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REVIEW ARTICLE

# Developed/Developing Nations Perspectives about COVID-19 Vaccination: A Narrative Systematic Review

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## ABSTRACT

***Background.*** The global spread of COVID-19 prompted a need for widespread vaccination to slow the transmission of the virus. Despite global, national, and local efforts, many people in various nations hesitated to receive a COVID-19 vaccine.

***Aims.*** The objective of this systematic review was to synthesize the existing literature addressing factors influencing COVID-19 vaccine acceptance and hesitancy.

***Methods.*** A literature search was conducted between November 2021 and March 2022. Inclusion criteria were studies identifying causations of COVID-19 vaccine acceptance and/or hesitancy since March 2020 in six developed/developing countries, Australia, Brazil, India, Nigeria, Russia, and the United States. Studies that were not originally published in English were excluded.

***Results.*** Patterns in the factors influencing both acceptance and hesitancy toward the COVID-19 vaccines emerged. Vaccination acceptance was largely related to individuals' personal preferences and beliefs regarding immunity, while vaccination hesitancy was attributed to fears and distrust of vaccine safety, side effects, and efficacy.

***Limitations.*** Lack of consistency in methodical procedures and text availability by country may limit the generalizability of the findings.

***Conclusion.*** In developed/developing nations, emerging data suggest that skepticism surrounding COVID-19 vaccines was the most prevalent factor leading to vaccination hesitancy, while factors including personal protection were largely associated with higher acceptance rates of the COVID-19 vaccine. Because widespread immunization is necessary to slow the transmission of COVID-19, it is important that factors leading to hesitation are addressed in order to increase vaccination rates and achieve herd immunity.

## 1. Introduction

The spread of COVID-19 is the first global pandemic of the modern age, where public health took a backseat to politics and personal interest. The emergence of a novel virus paired with rapid transmission left public health experts, global health organizations, and medical professionals at a loss.[13] As experts searched for answers and solutions, so were members of the general public, turning to sources outside of health organizations to search for answers. Many people sought guidance from politicians, viral social media posts, or using personal judgement–often without a scientifically accurate basis. Amid the search for answers, immunology experts and pharmacological companies raced toward the most obvious solution: a vaccine against COVID-19.[13] Upon testing and release, however, this solution was met with intense public scrutiny, protests, and a new wave of the anti-vaccination movement. This pushback has proven to be dangerous in the world's leading countries, where spikes of COVID-19 cases lead not only to the hospitalization of the vulnerable and unvaccinated, but also provide time for the virus to mutate into unpredictable variants.

The development of vaccines is widely considered to be one of the greatest public health developments in human history.[11] Epidemics have swept the globe since the beginning of recorded civilization, with diseases spreading rapidly through people groups and leaving many with serious health impairments and killing many others. From the development of the first vaccine in 1885, vaccines and antitoxins were developed over the next 50 years against diphtheria, tetanus, anthrax, cholera, plague, typhoid, tuberculosis, and more.[25] Throughout the 20th century, vaccine development and research gained funding and manpower, leading to the development of the infamous polio vaccine following its first epidemic in the US in 1894. Poliovirus was one of the few viruses eradicated in the United States, where continued, widespread vaccine efforts proved to be effective in the elimination of transmissible disease.

In the United States in the 1950s, poliovirus outbreaks led to over 15,000 cases of paralysis annually. Successful vaccine research and trials brought the introduction of the trivalent inactivated poliovirus vaccine (IPV) in 1955 and the trivalent oral poliovirus vaccine (OPV) in 1963. Thanks to worldwide vaccination efforts, there was a 99% global reduction in cases of wild polio between 1989 and 2000.[25] Both IPV and OPV have been discontinued in countries with eradication status due to the low number of cases. This discontinuation exemplifies the overarching goal of vaccines: to use them consistently on a widespread scale so herd immunity can be achieved and the vaccine is no longer a necessity. Despite positive outcomes achieved by polio vaccine efforts, it was not accomplished without criticism and pushback from anti-vaccination groups. The objections of these groups often stem from religious and political motives, ultimately compromising entire groups of people and delaying eradication status.

The anti-vaccination movement is not a new development, as vaccination has met opposition since the development of the smallpox vaccine in the 1800s in England and the US. Understandably, Edward Jenner was

met with criticism for his method of smallpox immunization: exposing children to lymph from a cowpox blister. The criticism brought up not only sanitary concerns, but religious, scientific, and political objections.[24] With decades of research and development, immunization practices have made incredible advancements in safety and efficacy; the sources of criticism toward immunization, however, have not. These objections are often based in philosophical, political, or spiritual beliefs and are only worsened with instances of vaccine controversies. One of the most infamous controversies surrounded the measles, mumps, and rubella (MMR) vaccine in 1998, where British doctor Andrew Wakefield alleged the vaccine was not properly tested and a link between the vaccine, bowel disease, and autism should be investigated.[24] This claim caused a public panic, leading to public distrust in the MMR vaccine and immunizations in general. This paper was later discovered to be fabricated in that Andrew Wakefield "had been paid by a law board to find out if there was evidence to support a litigation case by parents who believed that the vaccine had harmed their children".[24] Though this claim and many like it have been disproven by peer-reviewed studies, vaccine hesitancy remains one of the biggest obstacles in controlling the COVID-19 virus.

*1.1 COVID-19 PANDEMIC*

Despite 2020 being infamous as the year COVID-19 irreparably altered modern life, the virus was discovered in late 2019. According to the CDC[6], the first symptoms discovered were in patients in Wuhan, Hubei Providence in China who began experiencing fever and shortness of breath on December 12, 2019. Weeks later, on December 31, 2019, the Huanan Seafood Wholesale Market was determined by the World Health Organization (WHO) China Country Office to be the origin of several cases of this "pneumonia of known etiology".[6] At this time, the virus was contained in China, but Chinese New Year celebrations facilitated the spread of the virus throughout other provinces, while international travel led to imported cases of "novel coronavirus" in Thailand, Japan, and the United States by January 20, 2020. The first coronavirus precautions were implemented on January 17th as the CDC began screening passengers for the virus on flights from Wuhan in San Francisco, New York City, and Los Angeles. The CDC activated its Emergency Response System on January 21, 2020, a universal emergency protocol that has been activated for over 60 public health threats: engaging scientific experts, coordinating the distribution of supplies, monitoring response activities, and providing resources to state and local public health departments. On January 22, 2020, the WHO International Health Regulation Emergency Committee met and determined that it was unnecessary to declare the novel coronavirus a Public Health Emergency of International Concern, instead deciding to meet again in 10 days to reevaluate the situation. Just five days later, on January 27th, the United States Food and Drug Administration (FDA) became involved and announced its intention to take action to develop medical countermeasures against the virus. Fifty days after the initial discovery of the virus, the WHO International Health Regulation Emergency Committee declared the coronavirus outbreak a Public Health Emergency of International Concern.

In response to the virus's rapid spread, vaccine research, and development began nearly immediately, with the first human trial by Moderna Therapeutics beginning on March 17, 2020, in Seattle, Washington. As vaccine trials were underway, the FDA approved hydroxychloroquine sulfate, chloroquine phosphate, and remdesivir with an Emergency Use Authorization (EUA) as treatments for hospitalized patients. In April 2020, President Donald Trump enacted Operation Warp Speed, an initiative to produce a vaccine against COVID-19 as soon as possible.

There is no doubt an abundance of literature covering the virus and how it has impacted 21st century life, global and public health. In the last three years, studies have been conducted covering the origins of the virus, transmission, mutations, psychosociological effects, economic impacts, interpersonal relationships, the transformation of modern work, projections for the future, vaccination efficacy, vaccination attitudes and so much more. Despite the massive output of literature, it is noticeable that the public has been and misinformed about the global state of the COVID-19 crisis. Though humanity has been living through a shared global phenomenon, the focus of individuals appears to be highly singular with the general population concerning themselves with only local, state, and national guidelines. As several vaccinations against COVID-19 are now available and actively being distributed, it is time to address the factors preventing people from taking the ultimate precaution against the virus–immunization via vaccination.

*1.2 RATIONALE*

For this study, the researcher evaluated six developed/developing countries based on population: the United States of America, Brazil, Nigeria, Russia, Australia, and India. Countries of interest were chosen based on comparability of population, development and available data, with one country chosen per continent to ensure global representation. Countries of interest are comparable in population as to accurately reflect rates of COVID-19 vaccination or refusal of vaccination. Similarly, countries of interest are classified as developed or developing nations. When considering vaccine accessibility and interest, developed countries are more likely to utilize established public health infrastructure and pro-active health efforts, whether it be for treating affected patients or promoting public health initiatives that encourage preventive and precautionary measures. These countries also have adequate academic literature available to perform a systematic review.

As mentioned previously, there have been several studies conducted concerning the health, socioeconomic, interpersonal, and psychosociological implications of COVID-19 throughout its spread and the development of the vaccine. Due to the nature of the pandemic being global, yet widely individualized by country, there was a necessity for cross-examination of the world's leading countries for vaccination efforts. Immunization against the virus is the most effective preventative measure in stopping the spread of the virus and minimizing symptoms, but some of the most powerful countries in the world are met with resistance by skeptics. Examining these countries side by side allows a glimpse into the factors preventing individuals from taking the vaccine and therefore decreasing the effectiveness of

herd immunity and the ultimate eradication of the spread. Finding commonalities in factors affecting individuals' attitude toward vaccination can help public health officials meet the concerns of the public, as well as offer opportunities for countries to collaborate and learn from one another to achieve majority vaccination status.

## 2. Methods

### *2.1 LITERATURE SEARCH*

The populations of interest for this study included the United States of America, Brazil, Nigeria, India, Russia, and Australia. These countries were chosen based on total population and status as economically developed/developing nations who are proactive about health care. Choosing large, developed/developing countries ensured the reliable production of COVID-19 infection and vaccination data, as well as public health efforts and the public's response. This research was performed using published, peer reviewed literature from various sources including, scientific, medical, and psychological journals. To perform a systematic review of the data, articles were collected based on independent, primary studies in each country of interest, where the data was compiled to be subsequently compared to the other countries of interest. The data was prepared primarily through a literature search of databases available through Ball State University Libraries, but also includes information from print sources available through Ball State University Libraries, public governmental websites, and electronic newspaper articles. Databases used include EBSCO, PubMed, NCBI, and JSTOR.

### *2.2 Inclusion and Exclusion Criteria*

The primary factors analyzed in determining public attitudes for COVID-19 vaccination included public trust in government, socioeconomic distribution of a country's population, ethnicity, religion, employment and income, public health efforts, and healthcare accessibility.

A standardized search strategy was used to identify literature focused on factors influencing attitudes toward the COVID-19 vaccine. Between January and March 2022, the databases and university resources were used to identify relevant articles with combinations of the following keywords: COVID-19, vaccine, vaccination, immunization, hesitancy, resistance, acceptance, confidence, trust, refusal, rejection, attitude, perception, willingness, global, worldwide, United States, Brazil, Nigeria, Russia, Australia, and/or India.

Data was gathered based on inclusion criteria of (1) cross-sectional surveys, online surveys including those on social media platforms, phone surveys, and systematic literature reviews; (2) articles published in English; and (3) articles providing individualized data for at least one of the target countries (United States, Brazil, Nigeria, Russia, Australia, and India). Exclusion criteria consisted of (1) titles available as abstracts only, (2) studies not published in English, (3) studies with combined data for multiple countries or regions, and (4) studies without quantitative data. Dates reviewed range from March 2020 to September 2021. These dates vary by each country and study, and most studies concerning vaccine attitudes were performed before widespread vaccine availability, therefore vaccination rates and influencing factors are not included in this systematic review.

*2.3 DATA EXTRACTION*

Full texts of qualifying articles were assessed for inclusion and exclusion criteria. A standardized template (Microsoft Excel, Microsoft, 2021) was organized to sort the factor influencing vaccine hesitancy, author(s), study type, sample size, study number, time frame, influence of factor, and country.

*2.4 QUALITY APPRAISAL*

An assessment tool developed by the National Heart, Lung, and Blood Institute was used to assess the quality of articles included in the study. Articles were rated "good", "fair", or "poor" based on the *Quality Assessment Tool for Observational Cohort and Cross-sectional Studies*. This tool includes 14 items that help evaluate the validity of the studies' design, including items assessing internal soundness and possible flaws in the implementation of a study.

*2.5 RISK OF BIAS APPRAISAL*

The potential risk of bias for included articles was evaluated using the *Risk of Bias Instrument for Cross-Sectional Surveys of Attitudes and Practices* tool by the CLARITY Group at McMaster University. This tool graded articles using five domains for cross-sectional studies, prospective longitudinal studies, quasi-experimental interrupted time series, and case-control studies, where articles were graded on a scale of "definitely yes," indicating low risk of bias, to "definitely no," indicating high risk of bias.

## 3. Results

*3.1 STUDY CHARACTERISTICS*

Eighteen studies met the inclusion and exclusion criteria and are included herein Table 1. After examining articles studying the rates of vaccine acceptance, hesitancy, and rationale for each of the six target countries, patterns emerged in the factors influencing attitudes toward COVID-19 vaccination. Several papers included data for multiple target countries. For purposes of conciseness and the ability to draw from large sample numbers, factors were grouped into larger categories. Major factors influencing acceptance of the COVID-19 vaccine include an individual's confidence in authority and personal preferences regarding immunity. Major factors contributing to hesitancy and negative attitudes toward the COVID-19 vaccine include vaccine-specific concerns, mistrust of authority, and religious or cultural factors.

Table 1. Appraisal of Quality and Risk of Bias

| First Author and Year | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Quality Rating | Bias Risk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adebisi (2021) | Y | Y | N | N | N | Y | NR | Y | Y | N | Y | Y | NA | NR | Fair | Intermediate-High |
| Adigwe (2021) | Y | Y | N | Y | N | Y | Y | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-High |
| Bagateli (2021) | Y | Y | N | Y | N | Y | Y | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-High |
| Cascini (2021) | Y | Y | NR | Y | Y | Y | Y | Y | N | N | Y | Y | NA | NR | Good | Intermediate-Low |
| Danabal (2021) | Y | Y | N | Y | Y | Y | Y | Y | Y | N | Y | Y | NA | Y | Good | Intermediate-High |
| Dani (2021) | Y | Y | NR | Y | N | Y | Y | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-Low |
| Dodd (2021) | Y | Y | N | Y | Y | Y | N | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-High |
| Gramacho (2021) | Y | Y | N | Y | Y | Y | N | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-Low |
| King (2021) | Y | Y | N | Y | Y | Y | Y | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-High |
| Moore (2021) | Y | Y | N | Y | Y | Y | N | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-Low |
| Rozek (2021) | Y | Y | N | Y | N | Y | Y | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-High |
| Seale (2021) | Y | Y | N | Y | Y | Y | N | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-Low |
| Shih (2021) | Y | Y | N | Y | Y | Y | N | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-Low |
| Solís Arce (2021) | Y | N | N | Y | Y | Y | N | Y | Y | N | Y | Y | NA | NR | Fair | Intermediate-Low |
| Taylor (2020) | Y | N | Y | N | N | Y | Y | Y | Y | N | Y | Y | NA | NR | Fair | Intermediate-High |
| Tran (2021) | Y | Y | N | Y | N | Y | Y | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-Low |
| Umakanthan (2021) | Y | Y | N | Y | Y | Y | N | Y | Y | N | Y | Y | NA | NR | Good | Intermediate-low |
| Uzochukwu (2021) | Y | Y | N | Y | N | Y | Y | Y | Y | N | Y | Y | NA | Y | Good | Intermediate-Low |

## 3.2 MAJOR FINDINGS

### *3.2.1 Positive Factors Toward COVID-19 Vaccination*

Of the 18 studies in the inclusion category, seven included data citing factors that positively influence attitudes toward COVID-19 vaccination and generate acceptance for the vaccine (Table 2). Seventeen different positive factors were cited in these studies, which were then grouped into five broader categories: "Confidence in authority", "Personal preferences and beliefs regarding immunity", "Gender", "Age", and "Miscellaneous."

Table 2. Characteristics for Studies on Positive Factors toward COVID-19 Vaccination

| Factor categories | Positive factors toward COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% acceptance) | Country |
|---|---|---|---|---|---|---|---|
| Confidence in authority | Confidence in Government | Dodd et al. | Online survey | 4362 adults age 18+ | April 17-21, 2020 | 85.80% | Australia |
| | Confidence in health system | Solis Arce et al. | Phone survey | 1868 individuals in the country, 13 countries surveyed | November 18 - December 18, 2020 | 58% | Nigeria |
| | | Tran et al. | Cross-sectional survey via online questionnaire | 876 adults age 18+ | September 26-November 9, 2020 | 55.60% | Russia |
| Personal preferences and beliefs regarding immunity | Preference for personal protection against COVID-19 | Solis Arce et al. | Phone survey | 1959 individuals in the country, 13 countries surveyed | December 4-5, 2020 | 94% | USA |
| | | Solis Arce et al. | Phone survey | 1959 individuals in the country, 13 countries surveyed | November 6 - December 1, 2020 | 76% | Russia |
| | | Tran et al. | Cross-sectional survey via online questionnaire | 876 adults age 18+ | September 26-November 9, 2020 | 80.20% | Russia |
| | Preference to protect family against COVID-19 | Solis Arce et al. | Phone survey | 22125 individuals in the country, 13 countries surveyed | July-December 2020 | 76% | Russia |
| | Belief that vaccination eases complications of illness | Tran et al. | Cross-sectional survey via online questionnaire | 877 adults age 18+ | September 26-November 9, 2020 | 77.40% | Russia |
| | Belief that vaccine provides long-term immunity | Tran et al. | Cross-sectional survey via online questionnaire | 878 adults age 18+ | September 26-November 9, 2020 | 57.20% | Russia |
| Gender | Females | Seale et al. | Online survey | 1420 adults age 18+, English speaking | March 18-24, 2020 | 83% | Australia |
| | Males | Tran et al. | Cross-sectional survey via online questionnaire | 876 adults age 18+ | September 26-November 9, 2020 | 55.60% | Russia |

| Factor categories | Positive factors toward COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% acceptance) | Country |
|---|---|---|---|---|---|---|---|
| Age | Ages 14-30 | Cascini et al. | Systematic literature review | English speaking | February 24-July 5th, 2021 | 75% | USA |
| | | Adebisi et al. | Survey of social media users age 15+ | 518 respondents | August 2020 | 76.40% | Nigeria |
| | Ages 31-45 | Cascini et al. | Systematic literature review | English speaking | February 24-July 5th, 2021 | 81% | USA |
| | | Adebisi et al. | Survey of social media users age 15+ | 518 respondents | August 2020 | 65.50% | Nigeria |
| | Ages 46-60 | Adebisi et al. | Survey of social media users age 15+ | 518 respondents | August 2020 | 16.70% | Nigeria |
| | Ages 61+ | Adebisi et al. | Survey of social media users age 15+ | 518 respondents | August 2020 | 0.00% | Nigeria |
| | | Seale et al. | Online survey | 1420 adults age 18+, English speaking | March 18-24, 2020 | 90.90% | Australia |
| | | Cascini et al. | Systematic literature review | English speaking | February 24-July 5th, 2021 | 91% | USA |
| Miscellaneous | No international travel in 2020 | Seale et al. | Online survey | 1420 adults age 18+, English speaking | March 18-24, 2020 | 81.60% | Australia |
| | Private health insurance holder | Seale et al. | Online survey | 1420 adults age 18+, English speaking | March 18-24, 2020 | 83.50% | Australia |
| | Chronic health condition | Seale et al. | Online survey | 1420 adults age 18+, English speaking | March 18-24, 2020 | 84.60% | Australia |
| | Caregiver to a child | Bagateli et al. | Cross-sectional study | 501 caregiving adults age 18+, Portuguese speaking | May-June 2021 | 94% | Brazil |
| | Lower monthly income | Tran et al. | Cross-sectional survey via online questionnaire | 876 adults age 18+ | September 26-November 9, 2020 | 45.2%, 44.7%, 42.2% (for lowest three income brackets, respectively) | Russia |

From the factors addressed in the studies, four fell into the category "Personal preferences and beliefs regarding immunity". Within the broader category, the factor "Preference for personal protection against COVID-19" was cited most often, with acceptance rates over 75%. A 2020 study by Tran et al. showed an 80.2% acceptance among Russian adults, while a 2021 study by Solis Arce et al[22] showed 94% acceptance in the US and 76% acceptance in Russia for those who viewed the vaccine as a source of personal protection. Other factors in this category included "Preference to protect the family against COVID-19", "Belief that vaccination eases complications illness", and "Belief that vaccine provides long-term immunity", which showed 76%, 77.4%, and 57.2% acceptance, respectively.

Acceptance based on age was addressed eight times for four age categories, namely age groups 14-30, 31-45, 46-60, and 61+. Age categories were inconsistent across studies in Nigeria, Australia, and the U.S. and were grouped into larger categories. In the U.S. and Australia, increased age was associated with increased acceptance of a COVID-19 vaccination. In the U.S., ages 14-30 showed the lowest acceptance at 75%, ages 31-45 showed 81% acceptance, and ages 61+ reported 91% acceptance. [6] Similarly, in Australia, the eldest age group showed 90.9% acceptance. [20] Nigeria, however, showed a negative correlation, as the 14-30 age group reported 76.4% acceptance, ages 31-45 reported 65.5% acceptance, ages 46-60 reported 16.7% acceptance, and ages 61+ had 0% acceptance of a COVID-19 vaccine.[1]

The "Confidence in authority" category was broken down into "Confidence in government" and "Confidence in health system." Dodd et al[9] found 85.8% acceptance of the COVID-19 vaccine in populations with high confidence in their government. Similarly, a study by Tran et al[26] showed 58% acceptance in Nigeria and Solis Arce et al[22] showed 55.6% acceptance in Russia in populations with high confidence in their health system.

Gender was also a factor in vaccination acceptance though it varied widely. In Australia, Seale et al[20] revealed an 83% acceptance in females, while Tran et al[26] demonstrated a 55.6% acceptance for males in Russia.

The "Miscellaneous" category housed factors that were standalone or that could not be grouped into any of the other major categories. These factors included "No international travel in 2020", "Private health insurance holders", "Chronic health condition", "Caregiver to a child", and "Lower monthly income". Those who did not travel internationally in 2020 reported a higher acceptance rate than those who did travel internationally, with acceptance rates of 81.6% and 74.2%, respectively.[20] Those who held private insurance were associated with an 83.5% acceptance of the vaccine in Australia.[20] The same study reported an 84.6% acceptance of the vaccine for those suffering with a chronic health condition. Bagateli et al[4] reported that adults in Brazil identifying as a caregiver to a child showed a 94% acceptance of the vaccine. Lastly, Tran et al[26] addressed the effect of lower monthly income on vaccine acceptance, divided into three income brackets. The brackets included <20,000 RUB, 20,000-40,000 RUB, and 41,000-80,000 RUB and showed 45.2%, 44.7%, and 42.2% acceptance toward the vaccine, respectively.

### 3.2.2 Factors Negatively Influencing COVID-19 Vaccination

#### *3.2.2.1 Vaccine-specific concerns*

All 18 studies (from the six target countries) reported data for negative factors that led to vaccine hesitancy (Table 3). There were 41 factors identified that were categorized into seven broader categories. These categories included "Vaccine-specific concerns," "Mistrust of authority," "Preference for alternative solutions," "Age/Generation," "Education and employment status," and "Miscellaneous."

Table 3. Characteristics for Studies on Negative Factors toward COVID-19 Vaccination

| Factor categories | Negative factors influencing COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% hesitancy) | Country |
|---|---|---|---|---|---|---|---|
| Vaccine-specific concerns | Mistrust in vaccine safety | Danabal et al. | Community-based cross-sectional study | 564 adults age 18+, unvaccinated | March 2021 | 22% denial | India |
| | | Bagateli et al. | Cross-sectional study | 501 caregivers age 18+, Portuguese speaking | May-June 2021 | 34% hesitant | Brazil |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 9.17% of concerns | Nigeria |
| | | Tran et al. | Cross-sectional survey via online questionnaire | 878 adults age 18+ | September 26-November 9, 2020 | 61.5% of concerns | Russia |
| | Fear of side effects/post-vaccine adverse health effects | Bagateli et al. | Cross-sectional study | 501 caregivers age 18+, Portuguese speaking | May-June 2021 | 53% hesitant | Brazil |
| | | Umakanthan et al. | Minimetric poll, predominantly online | 3000 individuals across four states, mean age 46.64 | January 12-13, 2021 | 90.9% (of vaccine-hesitant population) | India |
| | | Dani et al. | Covid symptom survey via Facebook | n/a | September 2020 | 34% of concerns | India |
| | | Solis Arce et al. | Phone survey | 1959 individuals in the country, 13 countries surveyed | December 4-5, 2020 | 79.3% (of vaccine-resistant population) | USA |
| | | Solis Arce et al. | Phone survey | 22125 individuals in the country, 13 countries surveyed | November 6 - December 1, 2021 | 36.8% (of vaccine-resistant population) | Russia |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 11.2% of concerns | Nigeria |
| | | Adigwe | Online Cross-sectional study | 1767 individual age 18+ | January 2021 | 52.9% of concerns | Nigeria |
| | | Tran et al. | Cross-sectional survey via online questionnaire | 878 adults age 18+ | September 26-November 9, 2020 | 59.8% of concerns | Russia |

| Factor categories | Negative factors influencing COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% hesitancy) | Country |
|---|---|---|---|---|---|---|---|
| | Mistrust in vaccine efficacy | Umakanthan et al. | Minimetric poll, predominantly online | 3000 individuals across four states, mean age 46.64 | January 12-13, 2021 | 46.9% (of vaccine-hesitant population) | India |
| | | Solis Arce et al. | Phone survey | 1959 individuals in the country, 13 countries surveyed | December 4-5, 2020 | 46.8% hesitant | USA |
| | | Solis Arce et al. | Phone survey | 22125 individuals in the country, 13 countries surveyed | November 6 - December 1, 2020 | 29.6% hesitant | Russia |
| | | Dani et al. | Covid symptom survey via Facebook | n/a | January-September 2021 | 21% hesitant | India |
| | | Moore et al. | Online survey via social networks | 173,178 individuals | January 22-29, 2021 | 66.6% hesitant | Brazil |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 18.52% of concerns | Nigeria |
| | | Taylor et al. | Cross sectional internet questionnaire | 1772 adults | May 6-19, 2020 | 25% hesitant | USA |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 34.34% of concerns | Nigeria |
| | Concern for vaccine source/country of origin | Moore et al. | Online survey via social networks | 173,178 individuals | January 22-29, 2021 | 27.3% hesitant | Brazil |
| | | Gramacho et al. | Online survey | 2771 individuals | September 23-October 2, 2020 | Confidence decrease by 15.7% (Russian development) | Brazil |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 6% hesitant | Nigeria |
| | | Moore et al. | Online survey via social networks | 173,178 individuals | January 22-29, 2021 | 35.4% hesitant (Chinese development) | Brazil |
| | | Gramacho et al. | Online survey | 2771 individuals | September 23-October 2, 2020 | Confidence decrease by 21.3% (Chinese development) | Brazil |

| Factor categories | Negative factors influencing COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% hesitancy) | Country |
|---|---|---|---|---|---|---|---|
| | Against vaccines in general (fear of administration) | Umakanthan et al. | Minimetric poll, predominantly online | 3000 individuals across four states, mean age 46.64 | January 12-13, 2021 | 21.3% (of vaccine-hesitant population) | India |
| | | Adigwe | Online Cross-sectional study | 1767 individual age 18+ | January 2021 | 6.5% hesitant | Nigeria |
| | Call for more vaccine research | Umakanthan et al. | Minimetric poll, predominantly online | 3000 individuals across four states, mean age 46.64 | January 12-13, 2021 | 17.1% (of vaccine-hesitant population) | India |
| | | Adebisi et al. | social media users age 15+ | 517 respondents | August 2020 | 37.1% of concerns | Nigeria |
| | Disbelief in the vaccine | Dani et al. | Covid symptom survey via Facebook | n/a | January-September 2021 | 11% hesitant | India |
| | Vaccine preference | Moore et al. | Online survey via social networks | 173,178 individuals | January 22-29, 2021 | 6.7% hesitant | Brazil |
| | Possibility of receiving a fake vaccine | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 6.2% hesitant | Nigeria |
| | Vaccine is unnecessary if a person is not infected | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 3.72% hesitant | Nigeria |
| Mistrust of authority | Mistrust of government | Danabal et al. | Community-based cross-sectional study | 564 adults age 18+, unvaccinated | February 2021 | 24.6% of concerns | India |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 4.6% hesitant | Nigeria |
| | | Rozek et al. | Online cross-sectional study | Individuals from five world regions | May 21-June 24, 2020 | 40% confidence | Russia |
| | | Rozek et al. | Online cross-sectional study | Individuals from five world regions | May 21-June 24, 2020 | 29% confidence | Russia |
| | Mistrust of World Health Organization (WHO) | Rozek et al. | Online cross-sectional study | Individuals from five world regions | May 21-June 24, 2020 | 63% confidence | Russia |
| | Lack of clarity | Umakanthan et al. | Minimetric poll, predominantly Online | 3000 individuals across four states, mean age 46.64 | January 12-13, 2021 | 56.3% (of vaccine-hesitant population) | India |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 7.45% hesitant | Nigeria |
| Religious/ cultural reasons | Cultural group | Seale et al. | Online survey | 1421 adults age 18+, English speaking | March 18-24, 2021 | 68.1% acceptance, Aboriginal | Australia |

| Factor categories | Negative factors influencing COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% hesitancy) | Country |
|---|---|---|---|---|---|---|---|
| | | | | | | and/or Torres Strait Islander | |
| | Religious reasons | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 81.9% hesitant, Pentecostal/Sabbatherian | Nigeria |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 62.0% hesitant, Protestant | Nigeria |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 60.5% hesitant, Roman Catholic | Nigeria |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 1.43% of concerns | Nigeria |
| | | Tran et al. | Cross-sectional survey via online questionnaire | 878 adults age 18+ | September 26-November 9, 2020 | 54.5% acceptance | Russia |
| Preference for alternative solutions | Preference for natural immunity | Danabal et al. | Community-based cross-sectional study | 564 adults age 18+, unvaccinated | January 2021 | 14.5% hesitancy | India |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 0.86% hesitant | Nigeria |
| | | Tran et al. | Cross-sectional survey via online questionnaire | 878 adults age 18+ | September 26-November 9, 2020 | 26.1% acceptance | Russia |
| | Belief that personal immune Response is adequate without vaccine | Adebisi et al. | Social media users age 15+ | 518 respondents | n/a | 27.3% hesitant | Nigeria |
| | | Tran et al. | Cross-sectional survey via online questionnaire | 878 adults age 18+ | September 26-November 9, 2020 | 34.4% acceptance | Russia |
| | Preference for natural remedies | Tran et al. | Cross-sectional survey via online questionnaire | 879 adults age 18+ | September 26-November 9, 2020 | 30.2%% acceptance | Russia |
| Age/Generation | Gen Z (Age 18-23) | Shih et al. | Survey via social media and targeted ads | 713 participants | March 20-22, 2020 | 59.4% hesitant | USA |
| | Millennial Generation (Age 24-39) | Shih et al. | Survey via social media and targeted ads | 713 participants | March 20-22, 2020 | 46.2% hesitant | USA |
| | Generation X (age 40-55) | Shih et al. | Survey via social media and targeted ads | 713 participants | March 20-22, 2020 | 27.6% hesitant | USA |

| Factor categories | Negative factors influencing COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% hesitancy) | Country |
|---|---|---|---|---|---|---|---|
| | Baby Boomers/Silent Generation (Age >56) | Shih et al. | Survey via social media and targeted ads | 713 participants | March 20-22, 2020 | 20.5% hesitant | USA |
| | Age (16-30) | Adebisi et al. | Social media users age 15+ | 518 respondents (478 age 16-30) | August 2020 | 22.8% hesitant | Nigeria |
| | Age (31-45) | Adebisi et al. | Social media users age 15+ | 518 respondents (29 age 31-45) | August 2020 | 24.1% hesitant | Nigeria |
| | Age (46-60) | Adebisi et al. | Social media users age 15+ | 518 respondents (6 age 46-60) | August 2020 | 66.7% hesitant | Nigeria |
| | Age (61+) | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 100% hesitant | Nigeria |
| Education and employment status | Employed | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 30.2% hesitant | Nigeria |
| | Student | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 19.5% hesitant | Nigeria |
| | Unemployed | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 30.6% hesitant | Nigeria |
| | Graduate education | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 24.6% hesitant | Nigeria |
| | Postgraduate education | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 42.3% hesitant | Nigeria |
| | Secondary education | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 26.7% hesitant | Nigeria |
| | Undergraduate education | Adebisi et al. | Social media users age 15+ | 518 respondents (4 age 61+) | August 2020 | 20% hesitant | Nigeria |
| Miscellaneous | Lack of concern about COVID-19 | Solis Arce et al. | Phone survey | 1959 individuals in the country, 13 countries surveyed | December 4-5, 2020 | 39.3% hesitant | USA |
| | | Moore et al. | Online survey via social networks | 173,178 individuals | January 22-29, 2021 | 26% hesitant | Brazil |
| | | Adigwe | Online Cross-sectional study | 1767 individual age 18+ | January 2021 | 8% hesitant | Nigeria |
| | | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 12.89% hesitant | Nigeria |
| | | Adigwe | Online Cross-sectional study | 1767 individual age 18+ | January 2021 | 6% hesitant | Nigeria |
| | Prefer others to be vaccinated first | Umakanthan et al. | Minimetric poll, predominantly online | 3000 individuals across four states, mean age 46.64 | January 12-13, 2021 | 53.8% (of vaccine-hesitant population) | India |
| | | Dani et al. | Covid symptom survey via Facebook | n/a | September 2020 | 42% hesitant | India |
| | | Dani et al. | Covid symptom survey via Facebook | n/a | October 2020 | 35% hesitant | India |
| | Recent exposure to COVID-19 via close contact | Umakanthan et al. | Minimetric poll, predominantly online | 3000 individuals across four states, mean age 46.64 | January 12-13 2021 | 44.5% (of vaccine- | India |

| Factor categories | Negative factors influencing COVID-19 vaccination | Author(s) | Type of Study | Sample (n) / Studies (#) | Time frame of study | Influence of factor (% hesitancy) | Country |
|---|---|---|---|---|---|---|---|
| | | | | | | hesitant population) | |
| | Parental status | Moore et al. | Online survey via social networks | 173,178 individuals | January 22-29, 2021 | 11.9% hesitant | Brazil |
| | Vaccine storage challenges | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 24.07% hesitant | Nigeria |
| | Conspiracy theories | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 10.8% hesitant | Nigeria |
| | Marriage status (married) | Uzochukwu et al. | Online cross-sectional survey for university staff and students | 349 individuals age 16+ | January 21-February 28, 2021 | 70.70% hesitant | Nigeria |
| | Rural residence | Shih et al. | Survey via social media and targeted ads | 713 participants | March 20-22, 2020 | 40.2% hesitant | USA |

The largest category was "Vaccine-specific concerns," including ten individual factors.. These factors were "Mistrust in vaccine safety," "Fear of side effects/post-vaccine adverse health effects," "Mistrust in vaccine efficacy," "Concern for vaccine source or country of origin," "Against vaccines in general/fear of administration," "Call for more vaccine research," "Disbelief in the vaccine," "Vaccine preference," "Possibility of receiving a fake vaccine," and "Vaccine is unnecessary if a person is not infected." The studies included in each factor may have utilized different language in the questions used to survey and were grouped by general concern for brevity. Similarly, depending on the study, "vaccine hesitancy" may be defined by the rate of concern or rate of denial.

"Mistrust in vaccine safety" was addressed in five studies, where the safety of the COVID-19 vaccinations was a main concern of the study populations, leading to vaccine hesitancy. A study[7] in India reported that this factor led to 22% denial in the study population. Furthermore, this concern was held by 34% of hesitant population in Brazil,[4] 9.2% of the study population in Nigeria,[29] and 61.5% of the population in Russia.[26] In the U.S., individuals who "don't trust COVID-19 vaccines" accounted for 48.4% hesitancy, while 12.2% were concerned for vaccine safety because of a health condition.[14]

"Fear of side effects/post-vaccine adverse health effects" was cited ten times in the included studies, where potential negative side effects of COVID-19 vaccination led to vaccine hesitancy and possible refusal in study populations. This factor was cited as a concern for 53% of the study population in Brazil,[4] 34% in India,[8] 11.2% and 52.9% in Nigerian studies,[29,2] and 59.8% in Russia (Tran et al., 2021). Among individuals already vaccine-resistant, this was a concern among 90.9% of

the people in India,[28] 67.1% of individuals in Brazil,[17] 79.3% of individuals in the United States, and 36.8% of individuals in Russia.[22] In a different U.S. study, this factor accounted for 49.2% hesitancy, with 23.9% of participants concerned specifically about an allergic reaction (King et al., 2021).

"Mistrust in vaccine efficacy" was related to the effectiveness of the COVID-19 vaccine, where those surveyed did not believe a COVID-19 vaccine would fully prevent the contraction of COVID-19 and/or its variants nor contribute to attaining herd immunity. This factor was addressed eight times in six studies. Regarding studies in India, this factor attributed to 46.9% of the concerns of a vaccine-hesitant sample group[28] and 21% of concerns in the overall sample population in another study.[8] In a Solis Arce et al[22] study, mistrust in vaccine efficacy was attributed to 46.8% hesitancy in the U.S. and 29.6% hesitancy in Russia (2021). Beliefs about attaining herd immunity were addressed in the Taylor et al[23] study, where 25% of Americans would reject a COVID-19 vaccine due to the belief that herd immunity is not attainable (2020). Similarly, 21.9% of hesitancy was attributed to Americans who were unsure "if it will work" (King et al., 2021). Uzochukwu et al[29] found that uncertainty about vaccine efficacy in Nigeria was the most important concern at 34.3% of the sample population, while 18.5% believed that the COVID-19 vaccine would not protect against all strains of COVID-19 (2021). Lastly, in Brazil, Moore et al[17] reported a 66.6% hesitancy in the sample group due to this factor (2021).

The factor addressing "Concern for vaccine source/country of origin" produced five results, where surveyed people were hesitant to receive a vaccine based on the country where it was developed. Rather than hesitancy rates two studies reported a percentage decrease in vaccine confidence. In Brazil, vaccines developed in Russia led to a 15.7% decrease in confidence, while a vaccine developed in China led to a 21.3% decrease in confidence.[10] Similarly, in Brazil, Moore et al[17] reported a 27.3% hesitancy based on a vaccine's country of origin in general and a 35.4% hesitancy due to a Chinese-developed vaccine specifically (2021). Lastly, a 6% hesitancy was reported in Nigeria for safety concerns due to a lack of trust in the vaccine's source.[29]

Three studies in India and Nigeria cited "Against vaccines in general" as reasons for hesitancy. This factor included denial of all vaccinations for various reasons, including fear of administration. Umakanthan et al[28] reported that this factor was cited by 21.3% of vaccine-resistant individuals in India (2021) and 6.5% of the sample population in Nigeria.[2] Similarly, these countries also indicated a desire for more vaccine research or a belief that current research and clinical trials were unreliable. A study[1] in India showed this factor influenced 17.1% of vaccine-resistant individuals, while it accounted for 37.1% of non-acceptance in Nigeria. In the U.S., King et al[14] reported a 14.7% hesitancy among those who "don't like vaccines" (2021).

The remainder of vaccine-specific concerns were only addressed once throughout the included studies. "Disbelief in the vaccine" accounted for 11% of hesitancy in India.[8] "Vaccine preference" accounted for 6.7% of hesitancy in Brazil.[17] Finally, in Nigeria, the "Possibility of receiving a fake vaccine"

accounted for 6.2% of hesitancy, while the belief that the "Vaccine is unnecessary of a person is not infected" accounted for 3.7% of hesitancy.[29]

#### *3.2.2.2 Mistrust of authority*

Factors associated with mistrust of authority were identified seven times in the included studies and consisted of the factors "Mistrust of government," "Mistrust of the WHO," and a general "Lack of clarity" from authority figures regarding vaccine information.

Mistrust of the national government was cited as 24.6% of concerns in India[7] and 4.6% of concerns in Nigeria.[29] In Russia, studies showed only a 40% trust in national government and 29% trust in local health departments.[19] The Russian study also revealed a 63% trust in the World Health Organization, which was trusted more than local and national authorities.[19] Two studies cited a lack of clarity or knowledge surrounding COVID-19 vaccines, leading to 56.3% of concerns in a vaccine-hesitant sample group in India[28] and 7.5% of concerns in Nigeria.[29] In the U.S. mistrust of the government was associated with 41.5% hesitancy.[14]

#### *3.2.2.3 Religious and cultural reasons*

Religious and cultural reasons unsurprisingly appeared in factors associated with COVID-19 vaccine hesitancy, being cited six times by different religious and cultural groups. Aboriginal and/or Torres Strait Islander populations in Australia demonstrated greater vaccine hesitancy than non-Aboriginal groups, with only 68.1% acceptance compared to 80.9% acceptance, respectively.[20] Religious factors were attributed to 8.2% hesitancy in the U.S.[14] A study in Nigeria found three different religious groups showed varying rates of hesitancy, where Pentecostal/Sabbatherian groups showed 81.9% hesitancy, Protestant groups showed 62.0% hesitancy, and Roman Catholic groups showed 60.5% hesitancy.[29] In Nigeria overall, general religious beliefs were the primary concern of 1.4% of the study group.[29] Finally, 54.5% of religious participants in a Russian study accepted the COVID-19 vaccine, whereas religious reasoning accounted for 2.5% of the total study population.[26]

#### *3.2.2.4 Preference for alternative solutions*

For various reasons, some individuals preferred to seek immunity from COVID-19 through alternate routes. This category is made up of three factors including "Preference for natural immunity," "Belief that personal immune response is adequate without a vaccine," and a "Preference for natural remedies."

Three studies cited individuals' preference for natural immunity, where the individual would contract COVID-19 to develop natural antibodies through a secondary immune response. In India,[2] 14.5% of individuals favored natural immunity over vaccinations and those in Russia believing that "the best way is to let nature take its course" showed a 26.1% acceptance.[26]

Nigeria, Russia, and the U.S. provided data for the belief that one's personal immune response is strong enough to withstand contracting COVID-19. In Nigeria, Adebisi et al[1] reported that this belief was held by 27.3% of the study population, while Uzochukwu et al[29] found this belief contributed to 0.9% of concerns leading to vaccine hesitancy. In

Russia, those who reported themselves to be "young and healthy" showed only a 34.4% vaccine acceptance.[26] In the United States, those who claimed "Don't believe I need it" accounted for 38.1% hesitancy.[14]

Finally, 4.9% of the Russian study population reported their belief in natural remedies. Of this population, 30.2% showed acceptance toward a COVID-19 vaccine.[26]

#### *3.2.2.5 Age and generation*

Age and generation were major contributing factors to vaccine hesitancy in the U.S., Nigeria, and Brazil. In the U.S., Shih et al[21] showed decreasing hesitancy as generations advanced, where Generation Z is defined as ages 18-23, Millennial Generation as 24-39, Generation X as 40-55, and Baby Boomers/Silent Generation were ages 56+. Generation Z showed 59.4% hesitancy, Millennials 46.2%, Generation X 27.6%, and Baby Boomers 20.5% hesitancy. [21] Nigerian age ranges were defined differently and showed an opposite trend, where ages 16-30 showed 22.8% hesitancy, ages 31-45 showed 24.1% hesitancy, ages 46-60 showed 66.7% hesitancy, and ages 61+ showed 100% hesitancy toward a COVID-19 vaccination.[1] This trend was also supported by the Uzochukwu et al[29] research with smaller age range increments: Ages 16-20 were 51.9% hesitant, 21-25 were 56.8% hesitant, 26-30 were 61.7% hesitant, 31-40 were 64.4% hesitant, 41-50 were 77.4% hesitant, 51-60 were 76.5% hesitant, and ages 61-80 were 50% hesitant.[29] This trend was also seen in Brazil, as Moore et al[17] reported that ages 18-39 are 8.7% hesitant, ages 40-59 are 11% hesitant, ages 60-74 are 11.8% hesitant, and ages 75+ are 12.6% hesitant.[17]

#### *3.2.2.6 Education and employment status*

Three studies reported statistically significant data regarding the influence of education level and employment status on COVID-19 vaccine hesitancy. Employment status was defined by whether a person was employed, a student, or unemployed. The employed population in Nigeria showed 30.2% hesitancy, students showed 19.5% hesitancy, and the unemployed population showed 30.6% hesitancy.[1]

Also, in this study, education levels were defined as graduate, postgraduate, secondary, and undergraduate. Graduate students showed 24.6% hesitancy, postgraduates showed 42.3% hesitancy, secondary education students showed 26.7% hesitancy, and undergraduates showed 20% hesitancy.[1] Bagateli et al[4] also reported an association of education level of caregivers with vaccine approval for children. The study[4] population showed that 1.5% of participants did not complete high school and were vaccine-hesitant, 1.7% completed high school and/or technical school and were vaccine-hesitant, 0.8% had a university education and were vaccine-hesitant, and 0.2% had a postgraduate education and were vaccine-hesitant. From the vaccine-hesitant population in Brazil, 15.9% completed primary school or less, 13.2% did not complete secondary education, and 9.9% completed secondary education and/or more.[17] Generally, an inverse relationship between higher education and vaccine hesitancy was seen in these studies.

#### *3.2.2.7 Miscellaneous factors*

Many outstanding factors did not fit into the broader categories. "Lack of concern about

COVID-19" and general apathy towards the pandemic were cited five times in included studies. Studies showed this factor attributed to 39.3% hesitancy in U.S. populations[22] and 26% of hesitancy in Brazil.[17] This factor was addressed thrice in Nigerian populations, where 12.9% of hesitancy was due to the disbelief over the existence of COVID-19 in Nigeria,[29] 6.0% of hesitancy was due to the disbelief in COVID-19 in general, and 8.0% of hesitancy was due to the perceived low risk of contracting COVID-19.[2]

Others cited a desire for others to be vaccinated first, whether they be members of the general population or front-line healthcare workers. Umakanthan et al[28] reported that 53.8% of the vaccine-hesitant population preferred frontline COVID-19 workers to receive a complete vaccination series first. Similarly, Dani et al[8] reported this factor to include two of the top five reasons for not getting vaccinated, as 42% of the study population reported they were "waiting for others to get it first" and 35% said "others need it more than me." In the U.S., those who "Plan to wait and see if safe" accounted for 34.4% hesitancy while those who claim "Other people need it more" accounted for 12.6% hesitancy (King et al., 2021).

Some cited that "a recent exposure to COVID-19 through close contacts" contributed to their hesitancy, as this factor accounted for 44.5% of hesitant individuals in India.[28] Parental status was associated with higher vaccine hesitancy in Brazil with 11.9% hesitancy.[17] Similarly, marriage status in Nigeria was associated with higher hesitancy with 70.7% hesitancy in populations that were married or had ever been married.[29] Vaccine storage challenges were common in Nigeria, as cold-chain storage is required to store and transport vaccines but adequate cold rooms, freezers, refrigerators, etc. may not have been readily available. This challenge caused concern in Nigerian populations accounting for 24.1% of concerns leading to hesitancy.[29] In Nigeria, conspiracy theories surrounding COVID-19 and the vaccines were considered a major hindering factor, contributing to 10.8% of concerns leading to hesitancy.[29] Finally, in the U.S., those living in rural areas were more likely to show hesitancy, with 40.2% of rural residents being hesitant to receive a COVID-19 vaccine.

King et al.[14] cited three unique concerns in the U.S. leading to vaccine hesitancy, where lack of a doctor's recommendation accounts for 9.3% hesitancy, planning to be pregnant and/or breastfeeding accounts for 6.7% hesitancy, and cost concerns account for 3.2% hesitancy.

## *4. Discussion*

To the authors' knowledge, this narrative review is the first to systematically integrate the existing literature on the factors influencing vaccination hesitancy and acceptance in these developed/developing countries. Because the number of existing studies was relatively limited and unique to each country, this review took an inclusive approach regarding study design and population to measure the outcomes of interest. Altogether, the articles in the study provided evidence of patterns and common factors leading to hesitancy toward vaccination against COVID-19 in these diverse nations. Notwithstanding the findings, it is challenging to make any definitive claims due to the heterogeneity of the study designs.

Consequently, caution should be taken when interpreting the results of this review. Furthermore, with the ongoing COVID-19 pandemic and vaccination efforts, future studies are required to fully determine the impact social, economic, and geographic factors have on individuals' willingness to be vaccinated against COVID-19 and potential variants.

*4.1 VACCINE ACCEPTANCE*

When the COVID-19 pandemic spread worldwide in March 2020, the public was desperate for answers and a solution. After months of development and successful clinical trials, vaccines against COVID-19 became available to the public, an answer to pleas from all around the world. Though skepticism surrounding the vaccines and their potential side effects were quickly made known, several reported factors contributed to vaccine confidence and acceptance. Attitudes of acceptance toward a COVID-19 vaccine may provide personal protection against the virus and contribute to herd immunity that protects those who cannot be vaccinated.

Of the included studies, the prevailing factors leading to vaccine acceptance were reported in the category "Personal preferences and beliefs regarding immunity," where acceptance was above 50% for each individual factor. Those who sought personal protection against COVID-19 were reported by Solis Arce et al[22] and Tran et al,[26] where acceptance rates associated with this factor were reported as 80.2% and 76% in Russia and 94% in the United States. Russian studies also showed majority acceptance in individuals seeking to protect their family from COVID-19, those who believe that vaccination eases complications of illness and those who believe that vaccination against COVID-19 leads to long-term immunity. This category is interesting because of its association with available scientific data. Despite decades of global vaccine research, development, and testing, these factors are based on an individual's belief in those scientific reports. Incidentally, the reliance on personal belief over peer-reviewed literature and clinical trials is detrimental to vaccination hesitancy.

Age was also a notable positive influence, where vaccination acceptance increased with age in the U.S. as reported by Cascini et al.[5] This data corresponds with hesitancy data reported in Australia by Seale et al,[20] where COVID-19 vaccine hesitancy decreases as age increases. This trend is opposite to the data reported in Nigeria, however, where Adebisi et al[1] reported decreasing acceptance with age and increasing hesitancy with age. Early in the pandemic, older individuals and those with preexisting health conditions were identified as high-risk groups, so more advanced age groups would likely seek immunity via vaccination.

Of the factors most heavily contributing to vaccination acceptance, it is positive that the largest influencing factor can easily be encouraged and expanded with public education efforts. If individuals are more likely to seek vaccination for the personal protection and health of themselves or loved ones, public vaccination efforts can be adjusted to educate the public on how vaccination provides protection. Similarly, it is encouraging to see that vaccination acceptance was associated with individuals of older age, who have been consistently

identified as an at-risk group. Vaccinations for older generations, who have a higher likelihood of having preexisting conditions that could be fatal in conjunction with COVID-19, could prevent contraction of COVID-19, lifetime side effects, and possible death.

*4.2 VACCINE HESITANCY*

As COVID-19 began its global spread, pharmaceutical companies quickly began researching and developing a vaccine to prevent and slow the transmission of COVID-19, however these efforts were widely met with skepticism and criticism, even in developed and developing countries with established childhood vaccination schedules. Vaccination is critical to the prevention and control of outbreaks of infectious disease[30] so it was incredibly important to identify the factors contributing to individuals' attitudes toward a COVID-19 vaccine. Despite global research, successful clinical trials, peer-reviewed literature, and countless successful vaccinations, many people still hesitate to receive a COVID-19 vaccine.

The primary factors contributing to COVID-19 vaccine hesitancy in the chosen developed/developing nations were concerns related to the vaccine itself. Within this group, safety, side effects, and efficacy of the vaccine were the most prevalent concerns. Though hesitancy rates ranged drastically for the factors in this group, these prevailing factors were addressed 20 times in five out of the six target countries. As seen in the primary factors influencing acceptance of the COVID-19 vaccines, these attitudes are rooted in personal feelings of mistrust toward development and fear of the potential negative effects of the vaccine. Factors such as these may be difficult to combat, as scientific data and jargon need to do more to reassure the layman. Likewise, the unrelenting media coverage of the COVID-19 pandemic since March 2020 has resulted in an "infodemic," a term referring the rapid spread of both accurate and inaccurate information, where rumors and facts are mixed and distinguishing relevant, information from fallacy becomes nearly impossible.[16]

Another major factor within this category included concerns about a vaccine's country of origin, demonstrated in Brazil and Nigeria. Some studies considered this factor a general concern while others named a specific country. For example, Gramacho et al[10] and Moore et al[17] asked participants their hesitation toward a Chinese-developed vaccine that resulted in a 21.3% decrease in confidence and 35.4% overall hesitancy, respectively. Because COVID-19 is believed to have originated in Wuhan, China, vaccine products from the same country were met with hesitation and safety concerns. These concerns are generally unfounded but highlights the effect of misinformation, generalization, and potential racism in the general populous. Vaccine-specific concerns also included various factors that appeared twice, such as individuals "Against vaccines in general/fear of administration" and a "Call for more vaccine research."

Mistrust of authority was the next leading category, referenced six times throughout the studies reviewed. India, Nigeria, and Russia's mistrust of the government contributed to hesitancy, though Russia also demonstrated mistrust in the WHO specifically.[7,29,19] This category also included "Lack of clarity" of information from authorities, contributing to

56.3% of concerns leading to hesitation in India[28] and 7.5% hesitation in Nigeria.[29]

Some individuals indicated the preferred alternative solutions for immunization instead of receiving a COVID-19 vaccine. Three studies cited a preference for natural immunity, where instead of being vaccinated, an individual would prefer to contract COVID-19 and allow their immune system to generate natural antibodies against the virus. This is incredibly dangerous due to the volatility of the virus, where the infection of a healthy person could result in chronic side effects or even death [12]and could potentially allow the virus to mutate. This factor contributed to 14.5% hesitancy in India,[7] 0.9% hesitancy in Nigeria, [29] and is reflected in Russia's low acceptance rate of 26.1%.[26] Similarly, individuals in Nigeria and Russia indicated a belief that their personal immune response would be adequate to combat the virus without vaccination, leading to an even higher hesitation in Nigeria at 27.3%.[29] Finally, in Russia, some cited a preference for natural remedies, however, this group still showed a 30.2% acceptance of the vaccine.[26]

As aforementioned in the acceptance-related data, generation and vaccination hesitancy were inversely related in the United States but showed a positive relationship in Nigeria. In the U.S. Generation Z, including ages 18-23, showed the highest hesitancy at 59.4%, while the eldest generation, Baby Boomers, including ages 65 and above, showed the lowest hesitancy at 20.5%.[21] Alternatively, Adebisi et al[1] reported that in Nigeria, ages 16-30 showed the lowest hesitancy at 22.8% while the eldest age group, ages 61+ showed 100% hesitancy. This is the greatest conflict seen in the data, with trends in two countries directly opposing one another. This opposition is very interesting and prompts further investigation into age groups in different regions and their potential relationships with other hesitancy factors cited in this study.

Similar to what was seen in the rates of COVID-19 vaccination acceptance, the largest influencing factors remain in an individual's personal feelings and beliefs regarding the COVID-19 pandemic, the possible solutions, and the development leading to those solutions. These factors are heavily impacted by the infodemic surrounding COVID-19, where fact and fallacy have been delivered to the public simultaneously by hundreds of sources, making it difficult to change minds and deliver truth. Despite this,, understanding the driving elements of vaccine hesitancy provides a basis for public health institutions, healthcare providers, and research scientists to better communicate with the public.

This review was conducted with data from the first 15 months of COVID-19 vaccine availability. As of July 2023, the findings of this review are consistent with that of articles published after the conclusion of the literature search in March 2022. A recent systematic review[3] in Nigeria suggests substantial heterogeneity in acceptance rates for adults nationwide. Lazarus et al[15] found that COVID-19 vaccine acceptance increased between 2020 and 2021 in the United States, Russia, Nigeria, India, and Brazil. Australia was not included in this study. In Australia and the United States, Trent et al[27] evaluated individuals' intent to receive a COVID-19 vaccine based on confidence in the government, finding that high confidence in Australia led to greater willingness to take the

vaccine, whereas high confidence in American cities led to less willingness. While every factor evaluated in this study is not accounted for in recent data, the most prominent factors of trust, education, and government confidence remain consistent.

## 5. Conclusion

Attitudes toward the COVID-19 pandemic and subsequent vaccination efforts varied widely across the globe, where dozens of factors influenced one's acceptance or hesitance toward receiving a COVID-19 vaccine. Despite diverse developed/developing countries addressing this public health crisis uniquely, similar patterns emerged in the factors influencing acceptance and hesitancy, where personal beliefs regarding vaccine efficacy and safety prevail in both contrasting attitudes. To achieve herd immunity and slow the transmission of COVID-19, it is imperative that attitudes and factors leading toward acceptance are encouraged and hesitancies are corrected with data and effective communication. As COVID-19 continues to spread and threats of variants of SARS-Cov-2 remain, future research is required to investigate the rationales associated with the uptake of the COVID-19 vaccines. Now that COVID-19 vaccinations are widely available in developed/developing nations, effective communication and reassurance attributed to the vaccine's safety between the scientific community and the general public is the most important task in achieving mass immunity in these countries.

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