID-19 infection." The existence of a pre-vaccination consent form constitutes the most important negative effect on vaccine willingness.	Vaccine acceptance may increase if the forms of consent are clear and understandable. Participants should be clearly told about both risks and benefits they will have when they are vaccinated.

(Continued)

Table 5. Basic Information About the Articles Reviewed in the Scope of the STROBE Checklist (PubMed, January 18, 2021 at 23:20 Hours) (Continued)

Article Reference	Type of Research	Place of Research	Target Group	Average Age and Gender Distribution of Research Participants	Aim	Findings/Conclusion	Suggestion
Olagoke AA et al 2020[145]	Cross-sectional	America	The target group consists of individuals over 18 years of age residing in America. A total of 501 people participated in the survey.	Of the participants, 55.29% were female and 44.71% were male. The average age of the participants was 32.44 ± 11.94.	The aim of the study was to determine whether there is a relationship between piety and the intention to vaccinate against COVID-19 and to examine the role of health control focus (HLOC) in this relationship.	The study found a significantly negative relationship between piety and the intention to vaccinate against COVID-19. It was further observed that this relationship was partly mediated by the focus of external health control.	Religious leaders should consider educating their members on the need to take responsibility for their health. While scientists are struggling to develop a COVID-19 vaccine, it must establish a strong partnership with religious institutions through their leaders. This working relationship should be based on the transparency of ongoing vaccine development processes.
Lin Y et al 2020[114]	Cross-sectional	China	The participants are over 18 and literate, hold Chinese citizenship, and volunteer to work.	51.9% of the participants are female and 48.1% are male. The average age is not indicated.	The purpose of the article is to understand the vaccine hesitancy and demand for vaccination, to investigate the willingness to pay for vaccine. At the same time, it aims to compare locally produced and imported vaccines from the public eye.	83.5% of the respondents stated their intention to vaccinate, and 28.7% notified a definite intention. The perceived benefits have a strong and positive effect on the intention of vaccination. High prices that can be paid for vaccination are associated with a higher socioeconomic status. The majority stated to rely on the locally produced COVID-19 vaccine. Approximately two-thirds of the participants stated that they preferred domestic productions over foreign-produced COVID-19 vaccines.	Public health intervention programs should focus on improving humanity's perception of the benefits of COVID-19 vaccination. Clinical evidence of the safety and efficacy of COVID-19 vaccines is necessary for increasing vaccine coverage rates. Reducing inequalities in access to COVID-19 vaccines is crucial for financial reasons.
Reiter PL et al 2020[82]	Cross-sectional	USA	The target group consists of individuals over 18 years of age residing in the USA.	Of the participants, 43% are male and 57% are female. The average age is not indicated.	The aim is to investigate the acceptability of the potential COVID-19 vaccine in the USA based on a sample designed by interviewing a group of individuals over 18 years of age.	The study found that vaccine acceptability might vary according to the key role played by healthcare providers, and their health beliefs.	It is recommended to ensure the encouragement of the individuals who are unstable and opposed to vaccination through the affected factors that may be changed.

literature in comparison with the prevention of vaccine hesitancy. It may mean that further work can be done on the prevention of vaccine hesitancy. It is more effective to address the causes, detection, and prevention of vaccine hesitancy for a more comprehensive assessment of the concept of vaccine hesitancy.

Some of the topics examined within the framework of this research have contributed to our understanding of the extent of vaccine hesitancy in the COVID-19 process. While the vaccine is expected to be widely accepted by the community following its development process as one of the most important elements in the fight against the recent pandemic, the findings suggest that despite the ongoing pandemic, vaccine hesitancy exists at a level that threatens social immunity.[20] One of the sources of hesitancy predominantly emphasized in the articles we have reviewed here is insufficient confidence in the effectiveness of the vaccine. The fear of side effects that a potential COVID 19 vaccine is likely to have contribute to the general hesitancy as well. Consequently, we can suppose the general population's perception of the risk for side effects of vaccines to be far above the side effects that can actually occur. Another reason for vaccine hesitancy is the unusually rapid progress of COVID-19 vaccine studies during the pandemic. The perception of policymakers as instrumental in accelerating COVID-19 vaccine development processes may have increased the rate of vaccine hesitancy in communities.[66]

Fifty-five percent of the articles are original and authentic, since the COVID-19 pandemic is a very new topic open for research. Twenty-nine of the 80 articles are descriptive. In descriptive research, the number of the study group participants is less than 80% of the number of people in the sample group. The reasons for a less than 80% participation in vaccine hesitancy studies during the pandemic may include the online generation of research data and the failure to allocate the time required to participate in the study. The 14 research articles we have reviewed here are cross-sectional. Cross-sectional studies provide a "snapshot" of the finding and any related characteristics in a specific time frame and analyze them together with the cause–effect relationship. As the percentage of the participants of a cross-sectional study is expected to represent the target group in which the participation rate approximately equals 80% and above, the results of cross-sectional studies can be generalized to the sample group.[93] Cross-sectional studies are relatively cheap and less time consuming, which might be the main reason for the tendency favor this type of research during the pandemic. It might also have been chosen because the selected sample shows the COVID-19 vaccine hesitancy through the cause–effect relationship.

The ethics committee permission for data collection from participants should be shown in any kind of research carried out with qualitative or quantitative approaches (survey, observation, experiment). Approximately half of the articles that do not have the ethics committee permission in our review are research articles; it is an obvious lack of academic ethics.[95] The fact that only 6.2% of the articles have a conflict of interest can be considered as reassuring in such a research title open for referral as vaccine hesitancy.

The research derives its strength from offering answers to many additional research questions, from vaccine marketing strategies to vaccine safety and recommendations and from basic motivation to barriers to the COVID-19 vaccination.

This study has a number of limitations. First, all articles investigated in the study were written in English. Second, only PubMed was used. Third, selected types of research have been explored, and the research time frame reflects only a cross-section of the COVID-19 period. Fourth, only STROBE checklist was used for the assessment of the studies. However, there are other options, like the PRISMA checklist, which can be used in the same regard. Further studies can be done using such alternatives.

Based on the research findings, several suggestions have been developed. For example, the community needs to be trained on vaccines and clearly informed about their safety, qualification, and potential benefits. In this regard, all institutions and organizations should cooperate. The community's trust in healthcare systems can be strengthened. To maximize vaccine uptake, healthcare officials should assure the public that they have strictly followed all predetermined guidelines for developing vaccines and that the vaccine development process has not been haphazard. The results of the related studies on vaccines should be transparent and shared with society. Notifications about vaccines should be made by scientists or scientific organizations. Inequalities in access to COVID-19 vaccines due to financial reasons should be reduced, and a rightful policy should be followed in the distribution of vaccines. Mechanisms to strengthen the fight against information pollution in social media can be developed, and if necessary, social media should be used as a means to transmit the right information. To increase confidence in vaccinations, it is necessary to adopt a holistic approach to issues in the social, cultural, political, and economic domains. Increasing pursuit of scientific work is suggested to understand all the dimensions of vaccine hesitancy and to fight vaccine hesitancy.

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