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Willingness to Take the COVID-19 Vaccine as Reported Nine Months after the Pandemic Outbreak: A Cross-National Study

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Abstract: Although vaccination has been identified as an effective measure of reducing the spread of COVID-19, hesitancy to obtain a vaccine for COVID-19 has been shared. The aim of this cross-national study was to examine (i) the willingness in the general population to take the COVID-19 vaccine nine months after the pandemic outbreak and (ii) the willingness to take the vaccine in relation to sociodemographic variables, whether one has experienced COVID-19 infection, concerns about health and family, and trust in the authorities' information about the pandemic. A cross-sectional survey design was used to collect data online in Norway, the UK, the USA, and Australia. Chi-Square tests or Fisher's Exact test were used to analyze the data. Logistic regression analysis was used to assess direct associations between the independent variables and the outcome. Within the total sample (n = 3474), living in a city, having a college education, being concerned about your own health and the health of next of kin, and trusting information provided by authorities increased the likelihood of reporting willingness to take the COVID-19 vaccine. Across all countries, participants who reported trust in the authorities' information about COVID-19 demonstrated a significantly higher plausibility of taking the COVID-19 vaccine.

Keywords: coronavirus; cross-national study; pandemic; trust; vaccine

1. Introduction

COVID-19 has caused adverse impacts on the physical, mental, financial, and social health of individuals and communities internationally. Studies have attempted to measure the level and extent of the impact since the spread of COVID-19 was declared a public health crisis (Clemente-Suárez et al. 2021; Zahid and Perna 2021; USDHHS 2020). Public health departments across the world have provided guidelines and recommendations to prevent the spreading of the coronavirus. Adults with underlying medical conditions such as cancer, obesity, heart conditions, and asthma were identified as having increased risk of severe illness if contracting the coronavirus. COVID-19 spread rapidly resulting in

many deaths due to contracting the virus (Zahid and Perna 2021). Medical research communities in many countries have been working to identify treatment options that minimize the negative impacts of this virus on the health of individuals.

Screening, contact tracing, and prevention measures such as handwashing, social distancing, and immunizations are public health strategies to control the spread of infectious diseases (Althoff et al. 2020; Hochberg and van Seventer 2016). Developing and implementing a vaccine was prioritized as one primary method of managing the frequency of lethal impacts of the virus (Bloom et al. 2020). In the Fall 2020, many promising vaccines were being tested in different countries, and beginning in late December 2020, vaccines began to be distributed to immunocompromised individuals, older individuals, and health care workers. Although vaccination has been identified as an effective measure of reducing the spread of COVID-19, 65% of respondents in a survey in the UK reported that they would not voluntarily engage in a vaccination process (O'Callaghan 2020). Lack of trust in the government, concerns of side effects, time taken to develop and test the vaccine, and belief of limited inclusion of diverse populations in studies can impact the public perception of obtaining the vaccine when determined to be available to the public (Price et al. 2021; Ballantyne and Ganguli-Mitra 2021; O'Callaghan 2020; Moon 2020; Latkin et al. 2021).

Social demographics, attitudes, beliefs, and social norms can influence a person's willingness to obtain a vaccine (Bennett et al. 2011; Zimmerman et al. 2003; Price et al. 2021). The Theory of Planned Behavior suggests that attitudes and beliefs influence intention (e.g., the intention to take the vaccine), which in turn is a strong predictor of specific health behaviors (actually taking the vaccine) (Ajzen 2002; Hagger et al. 2016; Li et al. 2021). Health related attitudes and beliefs vary across sociodemographic segments of the population. Different sociodemographic groups may be exposed to diverse sources of influence and may be differently prepared to analyze and review the sources (e.g., on social media). Previous findings have found that rates for influenza vaccination were higher among females, persons of older age, and persons with higher education levels (Bennett et al. 2011). Investigating willingness or hesitancy to participate in vaccination for COVID-19 is critical due to the public and social health implications of the continuous spread of the virus. Identifying groups to engage with and address hesitancy to take a vaccine for COVID-19 can increase rates of vaccination and improve public health.

2. Methods

2.1. Design and Procedures

The study had a cross-sectional survey design. The link to the survey was distributed through social media in each of the involved countries between 24 October and 29 November 2020. A landing site for the survey was established at the researchers' universities; OsloMet—Oslo Metropolitan University, Norway; University of Michigan, USA; Northumbria University, UK; and the University of Queensland, Australia. The initiator of the project was AØG from OsloMet. Due to ethical considerations and permissions in each of the countries, each country had their own project lead. The survey was simultaneously co-developed by the researchers in two languages, Norwegian and English, and was based on a previous survey conducted by the research group in the early phase (April 2020) of the pandemic outbreak (Geirdal et al. 2021; Ruffolo et al. 2021). Language and cultural differences were considered during the survey development process.

2.2. Inclusion and Exclusion

To be included in the study, participants had to be 18 years or older, have access to the Internet, understand Norwegian or English, and live in Norway, the USA, the UK, or Australia. There were no exclusion criteria.

2.3. Measures

2.3.1. Sociodemographic Characteristics

Sociodemographic variables included age group (18–29 years, 30–39 years, 40–49 years, 50–59 years, 60–69 years, 70 years and above), gender identity (male, female, other, prefer not to respond), highest completed education level (high school or associated/technical degree or lower, bachelor's degree, master's/doctoral degree), size of place of residence (rural or farming area, town or suburb, or city) and employment status (having full-time or part-time employment or not).

2.3.2. Infection

Infection was measured with two items: "Have you been infected by COVID-19?" and "Has someone in your closest family been infected with COVID-19?" For both items, response options were 'yes' or 'no'.

2.3.3. Trust in Public Authorities

Trust in the public authorities was measured with the following question: "Do you have trust in the government and public authorities' information about the COVID-19 pandemic?" The question had the response options 'yes' and 'no'.

2.3.4. Pandemic-Related Concerns

Pandemic-related concerns were assessed with two separate items related to health and next of kin. The items were phrased as follows: "During the ongoing COVID-19 pandemic, are you worried about …", followed by "your own health" and "your next of kin". Response options were on a 0–4 rating scale, indicating totally disagree (0), disagree (1), neither agree or disagree (2), agree (3), and totally agree (4).

2.3.5. Willingness to Take the COVID-19 Vaccine

Willingness to take the COVID-19 vaccine was measured with one item: "When a COVID-19 vaccine becomes available, how likely would it be you would get the vaccine?" For the purposes of this study, response options were collapsed into 'likely or very likely' (1) and 'unsure or not likely' (0). The term 'willingness to take the COVID-19 vaccine' refers to being likely or very likely to take the vaccine.

2.4. Statistical Analysis

Analyses were performed for the total sample and for each of the four countries. Categorical independent variables were cross tabulated with willingness to take the vaccine, and differences in proportions were examined with Chi-Square tests or Fisher's Exact test. Logistic regression analysis was used to assess direct associations between the independent variables and the outcome, while concurrently controlling for covariation between all included variables. The independent variables were entered in one step: age group, gender, size of place of residence, education level, employment status, infection status, infection in the family, concerns about health, concerns about family, and trust in the information provided by public authorities. Odds ratio (OR) was used as effect size, and the 95% confidence interval of the OR was reported. Statistical significance was set at $p < 0.05$. Missing values were handled by case-wise deletion.

2.5. Ethics

The data collected in this study were anonymous. The researchers adhered to all relevant regulations in their respective countries concerning ethics and data protection. The study was approved by OsloMet (20/03676), and the regional committees for medical and health research ethics (REK; ref. 132066) in Norway, reviewed by the University of Michigan Institutional Review Board for Health Sciences and Behavioral Sciences (IRB HSBS)

and designated as exempt (HUM00180296) in the USA, by Northumbria University Health Research Ethics (HSR1920–080) in the UK, and (HSR1920–080 2020000956) in Australia.

3. Results

Participants included 3474 individuals from Norway (n = 547, 15.7%), the USA (n = 2130, 61.3%), the UK (n = 640, 18.4%), and Australia (n = 157, 4.5%). In the total sample, there was a spread across age groups, with a lower proportion of participants older than 70 years. There were more women (73.3% women versus 22.2% men), with 48 (1.4%) participants reporting "other" gender identity and 36 (1.0%) preferred not to say. Seventy-one percent of respondents had a bachelor's degree or higher levels of education. Full-time or part-time employment was held among 66.3% of respondents. In addition, 15% reported living in a rural/farming area, 46% in town/suburb, and 37% in the city.

3.1. Willingness to Take the Vaccine in Sample Subgroups

Table 1 displays the number and proportions of participants who reported to be likely or very likely to take the COVID-19 vaccine, in the total sample and for each of the four countries. Respondents that were in the older age categories (p = 0.001), female (p < 0.001), living in urban settings (p < 0.001), holders of degrees beyond high school (p < 0.001), employed (p < 0.05), not infected by COVID-19 personally (p < 0.001), nor having someone within their family infected (p < 0.001), and trusting in public authorities' information (p < 0.001) were significantly more likely to report a willingness to take the COVID-19 vaccine.

Table 1. Number and proportions of participants likely or very likely to take the COVID-19 vaccine.

Characteristics	Total Sample	USA	UK	Norway	Australia
Age group	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
All	2024 (65.1)	1181 (63.0)	367 (66.6)	380 (69.5)	96 (71.1)
18–29 years	442 (69.8)	293 (72.2)	82 (67.2)	51 (59.3)	16 (84.2)
30–39 years	463 (65.7)	322 (67.5)	66 (61.7)	60 (59.4)	15 (75.0)
40–49 years	334 (59.4)	162 (55.5)	81 (63.3)	78 (63.9)	13 (65.0)
50–59 years	274 (62.0)	106 (53.5)	76 (67.9)	76 (74.5)	16 (53.3)
60–69 years	284 (64.0)	163 (57.4)	38 (71.7)	60 (80.0)	23 (71.9)
70 years +	207 (71.6)	121 (62.4)	21 (91.3)	55 (90.2)	10 (90.9)
p	0.001	< 0.001	0.12	<0.001	0.12
Gender identity					
Male	420 (59.5)	231 (51.2)	75 (70.1)	97 (82.2)	17 (56.7)
Female	1553 (66.8)	911 (66.8)	286 (65.6)	281 (66.1)	75 (74.3)
p	<0.001	<0.001	0.38	0.001	0.06
Size of place					
Rural/farming	247 (53.1)	151 (48.4)	71 (64.5)	24 (57.1)	nr
Town/suburb	940 (64.5)	663 (63.4)	133 (67.5)	133 (67.5)	11 (61.1)
City	831 (70.4)	367 (70.8)	159 (66.3)	222 (72.3)	83 (72.2)
p	<0.001	<0.001	0.87	0.10	0.51
Education level					
High school/technical degree or lower	437 (51.2)	213 (43.8)	112 (58.9)	88 (62.4)	24 (66.7)
Bachelor's degree	752 (68.1)	457 (68.1)	131 (68.9)	129 (66.5)	35 (71.4)
Master's/doctoral degree	834 (72.5)	511 (71.2)	123 (72.4)	163 (76.9)	37 (74.0)
p	<0.001	<0.001	<0.05	<0.01	0.76
Employment					
No employment	620 (62.6)	382 (60.9)	92 (61.7)	115 (67.6)	31 (70.5)

Full-time or part-time employed	1397 (66.3)	793 (64.0)	275 (68.4)	265 (70.3)	64 (71.1)
p	<0.05	0.19	0.14	0.53	0.94
Infected					
Not infected	1899 (65.9)	1107 (64.1)	324 (66.8)	373 (69.5)	95 (72.5)
nfected	124 (55.1)	73 (50.0)	43 (65.2)	7 (70.0)	nr
p	<0.001	0.001	0.79	>0.99	0.19
Infection in the family					
No infection in the family	1630 (66.8)	900 (65.1)	279 (66.4)	360 (70.3)	91 (72.2)
Infection in the family	394 (59.2)	281 (57.1)	88 (67.2)	20 (57.1)	5 (62.5)
p	< 0.001	< 0.01	0.87	0.10	0.69
Trust in public authorities' information					
Yes	1256 (79.4)	635 (83.1)	158 (76.7)	373 (74.3)	90 (82.6)
No	765 (50.2)	543 (49.1)	209 (60.6)	7 (15.6)	6 (23.1)
p	<0.001	<0.001	<0.001	< 0.001	<0.001

Note. Statistical tests are Chi-Square test and Fisher's Exact test in cases where there were cells with expected count less than 5. *p*-values refer to differences within the total sample and within each of the subsamples. nr: not reported due to small cell sizes.

A total of 65% of the total sample reported being likely or very likely to take the COVID-19 vaccine (USA 63%, UK 66.6%, Norway 69.5%, and Australia 71.1%). Among participants in the USA, the variables significantly associated with the willingness to take the vaccine mirrored the pattern shown for the total sample, with the exception of employment status. Among the UK participants, higher educational levels ($p < 0.001$) and trust in public authorities' information ($p < 0.001$) were associated with willingness to take the vaccine. Among the Norway participants, willingness to take the vaccine was associated with higher age ($p < 0.001$), female gender ($p < 0.001$), higher educational levels ($p < 0.05$), and trust in public authorities' information ($p < 0.001$). Among participants from Australia, willingness to take the vaccine was associated with trust in public authorities' information ($p < 0.001$).

3.2. Associations with Willingness to Take the COVID-19 Vaccine

Table 2 displays the adjusted odds ratios for willingness to take the COVID-19 vaccine. When controlling for all independent variables, a greater likelihood of being willing to take the COVID-19 vaccine was found among respondents residing in a city (OR: 1.45, $p < 0.01$), having a bachelor's degree (OR: 2.03, $p < 0.001$) or higher (OR: 2.32, $p < 0.001$), expressing concerns about their own health (OR: 1.26, $p < 0.001$) or the health of family (OR: 1.13, $p < 0.01$), and having trust in information provided by authorities (OR: 3.83, $p < 0.001$).

Table 2. Adjusted associations with being likely or very likely to take the COVID-19 vaccine.

Independent Variables	Total Sample	USA	UK	Norway	Australia
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Higher age	1.05 (0.99–1.11)	0.98 (0.90–1.06)	1.13 (0.97–1.33)	1.46 (1.23–1.74) ***	0.91 (0.61–1.37)
Female gender	1.04 (0.84–1.27)	0.94 (0.71–1.23)	1.31 (0.78–2.20)	2.30 (1.23–4.29) ***	1.63 (0.36–7.44)
Town/suburb [1]	1.25 (0.98–1.60)	1.43 (1.04–1.95) *	1.17 (0.67–2.04)	1.20 (0.52–2.76)	-
City [1]	1.45 (1.12–1.89) **	1.81 (1.27–2.58) **	1.17 (0.68–2.04)	1.72 (0.76–3.88)	-
Bachelor's degree education [2]	2.03 (1.64–2.51) ***	2.43 (1.82–3.24) ***	1.87 (1.14–3.06) *	0.98 (0.55–1.74)	1.38 (0.34–5.58)
Master's/doctoral degree education [2]	2.32 (1.86–2.88) ***	2.73 (2.04–3.75) ***	1.83 (1.11–3.01) *	1.07 (0.59–1.95)	1.21 (0.33–4.51)
Having employment	1.13 (0.92–1.38)	0.88 (0.67–1.16)	1.46 (0.91–2.33)	1.78 (1.02–3.09) *	0.84 (0.24–2.96)
Have been infected	0.92 (0.65–1.30)	0.70 (0.45–1.09)	1.21 (0.63–2.34)	5.46 (0.59–51.00)	0.46 (0.10–20.30)

Family member has been infected	0.82 (0.66–1.02)	0.73 (0.56–0.95) *	1.12 (0.69–1.82)	0.49 (0.19–2.29)	1.76 (0.13–24.00)
Concerns about own health	1.26 (1.16–1.38) ***	1.29 (1.15–1.44) ***	0.88 (0.72–1.07)	1.19 (0.92–1.54)	1.14 (0.66–1.97)
Concerns about next of kin	1.13 (1.05–1.23) **	1.14 (1.03–1.27) *	1.05 (0.88–1.26)	1.31 (1.03–1.67) *	1.35 (0.81–2.25)
Trust in authorities' information	3.83 (3.21–4.57) ***	4.65 (3.63–5.96) ***	1.97 (1.28–3.03) **	20.7 (7.33–58.63) ***	29.46 (6.03–143.97) ***
Cox Snell R^2 (Nagelkerke R^2)	**14.3% (19.8%)**	**20.1% (27.4%)**	**6.0% (8.3%)**	**20.0% (28.4%)**	**28.3% (40.3%)**

[1] Compared with 'rural or farming'. The distribution on this variable in the Australian subsample did not allow for estimating OR.[2] Compared with 'high school, technical degree, or lower'. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Across all countries, participants who reported trust in the authorities' information about COVID-19 demonstrated a significantly higher plausibility of taking the COVID-19 vaccine (US OR: 4.65, $p < 0.001$; UK OR: 1.97, $p < 0.01$; Norway OR: 20.7, $p < 0.001$; Australia OR: 29.46, $p < 0.001$).

4. Discussion

4.1. Main Summary of Results

Within the total sample, living in a city, having a college education, being concerned about your own health and the health of next of kin, and trusting information provided by authorities increased the likelihood of reporting willingness to take the COVID-19 vaccine.

4.2. Willingness to Take the COVID-19 Vaccine

In the whole sample, living in a city was associated with a higher likelihood of being willing to take the COVID-19 vaccine, as compared to living in a rural or farming area. Vaccination rates have been reported to be lower among individuals who reside in rural towns than those in urban communities (Swiecki-Sikora et al. 2019; Zhai et al. 2020). Bennett et al. (2011) reported that even with specific strategies to increase the administration of influenza vaccines in rural communities, disparities in vaccination rates continued. Previous findings of reasons for this demographic's declining vaccines included a lack of trust in the efficacy and a lack of need (Ganczak et al. 2017; Zhai et al. 2020, Macintosh et al. 2014). Previous studies have provided knowledge that individuals that do not believe vaccination is effective to prevent an illness will not be likely to commit to vaccination coverage (Abbas et al. 2018; CDC 2018; Fiebach and Viscoli 1991). Limited access to clinics to provide information in a personal and confidential way may influence the belief of efficacy in rural communities (Bennett et al. 2011). Lower population rates in rural communities may attribute to a perceived lack of need, as individuals in urban communities are often in heavily populated spaces that requires frequent interactions with others (Macintosh et al. 2014). Thus, our study is in line with previous studies suggesting lower vaccination rates in rural areas, and it points towards lower trust in the information provided by public authorities as one important explanation for the lower vaccination rates in such areas. Possibly, as demonstrated by Bennett et al. (2011), ensuring an understanding of the rates of effectiveness, benefits, and safety may be important for increasing the trust people have and may in turn impact on vaccination rates in rural communities.

Overall, respondents without a college education were less likely to be willing to obtain the COVID-19 vaccine. Lower rates of trust in vaccinations have been reported by people with lower levels of education in previous studies (Steens et al. 2020; Bennett et al. 2011; Macintosh et al. 2014). Although access to comprehensive information about the efficacy and components of vaccination procedures may be available to everyone, those with higher educational levels may be more inclined to evaluate the validity of information. Study participants with higher levels of education have been found to be more likely to engage in elective vaccinations for themselves and their children (Mora and Trapero-Bertran 2018). Reliance on information from a personal medical provider has been

identified as a contributing factor for willingness to be vaccinated, which may be associated with educational levels based on access to private insurance benefits offered through an employer (Fiebach and Viscoli 1991). Providing opportunities for individuals without a college education to access personal medical providers to provide comprehensive information regarding the efficacy and safety of the COVID-19 vaccine instead of using mass vaccine clinics may support individuals with lower levels of education opportunities to receive credible information and identifying ways to discern irrelevant or false information.

Being concerned for the health of yourself and a relative increased the likelihood of being willing to obtain the COVID-19 vaccine. This is consistent with previous studies that found personal concern for self and others as a rationale for individuals to make the decision to vaccinate to protect against an illness (Shim et al. 2012; Vietri et al. 2012). Individuals that have a concern are more likely to engage in behaviors that will prevent illness, while people that do not feel that there is a need to be concerned may not elect to obtain a preventative measure (Abbas et al. 2018).

Across all involved countries, trust in the information provided by public authorities was consistently associated with higher likelihood of being willing to obtain a COVID-19 vaccine. Trust in the medical advice and information received from the government determines the public compliance with the recommendations (Newton 2020; Jakovljevic et al. 2020; Wong and Jensen 2020; Guillon and Kergall 2020; OECD 2013). Effective communication cannot solely focus on providing information but must also include listening and tailoring the information to the concerns of individuals (Goldstein 2015). If public authorities are the primary source of information about COVID-19, then trust in the authorities is critical to increase the willingness to obtain the vaccine. Populations that have a historical distrust in medical institutions due to previous medical abuse continue to report a lack of trust in vaccines (Budhwani et al. 2021; Hall et al. 2021, Jamison et al. 2019). Bennett and colleagues highlight that receiving information from private medical professionals increases comfort to be vaccinated, however, all health care professionals do not feel competent in communicating with patients who are hesitant to be vaccinated which leaves public authorities to be the primary source of information that is viewed as credible (Paterson et al. 2016; Shen and Dubey 2019). Improving the relationship between civilians and public authorities can increase the rates of willingness to obtain a COVID-19 vaccine.

4.3. Study Limitations

Although anyone within the four involved countries could participate, we may have a higher number of participants geographically located closer to our landing sites because of recruitment through the universities. Recruitment occurred solely through social media, which excludes individuals that do not have access to the Internet or do not utilize social media. The sample comprised a large proportion of women and participants were more often in the younger age groups. Due to the recruitment methods and demographics of the respondents, the results are therefore not representative of the population in the four countries. As the survey was open to an unlimited amount of people, we are unable to speak about response rates.

Trust was not operationally defined in the survey, so responses to items related to trust in government were based on the perception of the participant. Trust was measured in relation to the authorities' information about the COVID-19 pandemic, and we did not assess general trust. Therefore, we do not have information to compare our findings with the general levels of trust in the community of the participants, and thus rely on previous findings. There are pre-existing differences in the general levels of trust of the general population between the countries in our study, which may have increased or decreased due to how the government and authorities have responded to the pandemic (Dalton 2005; Easton 1975).

5. Conclusions

The aim of this cross-national study was to examine (i) the willingness in the general population to take the COVID-19 vaccine nine months after the pandemic outbreak, and (ii) the willingness to take the vaccine in relation to sociodemographic variables, whether one has experienced COVID-19 infection, concerns about health and family, and trust in the authorities' information about the pandemic. Respondents that were in the older age categories, female, living in urban settings, holders of degrees beyond high school, employed, not infected by COVID-19 personally or within their family, and trusting public authorities' information were significantly more likely to report a willingness to take the COVID-19 vaccine. Trusting information provided by authorities was the single variable that was associated with willingness to take the voluntary COVID-19 vaccine in each country, consistent with recommendations. Understanding variables consistent with being willing to obtain a COVID-19 vaccine can support professionals that engage in health care practice, policy development, and program implementation in identifying methods to increase the proportion of citizens being willing to take the COVID-19 vaccine. Because attitudes and beliefs influence behaviors, increasing trust among citizens is a public health intervention to prevent the future social, emotional, and financial challenges of COVID-19.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author by completion of the research project. The data are not publicly available due to the ongoing publication of the project.

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