# Knowledge, Attitude and Acceptance of a COVID-19 Vaccine: A Global Cross-Sectional Study

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# Knowledge, Attitude and Acceptance of a COVID-19 Vaccine: A Global Cross-Sectional Study

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## Abstract

The COVID-19 pandemic continues to ravage the world, with the United States being highly affected. A vaccine provides the best hope for a permanent solution to controlling the pandemic. Several coronavirus disease (COVID-19) vaccines are currently in human trials. However, to be effective, a vaccine must be accepted and used by a large majority of the population. This study aimed to investigate the acceptability of COVID-19 vaccines and its predictors in addition to the attitudes towards these vaccines among public. This study did an online survey during the period June-September 2020, were collected from 26,852 individuals aged 19 years or older across six continents as part of 60 nationally representative surveys to determine potential acceptance rates and factors influencing acceptance of a COVID-19 vaccine. Results revealed that two-thirds of respondents were at least moderately worried about a widespread COVID-19 outbreak. Differences in acceptance rates ranged from almost 93% (in Tonga) to less than 43% (in Egypt). Respondents reporting higher levels of trust in information from government sources were more likely to accept a vaccine and take their employer's advice to do so. Systematic interventions are required by public health authorities to reduce the levels of vaccines' hesitancy and improve their acceptance. These results and specifically the low rate of acceptability is alarming to public health authorities and should stir further studies on the root causes and the need of awareness campaigns. These interventions should take the form of reviving the trust in national health authorities and structured awareness campaigns that offer transparent information about the safety and efficacy of the vaccines and the technology that was utilized in their production.

**Keywords:** Novel Coronavirus, COVID-19, pandemic, outbreak, vaccine, knowledge, attitude, acceptance

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## INTRODUCTION

Vaccines are a key strategy to stop the escalation of the COVID19 pandemic. As of April 8, 2020, there were more than 100 COVID-19 vaccine candidates being developed (Pogue et al 2020). This vaccine development is proceeding at a fast pace; prior to March 30, 2020, two vaccine candidates had entered Phase 1 clinical trials (Lurie et al 2020) while on April 9, five vaccine candidates in total were in Phase 1 clinical trials (Thanh Le et al 2020). Understanding vaccine acceptance is important, given the large population and because it has relatively high vaccine hesitancy for existing vaccines and relatively low vaccination coverage (van Doremalen et al 2020; Harapan et al 2019). Characterizing how vaccine efficacy could impact acceptance is also important, given that actual or perceived vaccine efficacy could be relatively low.

The high usage of news media is concerning given the potential for alarming, sensationalist portrayals of the pandemic (Klemm et al 2016). In addition, myths, rumors and misinformation can quickly spread online, particularly via social media (Vosoughi et al 2018). Reliance on social media might have contributed to uncertainty around COVID-19, for example, about whether people have natural immunity and whether specific home remedies (garlic, vitamins, and rinsing noses with saline) help protect against coronavirus. It may also explain some uncertainty around whether the virus was human-made and deliberately released. Uncertainty and rapidly changing information may have contributed to increased worry about the virus (Han et al 2006). These findings speak to the importance of distributing accurate health information about COVID-19 through a variety of sources (news, social media, and government websites) to reach the general population and correct misinformation.

The effect of media exposure may be related to the provision of important health information about the pandemic. Although media exposure early in the outbreak appears to have facilitated health-protective behaviors, media fatigue—where people become desensitized to ongoing messaging—may reduce this effect as the pandemic continues (Collinson et al 2015). Repeated media exposure may also lead to heightened stress and anxiety, which can have longer-term health effects, as well as contributing to excessive or misplaced health-protective behaviors such as presenting for diagnostic testing when actual risk of exposure is low (Garfin et al 2020).

Emerging evidence from groups with widespread testing for the SARS-CoV-2 virus indicates that between 2 and 8 out of every 10 infections may be asymptomatic (Mizumoto et al 2020; Nishiura et al 2020). Despite being asymptomatic, those infected are still able to transmit the virus to others (Bai et al 2020; Zou et al 2020). In addition, people appear to be infectious and asymptomatic during the incubation period (Lauer et al 2020). People commonly rely on symptoms to indicate illness and assume that the absence of symptoms means they are well (Diefenbach & Leventhal 1996). Such assumptions in the COVID-19 pandemic

could have serious consequences, in terms of both community transmission and reduced health-protective behaviors. Therefore, public health communication campaigns about COVID-19 need to address these misconceptions.

There is an evident uncertainty clouding the COVID-19 vaccines. Firstly, the new mRNA-based vaccines as a novel technology could be received with some skepticism since no prior experience or successes with such approach have been reported in the past. Also, the speed of vaccine development and registration in less than a year may have mediated a role in lowering the acceptance level. Another global phenomenon that negatively contributed to such a low level is the numerous campaigns launched by anti-vaccinationists fueled by the new technology and short span of vaccine development. Such campaigns on social media with fabricated, false, and sometimes misleading translations feed the conspiracy beliefs of some people. Some factors that are specific to the country and the region could also play a role in this. For example, there is a sector of the public who had their trust shaken in local authorities and/or disapprove the overall handling of the pandemic. Some people expresses their frustration as many decisions could be unwelcomed, disproportional with the pandemic status, not justified or backed with science.

COVID-19 pandemic as with other previous pandemics is associated with feelings of fears, anxiety, and worries (Blakey & Abramowitz 2017; Wheaton et al 2012). However, it is unique in terms that people are not worried only about getting infected or transmit the disease to others (Blakey & Abramowitz 2017), but they suffered societal and economic concerns due to the measures that were undertaken by the governments to confine the pandemic and stopping the human-human transmission of the disease (Nicola et al 2020). These measures include enforcement of curfews and lockdowns (the largest throughout history), social distancing and self-isolation, schools and universities closures, borders' shutdowns, travel restrictions, and quarantine (Mannan & Farhana 2020; Nicola et al 2020).

## LITERATURE REVIEW

Holingue et al showed in a population-based study of US adults that the fears and anxiety of getting infected with and die from COVID-19 were associated with increased mental distress (Holingue et al 2020). Moreover, the personal hygienic precautions that were undertaken by individuals to avoid infecting others had increased the probability of becoming mentally distressed (Holingue et al 2020). A systematic review and meta-analysis of the psychological and mental impact of COVID-19 showed that the prevalence of anxiety and depression was 33% and 28%, respectively (Luo et al 2020). During the COVID-19 pandemic, people used multiple information resources to gain knowledge and health information about the disease, including television, radio, newspapers, social media, friends, co-workers, healthcare providers, scientists, governments, etc. (Ali et al 2020). Since such information sources can shape peoples' acceptance or refusal of COVID-19 vaccines[44], it is crucial to

disseminate transparent and accurate information about vaccines' safety and efficacy to gain the trust of the population especially the hesitant and skeptical ones (Siegrist, & Zingg 2014). Hence, gaining an understanding of the resources that people trust the most to get information about COVID-19 vaccines is critical for the success of any future national vaccination campaign.

In a further study, COVID-19 vaccine acceptance among college students in South Carolina was found to be affected by the information resources. Students largely trusted scientists (83%), followed by healthcare providers (74%), and then health agencies (70%) (Qiao et al 2020). In a study from France, vaccination practices and acceptance toward MMR and HBV vaccines were better when parents had reported getting the information from their healthcare providers compared with parents getting information from the internet or their relatives (Charron et al 2020). Recent research from China indicates that engaging in hand hygiene and other health protective behaviors was associated with reduced psychological impact of the COVID-19 outbreak, including lower stress and anxiety (Wang et al 2020). These findings highlight the importance of encouraging the public to engage with such behaviors not only to reduce the risk of infection but also to reduce anxiety associated with COVID-19.

Over the past decade, it has comprehensively explored the landscape of vaccine confidence issues and experiences in managing confidence crises around the world (Larson et al 2018; 2014; 2011; Jarrett et al 2015). The numerous surveys, focus groups, in-depth qualitative research, and large scale digital media analytics (Larson et al 2016; 2015; 2014), as well as convened expert roundtables and workshops to understand context specific attitudes to vaccines among the general public (Larson et al 2018; 2016), health-care professionals and providers (Larson et al 2018), and pregnant women (Wilson et al 2015). It continues to research the roots, trends, and impacts of vaccine confidence issues at national and supranational levels to inform policy and trust-building activities and mitigate the need for crisis management in immunisation programmes.

These studies have focused that a multiplicity of factors influencing vaccine decisions (SAGE 2014), key drivers of public confidence in vaccines were identified as trust in the importance, safety, and effectiveness of vaccines, along with compatibility of vaccination with religious beliefs (Larson et al 2015). These findings have resulted in the development of a Vaccine Confidence Index survey tool to measure individual perceptions on the safety, importance, effectiveness, and religious compatibility of vaccines. The research questionnaire has the primary focus of measuring confidence across multiple countries while being minimal, thus allowing ready integration into existing global surveys. The survey is one of a diverse set of metrics and indices used to measure confidence or hesitancy such as the Parent Attitudes About Childhood Vaccines Survey, which measures vaccine hesitancy among parents (Opel et 2013); the Vaccination Confidence Scale, which

measures confidence in adolescent vaccination (Gilkey et al 2014); the 5-C scale such as confidence, complacency, constraints, calculation, and collective responsibility, which identifies psychological barriers of vaccination behavior (Betsch et al 2018); and the SAGE Vaccine Hesitancy Scale, which has been deployed across multiple countries (Wagner et al 2019; Shapiro et al 2018; Domek et al 2018; Masters et al 2018; Ren et al 2018).

In 2017, the vaccine manufacturer Sanofi announced that their newly introduced dengue vaccine Dengvaxia posed a risk to individuals who had not previously been exposed to the virus, prompting outrage and panic across the population where nearly 850 000 children had been given the new vaccine the previous year. As the research measured a baseline confidence value in 2015, that were able to measure the change in confidence following the vaccine scare and found a significant drop in confidence in vaccine importance, safety, effectiveness (Larson et al 2019). The survey study tool has detected a rise in confidence across the country—although confidence is not back to 2015 levels—indicating a possible recovery and highlighting the value of the tool in assessing the effectiveness of national-level policy.

Japan ranked among the countries with the lowest vaccine confidence in the world: this might be linked to the human papillomavirus (HPV) vaccine safety scares that started in 2013, and following the decision by the Japanese Ministry of Health, Labour and Welfare in June, 2013, to suspend proactive recommendation of the HPV vaccine (Simms et al 2020). As a result of this vaccine safety scare, HPV vaccination coverage decreased from 68•4–74•0% in the 1994–98 birth cohort to 0•6% in the 2000 birth cohort.36 The news of Japan suspending their proactive recommendation of the HPV vaccine has travelled globally through online media and social media networks, being applauded by ant vaccination groups but not by the global scientific community (Larson et al 2014).

Moreover, Indonesia witnessed a large drop in confidence between 2015 and 2019, partly triggered by Muslim leaders questioning the safety of the measles, mumps, and rubella (MMR) vaccine, and ultimately issuing a fatwa—a religious ruling—claiming that the vaccine was haram and contained ingredients derived from pigs and thus not acceptable for Muslims. Local healers promoting natural alternatives to vaccines also contributed to the waning confidence in vaccines (Rochmyaningsih 2018; Yufika et al 2020). In addition, In South Korea and Malaysia, online mobilization against vaccines has been identified as a key barrier to vaccination (Wong et al 2020; Chang & Lee 2019). In South Korea, an online community named ANAKI (Korean abbreviation of ‘raising children without medication’) has been strongly advocating against childhood immunization (Park et al 2018). The internet is a main source of vaccination information in Malaysia, where misinformation has been identified as influencing vaccine reluctance (Mohd Azizi et al 2017). In Georgia, unfounded vaccine safety concerns, amplified by the media, were found to profoundly affect a

nationwide MMR vaccine campaign in 2008 (Khetsuriani et al 2010).

Furthermore, other studies in Asia have found that perceived risk or perceived susceptibility to an infection is associated with positive support for vaccination (Rajamoorthy et al 2019; Rajamoorthy et al 2018; Sundaram et al 2015). Another study also found that high perceived risk was associated with COVID-19 vaccine acceptance among general community members in Saudi Arabia (Padhi & Almohaithef 2020) and among HCWs in China (Fu et al 2020). Low perceived risk may not only be correlated with vaccine acceptance, but also adherence to social distancing measures and other public health countermeasures. These relationships may be complicated—for example, an individual highly compliant with social distancing measures may perceive their risk to be low but still want to obtain a vaccine. Lower vaccine acceptance among the retired population might be influenced by lower perceived risk. Although the elderly are more vulnerable to COVID-19, most of the retired population in Southeast Asian countries have low mobility and spend more time at home with less travel. These behaviors may lead them to having a lower perceived risk of being infected with SARS-CoV-2, and eventually may lead to lower acceptance of a vaccine. Moreover, their acceptance might also be influenced by knowledge about the disease. Much of the information about COVID-19 is spread through social media or online media, which is less frequently accessed by older adults. Therefore, older adults might have less exposure to information about COVID-19 that could contribute to framing their risk perception. In addition, less social media use might also be associated with less knowledge among the elderly and this could affect their perceived risk and vaccine acceptance.

## METHODOLOGY

Due to limitations in doing face-to-face research during the current active COVID-19 outbreak, this study did an online survey during the period June-September 2020, were collected from 26,852 individuals aged 19 years or older across six continents as part of 60 nationally representative surveys. This grouped countries and territories by WHO regional classification. Online, and telephone survey methodologies were used. In addition to probing individuals' knowledge, attitude and acceptances on vaccine confidence across the globe, the study was also surveyed individuals on a range of factors including sources of trust, and information-seeking behaviours. The surveys were weighted by sex and age according to national distributions, with equal sex representation in most surveys.

The questionnaire used in this study was developed based on literature review and discussion within the research team. The questionnaire was reviewed by experts in survey research for face validity. Participants were asked to indicate if they were infected with COVID-19 or knew anyone who was infected with confirmation of diagnosis using standard laboratory testing protocols. Another question item was dedicated to surveying participants who believe they may have contracted the virus but without a confirming test. Participants were asked to

indicate their most trusted sources when seeking knowledge of COVID-19 vaccines. Besides, participants were asked about their concerns during the COVID-19 pandemic. Participants were asked whether they accept to receive COVID-19 vaccines when they are approved and available. The attitudes towards COVID-19 vaccines' section consists of 10 statements with a 5-point Likert scale (5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree), with questions about hesitancy and concerns regarding COVID-19 vaccines. Categorical variables were presented as numbers and percentages, while continuous variables were presented as median.. The univariate analysis was performed using an independent Mann–Whitney U test for continuous variables and Chi-square test for categorical variables as appropriate. For analysis, responses to the attitudes section were combined.

The main outcome of the study was the public acceptance of COVID-19 vaccines. To determine the factors that affect the acceptance of the population to receive COVID-19 vaccines, both multinomial and binary logistic regressions were performed. At first, potential predictors for COVID19 vaccines were screened using univariable analysis, and variables with $p<.05$ were considered in both multinomial and binary logistic regression. When the multinomial logistic regression was conducted, the acceptance outcome was trichotomized as (non-acceptance, neutral, and acceptance). For a simpler interpretation of the analysis, the participants who answered 'neutral' were then removed and a binary logistic regression was performed. In the binary logistic regression model, the participants were dichotomized as acceptable or not acceptable. In both models, the odds ratio (OR) values and their 95% confidence intervals (95% CI) were calculated. A p-value of less than .05 was considered statistically significant. The analysis was carried out using the Statistical Package for Social Sciences (SPSS).

To assess knowledge, participants were asked to respond to a series of statements about the COVID19 coronavirus and whether these statements were true or false or they were unsure of the answer (Farhana & Mannan 2020). Correctly answered items were summed to generate a general virus knowledge subscale score. Participants were asked to identify the most common symptoms of COVID-19 infection, based on information provided to the public at the time: fever, cough, sore throat, and shortness of breath. More recent information includes fatigue or tiredness, which were not included in the survey. Three uncommon symptoms were included: diarrhea, vomiting, and nausea (Guan et al 2020). The number of correctly answered items was summed to generate a symptoms knowledge subscale score. Transmission knowledge items asked about the ways the virus can potentially be spread, including droplets spread through coughing or sneezing, touching or shaking hands with someone who is infected, and touching surfaces that have come into contact with the virus. Three other sources, which did not appear to be transmission mechanisms, were also included: water, mosquitoes, and airborne spread (Centers for Disease Control and Prevention, 2020; World Health Organization, 2020a,b). One

item assessed knowledge of recommended face mask use, with advice to the public at that time being that only people who were sick should be wearing masks to stop them spreading the virus.

## RESULTS AND DISCUSSIONS

Information was collected on participants' age group, gender, ethnicity, highest level of education, and region of residence around six continents as shown in Table 1.1. Participants were also asked to complete few questions. Firstly, they were a single-item measure assessing their self-rated heath (Idler & Benyamini, 1997), with responses on Likert scale. Secondly, respondents were an item assessing whether they had received a flu vaccine in the previous year (yes, no, don't know). For the purposes of analysis, no and don't know responses were combined to form a dichotomous measure. Finally, participants were asked whether they, or any family members or friends, had caught COVID-19 (yes, no, and don't know).

**Table 1.1 Demographic characteristics of the sample with number (percentage) of respondents**

| Demographic variables | (%) |
|---|---|
| **Gender** | |
| Male | 67.55 |
| Female | 33.45 |
| **Continents** | |
| Africa | 18.10 |
| Asia | 21.19 |
| Europe | 15.11 |
| North America | 16.23 |
| South America | 15.20 |
| Australia | 14.17 |
| **Age group** | |
| 19–29 | 22.25 |
| 30–49 | 36.50 |
| 50–59 | 30.50 |
| 60-69 | 7.30 |
| 70 and above | 2.25 |
| Not stated | 1.20 |
| **Religion** | |
| Christianity | 30.50 |
| Islam | 24.20 |
| Unaffiliated | 16.30 |
| Hinduism | 15.00 |
| Buddhism | 7.10 |
| Folk Religions | 4.60 |
| Other Religions | 1.20 |
| Not stated | 1.10 |
| **Highest Education** | |
| Completed 12 years education | 22.60 |
| Trade certificate, or diploma, | 26.30 |
| Bachelor's degree | 27.60 |
| Graduate diploma, graduate certificate, or postgraduate degree | 23.0 |
| Not stated | 0.5 |

Respondents were asked to a series of true–false questions to assess their more general knowledge of COVID-19. Knowledge questions were also asked relating to most common symptoms and routes of transmission. The percentage of true, false, and don't know responses can be seen in Table 1.2. Total general virus knowledge subscale scores ranged from 1 to 16.

**Table 1.2 Percentage of true, false, and unsure responses to general knowledge**

| Statements | True | False | Don't know |
|---|---|---|---|
| There is an effective medicine available for treating COVID-19 | 94.10 | 2.40 | 3.50 |
| There are ways to help slow the spread of COVID-19 | 4.20 | 78.40 | 17.40 |
| Currently there is no vaccine to protect against COVID-19 | 87.60 | 5.30 | 7.10 |
| The ordinary flu vaccine will protect me from COVID-19 | 27.40 | 35.20 | 37.40 |
| Antibiotics are an effective treatment for COVID-19 | 2.70 | 91.10 | 6.20 |
| Taking vitamin C or other vitamins will protect you from the COVID-19 | 3.30 | 92.30 | 4.40 |
| There is no evidence that vaccines against pneumonia will protect you against the COVID-19 | 3.20 | 85.60 | 11.20 |
| Regularly rinsing your nose with saline will protect you against the COVID-19 | 79.10 | 6.60 | 14.30 |
| To date, no one in your country has died from COVID-19 | 96.50 | 1.30 | 2.20 |
| To date, no one in your country who was infected with COVID-19 passed it on to infect another person | 96.10 | 1.20 | 2.70 |
| There is no evidence that eating garlic will protect you against the COVID-19 | 5.30 | 79.40 | 15.30 |
| The health effects of COVID-19 appear to be more severe for people who already have a serious medical condition | 5.50 | 68.40 | 26.10 |
| There are other strains of COVID-19 that can infect humans, including those that cause the common cold | 62.00 | 9.50 | 28.50 |
| Packages or letters can spread the virus | 3.60 | 75.10 | 21.30 |
| The virus was genetically engineered as part of a biological weapons program | 9.30 | 56.80 | 33.90 |
| The virus was human-made and deliberately released | 9.30 | 56.80 | 33.90 |

Respondents were more accurate in recognizing the symptoms that have been linked with COVID-19 and less certain of whether the other symptoms were indicative of illness. Symptoms knowledge subscale scores ranged from 1 to 8. The subscale score was, indicating good recognition of the symptoms commonly mentioned in public health information provided to the public at this time. Respondents typically recognized transmission routes associated with droplet spread but were less certain of whether the virus can also spread via air, water, or insects. Transmission knowledge subscale scores ranged from 1 to 6.

**Table 1.3 Percentage of yes, no, and don't know responses to symptoms and transmission**

| Statements | Yes | No | Don't know |
|---|---|---|---|
| **Symptoms** | | | |
| Fever | 96.30 | 1.20 | 2.50 |
| Cough | 95.10 | 2.70 | 2.20 |
| Sore throat | 85.20 | 6.50 | 8.30 |
| Shortness of breath | 88.70 | 5.20 | 6.10 |
| Nausea | 24.20 | 49.10 | 26.70 |
| Vomiting | 12.40 | 61.30 | 26.30 |
| Diarrhea | 16.40 | 62.40 | 21.20 |
| No any Symptom | 26.20 | 25.70 | 48.10 |
| **Transmission** | | | |
| Touching or shaking hands with a person who is affected | 97.70 | 1.20 | 1.10 |
| Droplets spread through coughing or sneezing | 89.10 | 4.20 | 6.70 |
| Surfaces recently touched by someone who is affected | 51.10 | 25.10 | 23.80 |
| Airborne | 7.00 | 63.40 | 29.60 |
| Waterborne | 6.10 | 65.50 | 28.40 |
| Insects | 1.10 | 81.00 | 17.90 |

The results of the survey provide information on public knowledge in the early period of the COVID-19 pandemic. Majority of respondents were at least moderately worried about the possibility of a widespread outbreak. These rates are commensurate with past pandemics such as SARS (Bults et al 2011; Wheaton et al 2012). Recent research from China indicates that engaging in hand hygiene and other health protective behaviors was associated with reduced psychological impact of the COVID-19 outbreak, including lower stress and anxiety (Mannan et al 2020; Wang et al 2020). These findings highlight the importance of encouraging the public to engage with such behaviors not only to reduce the risk of infection but also to reduce anxiety associated with COVID-19. This study also provide important insights into what participants expected in terms of how serious the symptoms of coronavirus would be, should they contract COVID-19. There is a clear discrepancy between respondents' perceived severity of symptoms and current data on rates of asymptomatic infection. The results also provide insights into where residents are seeking their information about COVID-19 and their level of knowledge about the virus and is transmission. While it was promising to see sourced information from official and government websites, mainstream news media was the most popular, and social media use was also high.

This paper provided important insights into what participants expected in terms of how serious the symptoms of coronavirus would be, should they contract COVID-19. There is a clear discrepancy between respondents' perceived severity of

symptoms and current data on rates of asymptomatic infection. Very few participants believed that they would experience no symptoms. In contrast, emerging evidence from groups with widespread testing for the SARS-CoV-2 virus indicates that between 2 and 8 out of every 10 infections may be asymptomatic (Mizumoto et al 2020; Nishiura et al 2020). Despite being asymptomatic, those infected are still able to transmit the virus to others (Bai et al 2020; Zou et al 2020). In addition, people appear to be infectious and asymptomatic during the incubation period (Lauer et al., 2020). People commonly rely on symptoms to indicate illness and assume that the absence of symptoms means they are well (Diefenbach & Leventhal, 1996). Such assumptions in the COVID-19 pandemic could have serious consequences, in terms of both community transmission and reduced health-protective behaviors. Therefore, public health communication campaigns about COVID-19 need to address these misconceptions.

Majority (81.5%) of the participants were strongly agreed that it is important to get a vaccine to protect people from COVID-19. Besides, less than 59% of the participants agreed that pharmaceutical companies will be able to develop safe and effective COVID-19 vaccines. Moreover, about half of the respondents (51.6%) reported that side effects will prevent them from taking a COVID-19 vaccine and that 52.1% will refuse to take COVID-19 vaccines once licensed. Importantly, around a quarter of all respondents were neutral regarding most attitudes as shown in Table 1.4

**Table 1.4. Attitudes toward COVID-19 vaccines in percentage**

| Attitudes | Strongly agree | Neutral | Strongly disagree |
|---|---|---|---|
| It is important to get a vaccine to protect the people from COVID-19. | 65.50 | 19.60 | 12.90 |
| Worries about unforeseen impacts | 44.70 | 35.20 | 20.10 |
| Pharmaceutical companies are going to develop safe and effective COVID-19 vaccines. | 57.60 | 28.70 | 13.70 |
| General mistrust of vaccine benefit | 42.60 | 36.30 | 21.10 |
| COVID-19 vaccines made in Europe or America are safer than those made in other world countries. | 31.70 | 38.40 | 29.90 |
| Concerns about commercial profiteering | 43.70 | 32.20 | 24.10 |
| Side effects will prevent me from taking a vaccine for the prevention of COVID-19. | 48.70 | 23.10 | 28.20 |
| Preference for natural immunity | 34.60 | 31.20 | 34.20 |
| Most people will refuse to take the COVID-19 vaccine once licensed in your country. | 49.20 | 26.40 | 24.40 |
| The government of your country will make the vaccine available for all citizens for free? | 35.20 | 27.00 | 37.80 |

Further, the trust in the manufacturer that provides effective and noncontaminated products is another important determinant of confidence. About two-thirds of respondents in the current study had confidence in pharmaceutical companies to develop safe and effective COVID19 vaccines. However, the source of the vaccine affects the perceived safety, as only one-third of the participants in the current study perceived that COVID-19 vaccines that were manufactured in Europe or America were safer than those made in other countries. This is rather lower than the reported percentage by Pogue and colleagues where ~55% and 36% of participants stated that they were more comfortable with vaccines made in the USA and Europe, respectively (Pogue et al 2020).

Respondents from African continent, Mauritius gave the highest proportion of positive responses (82.76%) and the lowest proportion of responses from Egypt (43.55%) when asked if they would take a 'when vaccine will available in your country'. Participants from Asian continent, China gave the highest proportion of positive responses (87.42 %) and the lowest proportion of responses from Afghanistan (47.22%) when asked if they would take a 'when vaccine will available in your country'. Respondents from Australian continent, Tonga gave the highest proportion of positive responses (92.88%) and the lowest proportion of responses from Fiji (87.21%) when asked if they would take a 'when vaccine will available in your country'. There was considerable variation by country, with Tonga from Australian continent again having the highest proportion of positive responses (92.88%) and the lowest proportion of responses in Egypt (43.55 %) from African continent. The proportion of positive responses for all three continents can be found in Table 1.5

**Table 1.5 COVID-19 Vaccine Acceptance in the Scale of Strongly Agreed in Africa, Asia and Australia Continents**

| Africa | % | Asia | % | Australia | % |
|---|---|---|---|---|---|
| Algeria | 66.32 | Afghanistan | 47.22 | Australia | 89.88 |
| Egypt | 43.55 | Bangladesh | 49.81 | Fiji | 87.21 |
| Botswana | 71.23 | China | 87.42 | New Zealand | 88.44 |
| Kenya | 61.33 | India | 73.85 | Kiribati | 89.84 |
| Libya | 49.63 | Japan | 71.44 | Nauru | 88.27 |
| Mali | 62.44 | Malaysia | 52.67 | Palau | 89.22 |
| Mauritius | 82.76 | Saudi Arabia | 51.11 | Papua New Guinea | 91.91 |
| Morocco | 48.44 | Singapore | 66.77 | Solomon Islands | 92.55 |
| Nigeria | 61.54 | South Korea | 76.23 | Tonga | 92.88 |
| South Africa | 79.26 | Turkey | 59.21 | Tuvalu | 90.45 |

Respondents from North American continent, Panama gave the highest proportion of positive responses (87.44%) and the lowest proportion of responses from Canada (62.55%) when asked if they would take a 'when vaccine will available in your country'. Participants from South American continent, Brazil gave the highest proportion of positive responses (86.24%) and the lowest proportion of

responses from Paraguay (67.66%) when asked if they would take a 'when vaccine will available in your country'. Respondents from European continent, England gave the highest proportion of positive responses (69.33%) and the lowest proportion of responses from Russia (51.34%) when asked if they would take a 'when vaccine will available in your country'. There was considerable variation by country, with Panama from North American continent again having the highest proportion of positive responses (87.44%) and the lowest proportion of responses in Russia (51.34%) from African continent. The proportion of positive responses for all three continents can be found in Table 1.6

**Table 1.6 COVID-19 Vaccine Acceptance in the Scale of Strongly Agreed in North America, South America and Europe Continents**

| North America | % | South America | % | Europe | % |
|---|---|---|---|---|---|
| Canada | 62.55 | Argentina | 81.33 | England | 69.33 |
| Cuba | 77.89 | Brazil | 86.24 | Belgium | 60.44 |
| Dominican Republic | 79.49 | Bolivia | 82.77 | Germany | 65.22 |
| El Salvador | 71.81 | Chile | 79.21 | Italy | 68.44 |
| Guatemala | 74.99 | Colombia | 81.77 | France | 51.89 |
| Jamaica | 70.98 | Ecuador | 70.22 | Poland | 52.33 |
| Mexico | 73.25 | Paraguay | 67.66 | Spain | 72.45 |
| Nicaragua | 81.22 | Peru | 77.77 | Sweden | 62.66 |
| Panama | 87.44 | Uruguay | 75.57 | Switzerland | 60.21 |
| United States of America | 74.77 | Venezuela | 74.76 | Russia | 51.34 |

Our findings provide insights into the demographic behaviors in the early stages of a pandemic disease outbreak. The results of this study shed light on how many respondents plan to get a COVID-19 vaccine if available. Concern about the outbreak, greater media exposure, and higher knowledge predicted vaccination intentions. These findings are in line with previous research showing that concern and knowledge were associated with increased Ebola vaccine intentions (Petrie et al 2016). In contrast to previous research, perceived likelihood and severity of infection were only marginally associated with intentions to get a vaccine (Weinstein et al 2007; Bish & Michie 2010). Previous research has typically focused on personal risk. In the case of COVID-19, the personal risk to most individuals is low, and behavior may be driven primarily by perceived risk to others, which was not assessed in the current study.

**Table 1.7 Predictors of likelihood of getting vaccinated against COVID-19 if a vaccine becomes available**

| Variable | | 95% Wald CI for Exp(B) | | | | | |
|---|---|---|---|---|---|---|---|
| | | B | SE | Exp(B) | Lower | Upper | P |
| **Gender** | | | | | | | |
| | Male | 0 | - | 1 | - | - | - |
| | Female | -0.33 | 0.10 | 0.72 | 0.51 | 0.79 | <0.001 |
| **Continents** | | | | | | | |
| | Africa | 0 | - | 1 | - | - | - |
| | Asia | -0.07 | 0.13 | 0.81 | 0.78 | 1.11 | 0.67 |
| | Europe | -0.05 | 0.12 | 0.84 | 0.61 | 1.11 | 0.67 |
| | North America | -0.12 | 0.11 | 0.81 | 0.50 | 1.11 | 0.23 |
| | South America | -.0.17 | 0.14 | 0.72 | 0.74 | 1.11 | 0.11 |
| | Australia | 0.28 | 0.11 | 1.31 | 0.76 | 1.40 | 0.11 |
| **Age group** | | | | | | | |
| | 19–29 | 0 | - | 1 | - | - | - |
| | 30–49 | -0.61 | 0.12 | 0.37 | 0.26 | 0.71 | <0.001 |
| | 50–59 | -0.75 | 0.14 | 0.31 | 0.20 | 0.52 | <0.001 |
| | 60-69 | -0.51 | 0.17 | 0.51 | 0.28 | 0.70 | 0.002 |
| | 70 and above | -0.52 | 0.18 | 0.52 | 0.29 | 0.71 | 0.002 |
| | Not stated | -0.53 | 0.19 | 0.53 | 0.30 | 0.89 | 0.002 |
| **Religion** | | | | | | | |
| | Christianity | 0 | - | 1 | - | - | - |
| | Islam | -0.06 | 0.12 | 0.71 | 0.68 | 1.21 | 0.77 |
| | Unaffiliated | -0.05 | 0.13 | 0.74 | 0.71 | 1.21 | 0.77 |
| | Hinduism | -0.22 | 0.21 | 0.71 | 0.51 | 1.21 | 0.33 |
| | Buddhism | -.0.18 | 0.15 | 0.62 | 0.64 | 1.11 | 0.21 |
| | Folk Religions | 0.27 | 0.21 | 1.21 | 0.66 | 1.30 | 0.31 |
| | Other Religions | -0.06 | 0.14 | 0.91 | 0.88 | 1.31 | 0.87 |
| | Not stated | -0.05 | 0.13 | 0.74 | 0.71 | 1.11 | 0.77 |
| **Highest Education** | | | | | | | |
| | Completed 12 years education | 0 | - | 1 | - | - | - |
| | Trade certificate, or diploma, | 0.07 | 0.12 | 1.07 | 0.92 | 1.27 | 0.61 |
| | Bachelor's degree | 0.01 | 0.13 | 1.71 | 0.82 | 1.22 | 0.91 |
| | Graduate diploma, graduate certificate, or postgraduate degree | -0.18 | 0.13 | 0.71 | 0.73 | 1.07 | 0.18 |
| | Not stated | 0.06 | 0.13 | 1.06 | 0.82 | 1.17 | 0.61 |

The current study is strengthened by a large sample size and a good representation of participants from different educational backgrounds from the world. Respondents were recruited through Social Network and as such are not representative of the general population. The pattern of results may be generalize to the broader population. To maximize convenience sampling, we used solely self-report measures, which may lead to biased effects. While the results of the regression analyses provide interesting starting points to identify the demographic and risk variables that predict health behaviors and vaccine intentions, they cannot establish causality and must be interpreted with caution. Given the large sample, the relationships between some of the significant predictors are likely to be small and may not be clinically meaningful.

The current results provide information on the public responses to the COVID-19 pandemic, including information sources and engagement, knowledge, and vaccine intentions. The findings show that there was a critical mismatch between expected

severities of symptoms versus data on how COVID-19 is experienced, which needs to be addressed in government education campaigns. Without a vaccine currently available, encouraging widespread and sustained engagement with hygiene and distancing behaviors is critical to successfully manage the COVID-19 pandemic, flatten the curve of infections, and protect vulnerable individuals and overburdened healthcare systems. The results of the current study provide important insights into psychological and behavioral responses early in the outbreak of this COVID-19. The findings point to types of information that may be particularly effective and groups that may benefit from clear and targeted messaging to promote engagement with health-protective behaviors.

Vaccine hesitancy could threaten the efficiency of COVID-19 vaccines once they become commercially available worldwide (French et al 2020). There are contrasting reports of gender effects in the literature, wherein some males were more likely to accept the vaccine (Malik et al 2020), compared to others reporting higher acceptance among females (Lazarus et al 2020; Al-Mohaithef & Padhi 2020). In our study, males were more likely to take the vaccine, in agreement with studies reported elsewhere (Malik et al 2020). Interestingly, males were more likely to participate in COVID-19 vaccine clinical trials compared to females in 2020 (Abu-Farha et al 2020). The low acceptance level of COVID-19 vaccines among them can be attributed to multi factors, some of which are shared with the wide global community. The current study revealed that half of the participants had safety concerns about the vaccine once it being available as indicated by their concerns about related side effects. This is consistent with Pogue and colleagues finding where the majority of participants (~63%) in the USA stated that they were worried about the side effects of the COVID-19 vaccines (Pogue et al 2020). Most of the participants in the current study stated that receiving the vaccine is important to protect against COVID-19. However, almost half of them agreed that most people would refuse to take the vaccine. This discrepancy could be due to their concerns about the vaccine's side effects. Our results supported such perceived viewpoints, where those who did not believe in a conspiracy behind COVID-19 were more likely to accept COVID-19 vaccines. An important factor to consider when exploring vaccine acceptability is vaccine convenience in terms of its availability and affordability (MacDonald 2015).

## CONCLUSION

The determinants of vaccine uptake across the globe show strong consistency, with being male or having fewer years of education associated with decreased chances of uptake. Positive information-seeking behaviours and trusting health-care workers more than other sources such as one's social circle for medical and health advice were associated with increased chances of uptake. Results from our survey can inform the need for further research, to explore why certain countries might experience sudden increases or decreases in confidence. We have highlighted countries with marked decreases in percentages reporting that

they strongly agree that vaccines are safe and countries with significant increases in those strongly disagreeing that vaccines are safe. These countries are candidates for more nuanced follow-up surveys to understand the precise drivers of confidence and the link between confidence and uptake.

There is a study limitation to note. As not all surveys used have consistent responses, we have made a key assumption that, presented with different options between the extreme categories of "strongly agree" and "strongly disagree" (which are consistent across all surveys), respondents with the strongest sentiment will fall into one of these extreme groups regardless of additional categories. While this approach probably allows meaningful comparison across surveys—although it needs testing for validation—it pools vaccination beliefs among those without the strongest beliefs, masking potentially key information. Finally, owing to low case counts of respondents who have not had their children vaccinated and the varying religious groups across countries, religious groups were recoded into the largest and minority groups to extract results from our regression analysis. In many settings, more nuanced regression findings are possible, and a comprehensive regression analysis could reveal more informative country-specific determinants of vaccine uptake.

Further research should investigate the link between political polarisation, religious extremism, and populism and vaccination beliefs to better understand these complex ties. Having a common metric of confidence and a baseline for comparison is crucial to understanding these changing trends over time, which can serve as an early warning system to prompt needed intervention to avert drops in vaccine confidence and acceptance.

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The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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