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Vaccine hesitancy among communities in ten countries in Asia, Africa, and South America during the COVID-19 pandemic

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ABSTRACT

Vaccine hesitancy is considered one of the greatest threats to the ongoing coronavirus disease 2019 (COVID-19) vaccination programs. Lack of trust in vaccine benefits, along with concerns about side effects of the newly developed COVID-19 vaccine, might significantly contribute to COVID-19 vaccine hesitancy. The objective of this study was to determine the level of vaccine hesitancy among communities in particular their belief in vaccination benefits and perceived risks of new vaccines. An online cross-sectional study was conducted in 10 countries in Asia, Africa, and South America from February to May 2021. Seven items from the WHO SAGE Vaccine Hesitancy Scale were used to measure a construct of belief in vaccination benefit, and one item measured perceived riskiness of new vaccines. A logistic regression was used to determine which socio-demographic factors were associated with both vaccine hesitancy constructs. A total of 1,832 respondents were included in the final analysis of which 36.2% (range 5.6–52.2%) and 77.6% (range 38.3–91.2%) of them were classified as vaccine hesitant in terms of beliefs in vaccination benefits and concerns about new vaccines, respectively. Respondents from Pakistan had the highest vaccine hesitancy while those from Chile had the lowest. Being females, Muslim, having a non-healthcare-related job and not receiving a flu vaccination during the past 12 months were associated with poor beliefs of vaccination benefits. Those who were living in rural areas, Muslim, and those who did not

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received a flu vaccination during the past 12 months had relatively higher beliefs that new vaccines are riskier. High prevalence of vaccine hesitancy in some countries during the COVID-19 pandemic might hamper COVID-19 vaccination programs worldwide. Programs should be developed to promote vaccination in those sociodemographic groups with relatively high vaccine hesitancy.

Introduction

The current coronavirus disease 2019 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is a major threat to human civilization [1–3]. The pandemic has affected more than 246 million individuals resulting in the death of 4.99 million worldwide as of 2 November 2021 [4]. Although several vaccine candidates completed phase III clinical trials toward the end of 2020, most of the global vaccination drives were initiated only during the beginning of 2021 due to the lack of COVID-19 vaccine supply [5]. In addition to the limited vaccine supply and vaccine nationalism, vaccine hesitancy has significantly affected the vaccination drive, reducing the overall rate of COVID-19 vaccination globally [6]. According to the World Health Organization Strategic Advisory Group of Experts (WHO SAGE) Working Group, vaccine hesitancy is defined as the 'delay in acceptance or refusal of vaccination despite the availability of vaccination services' [7].

Vaccine hesitancy is prevalent globally in particular in low- and middle-income countries [8–11]. The lack of trust in vaccines, mistrust in government, belief in conspiracy theories and rumors, economics issues, fear of side effects, and the rapid spread of misinformation through social media have significantly contributed to COVID-19 vaccine hesitancy [12–16]. Among these, the general mistrust in available COVID-19 vaccines and exaggerated concerns about vaccine side effects are considered major barriers to achieving population immunity through vaccination [14]. In addition, certain pockets of the population, especially ethnic minorities in high income countries, remain unvaccinated due to concerns about the vaccine [17]. COVID-19 vaccine acceptance is reportedly high in the countries such as India, China, Ecuador, Vietnam, Malaysia, Indonesia, South Korea, and Denmark and low in some countries such as Serbia, France, Croatia, Paraguay, Kuwait, Jordan, the US, Russia, Italy, Poland, and Lebanon [9,10,18].

Vaccine hesitancy is considered one of the greatest threats to the ongoing COVID-19 vaccination programs [13]. Failure to achieve herd vaccination status may contribute to the emergence of novel SARS-CoV-2 variants that could affect the neutralizing potential of monoclonal antibodies and vaccine-elicited antibodies [19]. This could further affect the efficacy of COVID-19 vaccines and monoclonal antibodies that are currently used for passive immunization [19,20]. Therefore, it is essential to determine the level of vaccine hesitancy throughout the pandemic period so that sufficient measures can be taken to improve the acceptance of COVID-19 vaccines within diverse populations. This study aimed to determine the level of vaccine hesitancy among ten countries in Asia, Africa, and the Americas. Particularly, the investigation explored beliefs in vaccine benefits and concerns about the riskiness of new vaccines during the COVID-19 pandemic using the Vaccine Hesitancy Scale questionnaire from the WHO SAGE. To the best of our knowledge, this this the first study that assess the vaccine hesitancy during the COVID-19 pandemic using the WHO SAGE Vaccine Hesitancy Scale questionnaire covering diverse countries across three continents.

Methods

Study design and setting

An online cross-sectional study was conducted in 10 countries in Asia (Bangladesh, India, Iran, and Pakistan), Africa (Egypt, Nigeria, Sudan, and Tunisia), and South America (Brazil and Chile) from February to May 2021. These countries were chosen as representative of low- and middle-income countries from Asia, Africa, and South America. The invitations to participate in an anonymous online survey, hosted by SurveyMonkey, were distributed on communication platforms such as WhatsApp, Twitter, and Facebook. The potential respondents were provided with an introduction page consisting of information about the study, benefits, and risks of the study. Each respondent was asked to provide the consent to participate before the next page could be opened. To ensure the anonymity and confidentiality, the survey account could only be accessed by the principal investigator. The survey took approximately 15 minutes to be completed.

Study instrument and study variables

A set of questionnaires to collect information on sociodemographic data and vaccine hesitancy was prepared. Hesitancy domain was assessed using questions that were adopted from the WHO SAGE Vaccine Hesitancy Scale questionnaire, which has previously been used in cross-national study [21,22]. Eight items of WHO SAGE Vaccine Hesitancy Scale were used in this study to measure

the two constructs: (a) belief in vaccination benefits, which was based off seven items and (b) perceived risk of new vaccines construct, which came from one item. The detailed questions from the first construct were: (1) 'Vaccines are important for my health'; (2) 'Vaccines are effective'; (3) 'Being vaccinated is important for the health of others in my community'; (4) 'All routine vaccines recommended by the healthcare workers are beneficial'; (5) 'The information I receive about vaccines from the government is reliable and trustworthy'; (6) 'Getting vaccines is a good way to protect me from disease'; and (7) "Generally I follow vaccine recommendations from my doctor or healthcare provider. The possible responses for each statement were in 5-Likert scale from 'Strongly agree (1)' to 'Strongly disagree (5)' and the higher score indicating greater hesitancy. For each respondent, the score for belief in vaccination benefits construct ranged between 7 to 35 and a 75% cutoff was used to dichotomize the respondents to non-hesitant and hesitant (i.e. those with score 14 or less were classified as non-hesitant while those with 15 or more were classified as vaccine hesitant). For the second construct, respondents were asked to respond the statement 'New vaccines carry more risks than older vaccines.' The possible responses for the statement were in a 5-point Likert scale ranging from 'Strongly agree (5)' to 'Strongly disagree (1).' Those who had responses 1 and 2 were classified as non-hesitant while the options 3, 4, and 5 were categorized as hesitant.

The questionnaire also collected sociodemographic characteristics of the respondents, including age, gender, urbanicity, monthly household income, religion, and types of occupation. Age was grouped into five categories in a ten-years interval (less than 20, 21–30, 31–40, 41–50, and >51 years old). Self-declared urbanicity was divided into rural and urban. Monthly household income was grouped into <US$ 500, $500-$999, $1,000-$1,999, $2,000-$2,999, $3,000-$4,999, $5,000-$7,999, and ≥$8,000. The relevant currencies from each country were given during the survey in order to help the respondents. Religion was grouped as Islam, Protestant Christian (Protestant/Methodist/Lutheran/Baptist), Catholic, Hindu, Mormon, Greek or Russian Orthodox, Jewish, Buddhist, Atheist or agnostic, and other. Due to small number of samples for Mormon, Greek or Russian Orthodox, Jewish, and Buddhist, all were grouped into other. The respondents were also asked whether they were working in healthcare-related sectors such as a nurse, medical doctor, pharmacist, laboratory staff, and others and whether they had received a flu vaccination in the last in the past 12 months.

Statistical analysis

We used a logistic regression to determine the sociodemographic variables associated with both of constructs of vaccine hesitancy. In the univariate analysis, the associations between the potential variable and the vaccine hesitancy were determined separately. If the relationship between explanatory variables and the outcome had a p-value <0.25 in the univariate analysis, the explanatory variables were included in the adjusted multivariable analysis. The crude odds ratios (ORs) of univariate and adjusted odds ratios (aOR) of multivariable analyses were calculated using a reference group. All analyses were conducted using SPSS software (SPSS Inc., Chicago, IL, USA).

Ethics approval

The protocol of this study was approved by the Institutional Review Board of the Universitas Syiah Kuala & Zainoel Abidin Hospital (129/EA/FK-RSUDZA/2021) and National Health Research and Development Ethics Commission (KEPPKN) of the Ministry of Health of the Republic of Indonesia (#1171012P).

Results

Demographic characteristics

We received 1,849 responses from 10 countries from Asia, Africa, and South America of which 17 of them were excluded due to data incompleteness. A total of 1,832 respondents were included in the final analysis and most participants originated from India (365, 19.9%), Pakistan (270, 14.7%), and Sudan (204, 11.1%) (Table 1). More than half of the respondents (1029, 56.2%) were aged between 21 and 30 years old and 58.4% were female. The vast majority of the participants were living in urban areas (81.1%), with 38% earning less than $500 each month. More than half (55.5%) identified themselves as Muslims, followed by Hindus (14.6%) and Christians (10.9%). There were 853 (46.6%) participants working in healthcare-related sectors, such as doctor, nurse, pharmacist, laboratory staff and others; moreover, 380 (20.7%) had received a flu shot during the past 12 months (Table 1).

Belief in vaccination benefits and its determinants

In total, 36.2% (665 out of 1832) of the respondents were classified as vaccine hesitant based on their beliefs about vaccination benefits. Those from

Table 1. Unadjusted and adjusted logistic regression analyses showing factors associated with belief in vaccination benefits construct (*n* = 1832).

Variable	*n* (%)	Hesitant *n* (%)	Unadjusted OR (95% CI)	*p*–value	Adjusted OR (95% CI)	*p*–value
Country						
India *(R)*	365 (19.9)	126 (34.5)	1			
Brazil	125 (6.8)	7 (5.6)	0.11 (0.05–0.25)	<0.001**		
Chile	115 (6.3)	7 (6.1)	0.12 (0.06–0.27)	<0.001**		
Egypt	114 (6.2)	56 (49.1)	1.83 (1.20–2.80)	0.005*		
Bangladesh	160 (8.7)	56 (35.0)	1.02 (0.69–1.51)	0.915		
Iran	152 (8.3)	68 (44.7)	1.54 (1.04–2.26)	0.029*		
Nigeria	179 (9.8)	66 (36.9)	1.11 (0.76–1.61)	0.590		
Pakistan	270 (14.7)	141 (52.2)	2.07 (1.50–2.86)	<0.001**		
Sudan	204 (11.1)	71 (34.8)	1.01 (0.71–1.45)	0.946		
Tunisia	148 (8.1)	67 (45.3)	1.57 (1.06–2.32)	0.023*		
Age group (year)						
≤20 *(R)*	313 (17.1)	142 (45.4)	1		1	
21–30	1029 (56.2)	333 (32.4)	0.58 (0.45–0.75)	<0.001**	0.73 (0.54–0.97)	0.029*
31–40	298 (16.3)	122 (40.9)	0.84 (0.61–1.15)	0.270	1.18 (0.78–1.78)	0.437
41–50	129 (7.0)	51 (39.5)	0.79 (0.52–1.20)	0.261	1.07 (0.64–1.79)	0.803
>51	63 (3.4)	17 (27.0)	0.45 (0.24–0.81)	0.008*	0.75 (0.38–1.50)	0.414
Gender						
Male *(R)*	763 (41.6)	239 (31.3)	1		1	
Female	1069 (58.4)	426 (39.9)	1.45 (1.19–1.77)	<0.001**	1.41 (1.15–1.75)	0.001*
Urbanicity						
Rural *(R)*	346 (18.9)	133 (38.4)	1			
Urban	1486 81.1)	532 (35.8)	0.89 (0.70–1.14)	0.358		
Monthly household income (USD)						
<$500 *(R)*	697 (38.0)	256 (36.7)	1		1	
$500-$999	324 (17.7)	136 (42.0)	1.25 (0.95–1.63)	0.109	1.37 (1.03–1.82)	0.031*
$1,000-$1,999	214 (11.7)	67 (31.3)	0.79 (0.57–1.09)	0.148	1.00 (0.71–1.42)	0.998
$2,000-$2,999	163 (8.9)	50 (30.7)	0.76 (0.53–1.10)	0.147	1.09 (0.73–1.61)	0.686
$3,000-$4,999	140 (7.6)	42 (30.0)	0.74 (0.50–1.09)	0.130	0.96 (0.63–1.46)	0.851
$5,000-$7,999	107 (5.8)	39 (36.4)	0.99 (0.65–1.51)	0.955	1.12 (0.71–1.77)	0.616
≥$8,000	187 (10.2)	75 (40.1)	1.15 (0.83–1.61)	0.397	1.65 (1.14–2.40)	0.009*
Religion						
Islam *(R)*	1016 (55.5)	446 (43.9)	1		1	
Christian	200 (10.9)	71 (35.5)	0.70 (0.51–0.96)	0.029*	0.64 (0.46–0.90)	0.010*
Catholic	139 (7.6)	20 (14.4)	0.22 (0.13–0.35)	<0.001**	0.22 (0.13–0.36)	<0.001**
Hindu	268 (14.6)	84 (31.3)	0.58 (0.44–0.78)	<0.001**	0.58 (0.42–0.80)	0.001*
Atheist or agnostic	95 (5.2)	12 (12.6)	0.19 (0.10–0.34)	<0.001**	0.17 (0.09–0.32)	<0.001**
Others	114 (6.2)	32 (28.1)	0.50 (0.33–0.76)	0.001*	0.48 (0.31–0.75)	0.001*
Healthcare related job						
Yes *(R)*	853 (46.6)	261 (30.6)	1		1	
No	979 (53.4)	404 (41.3)	1.59 (1.31–1.93)	<0.001**	1.63 (1.31–2.01)	<0.001**
Occupation						
Employed for wages *(R)*	459 (25.1)	153 (33.3)	1		1	
Self-employed	177 (9.7)	69 (39.0)	1.28 (0.89–1.83)	0.181	1.29 (0.88–1.89)	0.188
Out of work for 1 year or more	42 (2.3)	16 (38.1)	1.23 (0.64–2.36)	0.533	1.10 (0.55–2.21)	0.783
Out of work for less than 1 year	38 (2.1)	14 (36.8)	1.17 (0.59–2.32)	0.660	1.51 (0.73–3.14)	0.269
Homemaker	35 (1.9)	17 (48.6)	1.89 (0.95–3.77)	0.071	1.73 (0.82–3.65)	0.148
Student	1057 (57.7)	388 (36.7)	1.16 (0.92–1.46)	0.208	1.08 (0.79–1.47)	0.637
Retired or unable to work	24 (1.3)	8 (33.3)	1.00 (0.42–2.39)	1.000	0.97 (0.39–2.43)	0.956
Received a flu vaccination during the past 12 months						
Yes *(R)*	380 (20.7)	106 (27.9)	1		1	
No	1452 (79.3)	559 (38.5)	1.62 (1.26–2.07)	<0.001**	1.45 (1.11–1.89)	0.007*

*Significant at p < 0.05
**Significant at p < 0.001
R: reference group

Pakistan, Egypt, and Tunisia had the highest percentage: 52.2%, 49.1%, was 45.3%, respectively (Table 1). Respondents from Chile and Brazil had the lowest vaccine hesitancy percentages with 6.3% and 6.8%, respectively. Country, age group, gender, religion, healthcare-sector related job, and experience of flu vaccination were all associated with vaccine hesitancy (Table 1). The highest percentage of the vaccine hesitancy was reported among the respondents within the youngest age group while the oldest group had the lowest percentage. Females had 1.4 times the odds of being vaccine hesitant compared to males (aOR: 1.41; 95% CI: 1.15–1.75). Compared to Muslim, those who were Protestant Christians (aOR: 0.64; 95% CI: 0.46–0.90), Catholic (aOR: 0.22; 95% CI: 0.13–0.36), Hindus (aOR: 0.58; 95% CI: 0.42–0.80), and atheist or agnostic (aOR: 0.17; 95% CI: 0.09–0.32) were less vaccine hesitant. In addition, participants who were working in non-healthcare-related job had 1.6 times greater odds of being vaccine hesitant compared to those

who were working in medical sectors, aOR: 1.63; 95% CI: 1.31–2.01. Those who had not received a flu vaccination during the past 12 months were also more vaccine hesitant compared to those who had with an aOR of 1.35 (95% CI: 1.03–1.79). Urbanicity, monthly household income and type of occupation had no association with vaccine hesitancy (Table 1).

Perceptions of riskiness of new vaccine and its determinants

In total, 1422 (77.6%) respondents had vaccine hesitancy in terms of perceptions of the riskiness of new vaccines. The highest percentage of vaccine hesitancy was found in Egypt (91.2%) followed by Pakistan (90.7%), and Tunisia (87.2%) while the lowest was in Chile (38.3%) followed by Brazil (49.6%) (Table 2). Country, age group, gender, urbanicity, monthly income, religion, and experience of flu vaccination were associated with vaccine hesitancy (Table 2). The oldest age group had the lowest percentage of hesitant respondents and had lower odds of being vaccine hesitant compared to the youngest age group in the univariate (aOR: 0.49; 95% CI: 0.27–0.88) but not multivariable analysis. In the univariate analysis, females had higher odds of being hesitant compared to males (aOR: 1.33; 95% CI: 1.07–1.66) but this was not significant in multivariable analyses.

Those living in the urban areas were less hesitant compared to those living in rural areas (aOR: 0.70 and 95% CI: 0.51–0.97). In the univariate analyses, monthly household income was associated with vaccine hesitancy, those who earned less had higher odds of being vaccine hesitant compared to those who earned more (<$500 vs. $2,000-$2,999 or $3,000-$4,999). However, multivariable analyses did not maintain these associations as significant. Compared to Muslims, those who identified as not being Muslim were less vaccine hesitant. Compared to those who had received a flu vaccination during the past 12 months, those who had not received were more vaccine hesitant (aOR: 1.35; 95% CI: 1.03–1.7). Having a healthcare-related job and type of occupation had no significant association with vaccine hesitancy based on their perception of the risks of new vaccines (Table 2).

Discussion

The global roll-out of the COVID-19 vaccine not only will require access to the vaccine but also widespread acceptance of a relatively new vaccine [23]. Currently, access to COVID-19 vaccines is limited in many low- or middle-income countries, and we identified issues with vaccine hesitancy that could impede uptake of the COVID-19 vaccine. In a multinational study, we found that being female, Muslim, having a non-healthcare-

related job, and not receiving a flu vaccination during the past 12 months were associated with vaccine-hesitancy (i.e. poor beliefs in vaccination benefits).

The relationship between vaccine acceptance or hesitancy and gender is considered complex [24]. While some studies have reported gender-related differences in COVID-19 vaccine acceptance [10,11,25,26], others have not [27]. In the case of a COVID-19 vaccine, a study among Greek adults found that vaccine hesitancy was found to be more pronounced in females and less educated individuals [28], and in a study in Detroit, Michigan, women were more sensitive to not accepting a less effective vaccine than men [29]. A study among the general population of Arabian countries showed that females, non-healthcare workers, and those who do not get a flu vaccination were more hesitant to take the vaccine [30]. Overall, these results pose a special concern since and women play an important role in vaccination decision for children [31,32] and the decisions can influence other within the same household [29]. The exact mechanism for why there are gendered differences in vaccine hesitancy is unknown, but it could be that some women of childbearing age express concerns about vaccines [33,34]. Given limited information from initial clinical trials about safety and effectiveness of COVID-19 vaccines in pregnant women.

Vaccine hesitancy will be comparatively lower in healthcare professionals (physicians, physician assistants, nurses, and others) due to their in-depth understanding of vaccines and their efficacy [35,36]. Healthcare professionals are considered the most trusted advisor, having a direct influence on the vaccination decisions of the public [10,37,38]. The lack of knowledge and understanding about the mechanism, risk, and safety of vaccines partly explains the reason for higher vaccine hesitancy in a population with a non-healthcare-related job. Therefore, strategies have to be formulated to increase knowledge and awareness of the benefits of vaccination using audiovisual aids by targeting individuals with a non-healthcare-related job. In addition, the individuals not receiving a flu vaccination during the past 12 months also exhibited vaccine hesitancy, indicating a negative perception about vaccinations in general. A previous study also has identified a link between influenza vaccination and COVID-19 vaccine acceptance [39].

Vaccine hesitancy in Muslim-populated countries such as Afghanistan, Malaysia, and Pakistan were previously linked to an increase of vaccine-preventable diseases [40]. Over the years, the spread of incorrect information on vaccines and vaccination by the anti-vaccination movement has significantly contributed to the high rate of vaccine hesitancy within Muslim communities [40]. The same scenario is observed in our study, contributing to higher vaccine hesitancy among

Table 2. Unadjusted and adjusted logistic regression analyses showing factors associated with perceived risk of new vaccines construct (n = 1832).

Variable	n (%)	Hesitant n (%)	Unadjusted OR (95% CI)	p–value	Adjusted OR (95% CI)	p–value
Country						
India (R)	365 (19.9)	290 (79.5)	1			
Brazil	125 (6.8)	62 (49.6)	0.26 (0.17–0.39)	<0.001*		
Chile	115 (6.3)	44 (38.3)	0.16 (0.10–0.25)	<0.001**		
Egypt	114 (6.2)	104 (91.2)	2.69 (1.34–5.40)	0.005*		
Bangladesh	160 (8.7)	128 (80.0)	1.03 (0.65–1.64)	0.886		
Iran	152 (8.3)	118 (77.6)	0.90 (0.57–1.42)	0.644		
Nigeria	179 (9.8)	148 (82.7)	1.24 (0.78–1.96)	0.372		
Pakistan	270 (14.7)	245 (90.7)	2.53 (1.56–4.11)	<0.001**		
Sudan	204 (11.1)	154 (75.5)	0.80 (0.53–1.20)	0.274		
Tunisia	148 (8.1)	129 (87.2)	1.76 (1.02–3.03)	0.043*		
Age group (year)						
≤ 20 (R)	313 (17.1)	248 (79.2)	1		1	
21–30	1029 (56.2)	799 (77.6)	0.91 (0.67–1.24)	0.553	0.94 (0.67–1.32)	0.725
31–40	298 (16.3)	232 (77.9)	0.92 (0.63–1.36)	0.678	1.06 (0.65–1.71)	0.821
41–50	129 (7.0)	102 (79.1)	0.99 (0.60–1.64)	0.969	1.16 (0.63–2.11)	0.641
>51	63 (3.4)	41 (65.1)	0.49 (0.27–0.88)	0.016*	0.63 (0.32–1.26)	0.195
Gender						
Male (R)	763 (41.6)	570 (74.7)	1		1	
Female	1069 (58.4)	852 (79.7)	1.33 (1.07–1.66)	0.012*	1.25 (0.99–1.58)	0.066
Urbanicity						
Rural (R)	346 (18.9)	290 (83.8)	1		1	
Urban	1486 (81.1)	1132 (76.2)	0.62 (0.45–0.84)	0.002*	0.70 (0.51–0.97)	0.029*
Monthly household income (USD)						
<$500 (R)	697 (38.0)	564 (80.9)	1		1	
$500-$999	324 (17.7)	254 (78.4)	0.86 (0.62–1.18)	0.347	0.98 (0.70–1.39)	0.924
$1,000-$1,999	214 (11.7)	162 (75.7)	0.74 (0.51–1.06)	0.098	1.03 (0.69–1.52)	0.900
$2,000-$2,999	163 (8.9)	117 (71.8)	0.60 (0.41–0.89)	0.010*	0.85 (0.56–1.29)	0.440
$3,000-$4,999	140 (7.6)	101 (72.1)	0.61 (0.40–0.93)	0.020*	0.88 (0.56–1.38)	0.579
$5,000-$7,999	107 (5.8)	84 (78.5)	0.86 (0.52–1.42)	0.557	1.09 (0.64–1.85)	0.751
≥$8,000	187 (10.2)	140 (74.9)	0.70 (0.48–1.03)	0.069	0.94 (0.62–1.44)	0.784
Religion						
Islam (R)	1016 (55.5)	855 (84.2)	1		1	
Christian/Protestant/Methodist/Lutheran/Baptist	200 (10.9)	153 (76.5)	0.61 (0.42–0.89)	0.009*	0.63 (0.43–0.92)	0.017*
Catholic	139 (7.6)	88 (63.3)	0.33 (0.22–0.48)	<0.001**	0.39 (0.26–0.59)	<0.001**
Hindu	268 (14.6)	209 (78.0)	0.67 (0.48–0.93)	0.018*	0.69 (0.48–1.00)	0.051
Atheist or agnostic	95 (5.2)	45 (47.4)	0.17 (0.11–0.26)	<0.001**	0.19 (0.12–0.30)	<0.001**
Others	114 (6.2)	72 (63.2)	0.32 (0.21–0.49)	<0.001**	0.35 (0.23–0.54)	<0.001**
Healthcare related job						
Yes (R)	853 (46.6)	668 (78.3)	1			
No	979 (53.4)	754 (77.0)	0.93 (0.74–1.16)	0.507		
Occupation						
Employed for wages (R)	459 (25.1)	343 (74.7)	1		1	
Self-employed	177 (9.7)	142 (80.2)	1.37 (0.90–2.10)	0.145	1.30 (0.83–2.03)	0.248
Out of work for 1 year or more	42 (2.3)	35 (83.3)	1.69 (0.73–3.91)	0.219	1.62 (0.67–3.90)	0.281
Out of work for less than 1 year	38 (2.1)	30 (78.9)	1.27 (0.57–2.85)	0.564	1.21 (0.52–2.80)	0.661
Homemaker	35 (1.9)	28 (80.0)	1.35 (0.58–3.18)	0.488	1.41 (0.57–3.52)	0.459
Student	1057 (57.7)	825 (78.1)	1.20 (0.93–1.55)	0.158	1.00 (0.71–1.40)	0.986
Retired or unable to work	24 (1.3)	19 (79.2)	1.29 (0.47–3.52)	0.625	1.15 (0.40–3.26)	0.797
Received a flu vaccination during the past 12 months						
Yes (R)	380 (20.7)	268 (70.5)	1		1	
No	1452 (79.3)	1154 (79.5)	1.62 (1.26–2.09)	<0.001**	1.35 (1.03–1.79)	0.032*

*Significant at p < 0.05
**Significant at p < 0.001
R: reference group

Muslim participants. High vaccine hesitancy might as the result of conspiracy theories sprouted through social media. In case of COVID-19 vaccination, the claim of political figures stating that COVID-19 is a conspiracy against Muslim countries has significantly contributed to COVID-19 vaccine hesitancy within Muslim communities [41]. A study showed that religious teachings prioritize prayers over medicine and this might result in vaccination hesitancy among devotees [42]. Efforts to increase vaccine coverage must target figures that highly influence vaccine uptake, particularly caregivers, religious leaders, and healthcare providers [43]. The participation of religious leaders in promoting vaccination has been reported as an important strategy to overcome contradictions between religion beliefs and vaccination [44,45]. In the context COVID-19, the religious elements might be addressed by involving enlightened Islamic scholars in health promotion and awareness regarding COVID-19 and this might facilitate appropriate COVID-19 control efforts in Islamic countries.

In the context of COVID-19, vaccination not only to protect individuals' health but also plays a critical role in protecting vulnerable populations by achieving herd immunity [24]. There is a need to establish effective

COVID-19 vaccine communication strategies to improve vaccine trust, thereby enhancing vaccine acceptance. Such measures should focus on vaccine-hesitant groups to obtain the maximum result [46]. Active mass campaign focusing on the usefulness and benefits of vaccination [47] also could be implemented to increase the COVID-19 acceptance. The governments also should focus on addressing religious concerns associated with COVID-19 vaccines to improve the trust of the general public.

There are some limitations of this study. Since this study was an online survey means this survey might exclude people from who were illiterate, lower social-economic classes or those with lower educational attainment. The also prone to selection bias due to the variation in internet access across the countries. In addition, the samples of the study might not represent the population of the countries. Finally, social desirability bias, tendency of respondents to answer questions that favorable by others, might also influence the responses of participants in the survey.

Conclusion

Our initial survey in 10 countries in Asia, Africa, and South America suggests that vaccine hesitancy is relatively high. Vaccine hesitancy is significantly higher in females, those who identified themselves as Muslim, those living in rural areas, working in non-healthcare-related sectors, and those who have not received a flu vaccination during the past 12 months. These groups could be targets of vaccination campaigns for both routine childhood vaccination and COVID-19 vaccination. A multisectoral approach involving the collaborative effort of various stakeholders, such as the government, private companies, and religious groups, should be formulated to create a longstanding public trust in vaccinations.

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References

[1] Rodriguez-Morales AJ, Cardona-Ospina JA, Gutierrez-Ocampo E, et al. Clinical, laboratory and imaging features of COVID-19: a systematic review and meta-analysis. Travel Med Infect Dis. 2020;34:101623.

[2] Harapan H, Itoh N, Yufika A, et al. Coronavirus disease 2019 (COVID-19). J.Infect.Public Health. 2020;13 (5):667–673.

[3] Fahriani M, Anwar S, Yufika A, et al. Disruption of childhood vaccination during the COVID-19 pandemic in Indonesia. Narra J. 2021;1(1):e7.

[4] Coronavirus WHOWHO. (COVID-19) Dashboard. World Health Organization 2021; Available from https://covid19.who.int (2021 Jul 7).

[5] Torjesen I. Covid-19 vaccine shortages: what is the cause and what are the implications? BMJ. 2021 372 ;n781.

[6] Dhama K, Sharun K, Tiwari R, et al. COVID-19 vaccine hesitancy - reasons and solutions to achieve a successful global vaccination campaign to tackle the ongoing pandemic. Hum Vaccin Immunother. 2021;17(10):3495–3499.

[7] MacDonald NE. Vaccine hesitancy: definition, scope and determinants. Vaccine. 2015;33(34):4161–4164.

[8] Dhama K, Sharun K, Tiwari R, et al. COVID-19 vaccine hesitancy - reasons and solutions to achieve a successful global vaccination campaign to tackle the ongoing pandemic. Hum Vaccin Immunother. 2021;17(10 :3495–3499.

[9] Wouters OJ, Shadlen KC, Salcher-Konrad M, et al. Challenges in ensuring global access to COVID-19 vaccines: production, affordability, allocation, and deployment. Lancet. 2021;397(10278):1023–1034.

[10] Solis Arce JS, Warren SS, Meriggi NF, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. Nat Med. 2021;27(8):1385–1394.

[11] Malik AA, McFadden SM, Elharake J, et al. Determinants of COVID-19 vaccine acceptance in the US. EClinicalMedicine. 2020;26:100495.

[12] Jennings W, Stoker G, Bunting H, et al. Lack of Trust, Conspiracy Beliefs, and Social Media Use Predict COVID-19 Vaccine Hesitancy. Vaccines (Basel). 2021;9 (6). 10.3390/vaccines9060593.

[13] Nossier SA. Vaccine hesitancy: the greatest threat to COVID-19 vaccination programs. J Egypt Public Health Assoc. 2021;96(1):18.

[14] Paul E, Steptoe A, Fancourt D. Attitudes towards vaccines and intention to vaccinate against COVID-19: implications for public health communications. 2021; Lancet Reg Health Eur. 1:100012.

[15] Ullah I, Khan KS, Tahir MJ, et al. Myths and conspiracy theories on vaccines and COVID-19: potential effect on global vaccine refusals. Vacunas. 2021;22(2):93–97.

[16] Wagner AL, Rajamoorthy Y, Taib NM. Impact of economic disruptions and disease experiences on COVID-19 vaccination uptake in Asia: a study in Malaysia. Narra J. 2021;1(2):2

[17] Tanne JH. Covid-19: US doctors suggest new ways to target vaccine hesitancy. BMJ. 2021;373:n1640.

[18] Sallam MCOVID-19. Vaccine hesitancy worldwide: a concise systematic review of vaccine acceptance rates. Vaccines (Basel). 2021;9:2.

[19] Sharun K, Tiwari R, Patel SK, et al. Coronavirus disease 2019 (COVID-19) in domestic animals and wildlife: advances and prospects in the development of animal models for vaccine and therapeutic research. Hum Vaccin Immunother. 2020;16 (12):3043–3054.

[20] Ioannou P, Karakonstantis S, Astrinaki E, et al. Transmission of SARS-CoV-2 variant B. 1.1. 7 among vaccinated health care workers. Infect Dis (Lond). 2021; 53(11) ;876–879.

[21] Wagner AL, Masters NB, Domek GJ, et al. Comparisons of Vaccine Hesitancy across Five Low- and Middle-Income Countries. Vaccines (Basel). 2019;7:4.

[22] Akel KB, Masters NB, Shih S-F, . . In: Hum Vaccin Immunother. 2021 17 8 . p. 2639–2646.

[23] Thomson A, Robinson K, The V-TG. 5As: a practical taxonomy for the determinants of vaccine uptake. Vaccine. 2016;34(8):1018–1024.

[24] Cooper S, van Rooyen H, Wiysonge CS. COVID-19 vaccine hesitancy in South Africa: how can we maximize uptake of COVID-19 vaccines? In: Expert Rev Vaccines. 2021;20:921–933.

[25] Murphy J, Vallieres F, Bentall RP, et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. Nat Commun. 2021;12(1):29.

[26] Neumann-Bohme S, Varghese NE, Sabat I, et al. Once we have it, will we use it? A European survey on willingness to be vaccinated against COVID-19. Eur J Health Econ. 2020;21(7):977–982.

[27] Shih SF, Wagner AL, Masters NB, et al. Vaccine hesitancy and rejection of a vaccine for the novel coronavirus in the United States. Front Immunol. 2021;12:558270.

[28] Holeva V, Parlapani E, Nikopoulou VA, et al. COVID-19 vaccine hesitancy in a sample of Greek adults. Psychol Health Med 2021 1–7 10.1080/13548506.2021.1948579

[29] Thanee C, Kittikraisak W, Sinthuwattanawibool C, et al. Knowledge, attitude/ perception, and practice related to seasonal influenza vaccination among caregivers of young Thai children: a cross-sectional study. PLoS One. 2021;16(6):e0253561.

[30] Qunaibi EA, Helmy M, Basheti I, et al. A high rate of COVID-19 vaccine hesitancy in a large-scale survey on Arabs. Elife. 2021;10:e68038.

[31] Merten S, Martin Hilber A, Biaggi C, et al. Gender determinants of vaccination status in children: evidence from a meta-ethnographic systematic review. PLoS One. 2015;10(8):e0135222.

[32] Damnjanovic K, Graeber J, Ilic S, et al. Parental Decision-Making on Childhood Vaccination. Front Psychol. 2018;9:735.

[33] Huang W, Shao X, Wagner AL COVID-19 vaccine coverage, concerns, and preferences among Chinese ICU clinicians: a nationwide online survey. Expert Rev Vaccines. 2021;20(10):1361–1367.

[34] Townsel C, Moniz MH, Wagner AL, et al. COVID-19 vaccine hesitancy among reproductive-aged female tier 1A healthcare workers in a United States Medical Center. J Perinatol 2021;41:2549–2551.

[35] Elharake JA, Galal B, Alqahtani SA, et al. COVID-19 vaccine acceptance among health care workers in the Kingdom of Saudi Arabia. Inter J Infect Dis. 2021;109:286–293.

[36] Lmb A, Elharake JA, Al Memari S, et al. COVID-19 vaccine acceptance among healthcare workers in the United Arab Emirates. IJID Regions. 2021; 1: 20–26.

[37] Paterson P, Meurice F, Stanberry LR, et al. Vaccine hesitancy and healthcare providers. Vaccine. 2016;34 (52):6700–6706.

[38] Shafiq M, Elharake JA, Malik AA, et al. COVID-19 sources of information, knowledge, and preventive behaviors among the US adult population. Journal of Public Health Management and Practice. 2021;27 (3):278–284.

[39] Maraqa B, Nazzal Z, Rabi R, et al. COVID-19 vaccine hesitancy among health care workers in Palestine: a call for action. Prev Med. 2021;149:106618.

[40] Ahmed A, Lee KS, Bukhsh A, et al. Outbreak of vaccine-preventable diseases in Muslim majority countries.J Infect Public Health 2018;11(2):153–155.

[41] Khan YH, Mallhi TH, Alotaibi NH, et al. Threat of COVID-19 vaccine hesitancy in Pakistan: the need for measures to neutralize misleading narratives. Am J Trop Med Hyg. 2020;103(2):603–604.

[42] Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. England): Journal of Public Health (Oxford; 2020.

[43] Malosh R, Ohmit SE, Petrie JG, et al. Factors associated with influenza vaccine receipt in community dwelling adults and their children. Vaccine. 2014;32 (16):1841–1847.

[44] Padmawati RS, Heywood A, Sitaresmi MN, et al. Religious and community leaders' acceptance of rotavirus vaccine introduction in Yogyakarta, Indonesia: a qualitative study. BMC Public Health. 2019;19(1):368.

[45] Harapan H, Shields N, Kachoria AG, et al. Religion and measles vaccination in Indonesia, 1991-2017. Am J Prev Med. 2021;60(1 Suppl 1):S44–S52.

[46] Rosiello D F, Anwar, S, Yufika, A et al . (2021). Acceptance of COVID-19 vaccination at different hypothetical efficacy and safety levels in ten countries in Asia, Africa, and South America. Narra J, 1(3 e55),

[47] Faturohman T, Kengsiswoyo GAN, Harapan H, et al. Factors influencing COVID-19 vaccine acceptance in Indonesia: an adoption of technology acceptance model. F1000Res. 2021;10(476):476.