Original Article

MODESTUM

OPEN ACCESS

Perceived Vaccine Efficacy, Willingness to Pay for COVID-19 Vaccine and Associated Determinants among Foreign Migrants in China

Tosin Yinka Akintunde [1,2]*, Angwi Enow Tassang [1,2], Marvellous Okeke [3], Stanley Oloji Isangha [4], Taha Hussein Musa [5,6]

[1] Department of Sociology, School of Public Administration, Hohai University, Nanjing, CHINA
[2] Asian Research Center, Hohai University, Nanjing, CHINA
[3] Department of Oncology, School of Medicine, Southeast University, Nanjing, CHINA
[4] Department of Social and Behavioral Sciences, College of Liberal Arts and Social Sciences, City University of Hong Kong, Kowloon, HONG KONG
[5] Department of Epidemiology and Health Statistics, Key Laboratory of Environmental Medicine Engineering, Ministry of Education, School of Public Health, Southeast University, Nanjing, CHINA
[6] Biomedical Research Institute, Darfur University College, SUDAN
*Corresponding Author: akintunde.ty@hhu.edu.cn; akintunde_olayinka@yahoo.com

ARTICLE INFO	ABSTRACT
	Objectives: The COVID-19 public health crisis has increased the global burden of diseases and mortality. Hence, global vaccination becomes non-negotiable to support immunity to reduce morbidity and mortality burdens. The COVID-19 vaccine campaign hinges on health promotion and equitable distribution, especially among minority groups. Therefore, the current study investigated the determinants of perceived vaccine efficacy and willingness to pay among foreign migrants in China. **Methods:** The study appraised data from an online-based survey carried out among foreign migrants in mainland China through the WeChat platform. Data analysis was carried out through bivariate and multivariate logistic regression. **Results:** A total of 498 foreign migrants were recruited, with male 47.65%, female 45.2%, and other gender minority groups (7.15%). The study found that females, gender minorities, students, preference for alternative medicine, culture neutrality, belief against vaccination, and prefer free vaccination were less likely to pay for COVID-19 vaccination. Meanwhile, those whose families/relatives are opposed to vaccination and have good subjective health than others in their age group were less likely to believe in vaccine efficacy. Those who have received at least a dose of COVID-19 vaccine (AoR: 3.32, 95% CI: 1.94-5.58, p<0.001), believe vaccines are accessible (AoR: 2.40, 95% CI: 1.52-3.98, p<0.001) and have high perceived susceptibility to COVID-19 (AoR: 1.97, 95% CI: 1.18-3.28, p<0.01) were more likely to believe in vaccine efficacy. **Conclusion:** The research extends evidence on vaccination behavior among foreign migrant groups. Vaccination support among migrants should target indicators like culture, gender identity, psychological health, subjective health, and perceived severity to eradicate vaccine hesitancy and misinformation that can translate to increased vaccine participation among minority groups. **Keywords:** willingness to pay, vaccine efficacy, COVID-19, vaccine, migrant, psychosocial, foreigners, China, Asia

INTRODUCTION

COVID-19 public health crisis has caused millions of deaths globally [1]. Therefore, equitable vaccine distribution is pivotal for global transitioning from the health and social impact of the COVID-19 crisis. With an estimated one billion international and internal migrants globally, it is essential to integrate migrants into global COVID-19 vaccine implementation [2]. At the heart of the distribution of the COVID-19 vaccine are minority groups like "migrants," whose vaccine behavior is currently not well understood. The problem associated with ensuring global participation in COVID-19 vaccination is evident in the proliferation of vaccine hesitancy and refusal research. While vaccines are generally lauded as essential to boost immunity against infectious diseases [3,4], the issues

and series of clinical, social, and behavioral concerns about vaccine uptake among the global population constitute public health concerns [5,6]. Widespread vaccine hesitancy and negative perception have been well documented before the COVID-19 public health crisis [7,8]. Recent evidence attests that vaccine hesitancy and negative perception are historical, socio-cultural, and political debacles upsetting the trust in innovative medical developments. For example, some of the determinants of COVID-19 vaccination acceptance in the Bangladesh population were associated with perceived risk of COVID-19 infection and previous vaccination experience [9]. These results support the understanding that the past social and cultural problem related to vaccination has been witnessed in the current global COVID-19 vaccine roll-out. More recent evidence has consolidated lower perceived severity of COVID-19, female gender, and ethnicity as causative factors

associated with COVID-19 vaccine refusal and hesitancy [10,11]. Other studies have premised vaccine hesitancy due to misinformation and anti-vaccine movements [12,13].

Exploring migrants' perceived vaccine efficacy and willingness to pay for the COVID-19 vaccine may help understand and debunk vaccine misinformation. Willingness to pay (WTP), especially for the COVID-19 vaccine, is essential in aiding the government in delivering vaccines. This premonition is based on the government's limited capacity in providing health services, especially in overstretched health systems. Numerous research has highlighted the relevance of WTP in vaccine discourse [14,15]. Exploring the cultural, socioeconomic, and psychosocial determinants of perceived vaccine efficacy has the potential to explain why minority groups may exhibit hesitancy in vaccination. Therefore, the two domains of WTP and perceived vaccine efficacy become important in the vaccine discussion among minority groups. This study is relevant as no research has been conducted among these groups to understand their vaccine intentions and potential behaviors.

In effect, the current study explored multilevel indicators to determine migrants' perception of vaccine efficacy and willingness to pay for COVID-19 vaccines. The migrant population of China are diverse groups of students, expatriates, and business owners characterized by different historical, cultural, and beliefs that warrant extensive investigation to understand their potential vaccination behavior. Therefore, the current study explored indicators such as cultural perception, beliefs, history of vaccination and refusal, access, personal health assessment, mental health, and perceived seriousness of COVID-19 infection and other vital sociodemography characteristics to extend empirical evidence on WTP and perception of vaccine efficacy among the migrant group. The study premises can support global health promotion and the understanding of personalized behaviors and unique situations of migrants that may be adopted globally to offer support and framework for exclusive global vaccination against COVID-19.

METHODS

Study Design, Population, and Data Collection

The study adopted an online web-based instrument shared on the "WeChat" platform to survey migrants in China from November 21 to December 20, 2021. The approach was used based on the dispersed nature of foreign migrants in China since they are easily accessible via the internet and social media platforms. According to the international organization for migration, about one million foreign migrants are estimated to be registered in China [16]. The migrant population characterized in this study were students, expatriates, and business owners in China. The study accessed the biggest social media platform in China, "WeChat" [17], to assess the target population through a purposeful, convenient, and snowballing approach to increase the questionnaire response rate. The sample size was estimated using an online sampling calculator [18]. The sample size was estimated at 498 with a population proportion (60%), a margin of error of 4.38%, 95% confidence interval, and a population size of one million [19]. The recruited migrant population were nested in foreigner groups on "WeChat," and the participation was voluntary.

Measure

Outcome variable

Two outcome variables were conceptualized among the migrant population in China to establish evidence on their psychosocial behavior empirically. The first outcome of interest was based on WTP for the COVID-19 vaccine. The measure was premised on "Are you willing to pay for COVID-19 vaccination?". The second outcome explored perceived vaccine efficacy among the migrants. The measure was premised on "Do you believe vaccines are effective against viruses and infection (No/Yes)?" Dichotomous responses (No=0 or Yes=1) as binary step supports the exploration of the likelihood of WTP for COVID-19 vaccination and perceived vaccine efficacy among the study group.

Predictor variables

Multilevel indicators were conceptualized to adjudicate the determinant of WTP and perceived vaccine efficacy among the study population. Vital sociodemographic attributes such as gender identity (male, female, and others: non-binary, neutral, and prefer not to say), age (15-24, 25-34, 35-44, ≥45), education (university/postgraduate, college/technical training, secondary/high school), employment (employed (private/government), self-employed, students/scholarship), and income statuses (monthly income: >$3,500, $1701-3,500, and $300-1,700) were explored. Other subjective cultural and psychosocial indicators appraised were preference for traditional over modern medicine, vaccine development in an individual country, culture, and personal belief on COVID-19 vaccine. Transcultural indicators explored were "preference for alternative medicine (AM)" (I prefer traditional medicine over modern medicine–No/Yes), will accept the COVID-19 vaccine if made in my country–No/Yes). Culture (my culture is against vaccination–No/Yes) Belief on vaccination (I have not lived up to my belief if I accept COVID-19 vaccine–No/Yes). Vaccine behavior and intentions indicators were measured as Free vaccination (will receive COVID-19 vaccine if made free–No/Yes), experience with vaccine adverse effects, and relatives/family opposing vaccination were examined in dichotomous responses. History of vaccination against flu/hepatitis, past refusal, vaccine accessibility was considered further. We attempted to explore psychosocial indicators by asking questions premised on subjective/self-rated health [20], perceived vulnerability [21,22], the severity of/to COVID-19 [23,24], social anxiety, and psychological health [25,26], and were reclassified as good/poor based on the dimension of responses.

Analytical Strategy

We adopted a descriptive and analytical approach to achieve the study's objectives. Using percentage distribution and Chi-square estimations, the study characteristics were presented. The analytical measures were premised on binary logistic regression by using adjusted odds ratio (AoR) to appraise the unconditional and conditional influence of the predictors (sociodemographic and psychosocial indicators) on the outcome variables (willingness to pay and perceived vaccine efficacy) among the foreign migrant population. Five models were fitted to explore the correlates of the outcome variables. Model 1 explored the sociodemographic characteristics of the migrant population to determine their likelihood on WTP and perceived vaccine efficacy. Model 2 explored the traditional, historical, and cultural attributes of

Table 1. Characteristics of migrant participants in China

Variables	Attributes	Frequency (%)
Age	15-24	68 (13.7)
	25-34	278 (55.8)
	35-44	141 (28.3)
	44>	11 (2.2)
Gender Identity	Male	237 (47.6)
	Female	225 (45.2)
	Others	36 (7.2)
Income/Month	>$3,500	202 (40.6)
	$1,700-3,500	128 (25.7)
	$300-1,700	168 (33.7)
Employment	Employed	214 (43)
	Self-employed	75 (15.1)
	Students	185 (37.1)
	Unemployed/business	24 (4.8)
Education	University/postgraduate	458 (92)
	College/technical training	18 (3.6)
	Secondary/high school	22 (4.4)

Note. N=498

the migrants on the conceptualized outcomes. Model 3 examined vaccine behavior and intentions among the population, while model 4 delved into the subjective psychosocial indicators to investigate the likelihood of the study's conceptualized outcomes. Lastly, model 5 appraised the net effect of the sociodemographic, transcultural indicators, vaccine behaviors/intentions, and psychosocial attributes to examine the likelihood of the outcome variables. The multivariate logistic models' results were reported as Odds ratios (and confidence intervals), where an outcome above/below 1 is a compared category of specific

characteristics that indicates a higher/lower likelihood of an outcome. Statistical significance was fixed at p≤0.05 (95% significance level). The analysis was conducted using SPSS version 25 and STATA 17 statistical software.

Ethical Consideration

All research procedures adhered strictly to Helsinki declaration on human research. This study was approved by the ethical committee of Hohai University (No221/CCF_000027). Informed consent was received directly from study participants by asking respondents to fill out a questionnaire on their consent to participate in the research.

RESULTS

We recruited study participants totaling n=498 for the analysis. The distribution of participants shows that more than half (55.8%) were between ages 25-34, and there were more males (47.65%) than females (45.2%), with the rest accounting for the gender minority groups (7.15%). Most of the migrants had university/postgraduate education (92%), with 37.1% students and 43% employed at the time of the survey (**Table 1**).

Table 2 shows the recruited migrants' sociodemographic, cultural, and psychosocial indicators compared with the study outcomes (willingness to pay and perceived vaccine efficacy). Overall, about 35.5% of the migrants enumerated were unwilling to pay for COVID-19 vaccines, while approximately 29.9% reported negative perceptions about vaccine efficacy.

Table 2. Migrants participants sociodemographic and psychosocial indicators (outcome variables N=498)

		Willingness to pay			Perceived vaccine efficacy		
	Total (N= 498)	No (N=177)%	Yes (N=321)%	X^2; p-value	No (N=149)%	Yes (N=349)%	X^2; p-value
Demographic attributes							
Gender				19.13; 0.000			7.596; **0.022**
Male	237	70 (39.5)	167 (52)		69 (46.3)	168 (48.1)	
Female	225	83 (46.9)	142 (44.2)		62 (41.6)	163 (46.7)	
Others	36	24 (13.6)	12 (3.7)		18 (12.1)	18 (5.2)	
Age				11.007; 0.012			2.109; 0.550
15-24	68	19 (10.7)	49 (15.3)		17 (11.4)	51 (14.6)	
25-34	278	92 (52)	186 (57.9)		85 (57)	193 (55.3)	
35-44	141	58 (32.8)	83 (25.9)		42 (28.2)	99 (28.4)	
44>	11	8 (4.5)	3 (0.9)		5 (3.4)	6 (1.7)	
Education				4.015; 0.134			1.673; 0.433
University/postgraduate	458	160 (90.4)	298 (92.8)		140 (94)	318 (91.1)	
College/technical training	18	5 (2.8)	13 (4)		3 (2)	15 (4.3)	
Secondary/high school	22	12 (6.8)	10 (3.1)		6 (4)	16 (4.6)	
Employment status				4.420; 0.220			1.614; 0.656
Employed	214	66 (37.3)	148 (46.1)		63 (42.3)	151 (43.3)	
Self-employed	75	27 (15.3)	48 (15)		19 (12.8)	56 (16)	
Students	185	43 (41.2)	112 (34.9)		58 (38.9)	127 (36.4)	
Unemployed/business	24	11 (6.2)	13 (4)		9 (6)	15 (4.3)	
Income				0.226; 0.893			1.984: 0.371
>$3,500	202	71 (40.1)	131 (40.8)		60 (40.3)	142 (40.7)	
$1,701-3,500	128	44 (24.9)	84 (26.2)		33 (22.1)	95 (27.5)	
$300-1,700	168	62 (35)	106 (33)		56 (37.6)	112 (32.1)	
Psychosocial attributes							
Preference for AM				84.755; 0.000			16.336; 0.000
No	371	89 (50.3)	282 (87.9)		93 (62.4)	278 (79.7)	
Yes	127	88 (49.7)	39 (12.1)		56 (37.6)	71 (20.3)	
Home made vaccine				14.934; 0.000			5.794; 0.016
No	243	107 (60.5)	136 (42.4)		85 (57)	158 (45.3)	
Yes	255	70 (39.5)	185 (57.6)		64 (43)	191 (54.7)	

Table 2 (Continued). Migrants participants sociodemographic and psychosocial indicators (outcome variables N=498)

	Total (N= 498)	Willingness to pay			Perceived vaccine efficacy		
		No (N=177)%	Yes (N=321)%	X²; p-value	No (N=149)%	Yes (N=349)%	X²; p-value
Culture is against vaccine				**70.646; 0.000**			**15.383; 0.000**
No	387	101 (57.1)	286 (89.1)		100 (67.1)	287 (82.2)	
Neutral	59	36 (20.3)	23 (7.2)		23 (15.4)	36 (10.3)	
Yes	52	40 (22.6)	12 (3.7)		26 (17.4)	26 (7..4)	
Belief is against Vaccine				**77.387; 0.000**			**29.044; 0.000**
No	371	96 (54.2)	275 (85.7)		91 (61.1)	280 (80.2)	
Neutral	65	30 (16.9)	35 (10.9)		22 (14.8)	43 (12.3)	
Yes	62	51 (28.8)	11 (3.4)		36 (24.2)	26 (7.4)	
Free Vaccine				**4.669; 0.031**			0.765; 0.382
No	361	118 (66.7)	243 (75.7)		112 (75.2)	249 (71.3)	
Yes	137	59 (33.3)	78 (24.3)		37 (24.8)	100 (28.7)	
Vaccine has adverse effect				0.246; 0.620			0.002; 0.964
No	375	131 (74)	244 (76)		112 (75.2)	263 (75.4)	
Yes	123	46 (26)	77 (24)		37 (24.8)	86 (24.6)	
Family oppose vaccine				0.762: 0.383			**25.057; 0.000**
No	190	63 (35.6)	127 (39.6)		32 (21.5)	158 (45.3)	
Yes	308	114 (64.4)	194 (60.4)		117 (78.5)	191 (54.7)	
Willingness to pay							**30.569; 0.000**
	177				80 (53.7)	97 (27.8)	
	321				69 (46.3)	252 (72.2)	
Perceived vaccines efficacy				**30.569; 0.000**			
No	149	80 (45.2)	69 (25.5)				
Yes	349	97 (54.8)	252 (78.5)				
Received vaccine before				**11.203; 0.001**			**8.170; 0.004**
No	143	67 (37.9)	76 (23.7)		56 (37.6)	87 (24.9)	
Yes	355	110 (62.1)	245 (76.3)		93 (62.4)	262 (75.1)	
Declined vaccine before				2.666; 0.102			**5.794; 0.016**
No	415	141 (79.7)	274 (85.4)		115 (77.2)	300 (86)	
Yes	83	36 (20.3)	47 (14.6)		34 (22.8)	49 (14)	
Vaccines are accessible				**8.142 (0.004)**			**20.892; 0.000**
No	173	76 (42.9)	97 (30.2)		74 (49.7)	99 (28.4)	
Yes	325	101 (57.1)	224 (69.8)		75 (50.3)	250 (71.6)	
Received COVID-19 vaccine				**29.183; 0.000**			**44.719; 0.000**
No	153	81 (45.8)	72 (22.4)		78 (52.3)	75 (21.5)	
Yes	345	96 (54.2)	249 (77.6)		71 (47.7)	274 (78.5)	
Subjective health				0.048; 0.826			1.061; 0.303
Poor health	138	48 (27.1)	90 (28)		46 (30.9)	92 (26.4)	
Good health	360	129 (72.9)	231 (72)		103 (69.1)	257 (73.6)	
Health compared to others				1.713; 0.191			3.529; 0.060
Poor health	256	84 (47.5)	172 (53.6)		67 (45)	189 (54.2)	
Good health	242	93 (52.5)	149 (46.4)		82 (55)	160 (45.8)	
Perceived vulnerability to COVID-19				0.630; 0.430			**8.534; 0.003**
Low vulnerability	133	51 (28.8)	82 (25.5)		53 (35.6)	80 (22.9)	
High vulnerability	365	126 (71.2)	239 (74.5)		96 (64.4)	269 (77.1)	
Perceived severity of COVID-19				**6.934; 0.008**			**11.191; 0.001**
Low severity	176	76 (42.9)	100 (31.2)		69 (46.3)	107 (30.7)	
High severity	322	101 (57.1)	221 (68.8)		80 (53.7)	242 (69.3)	
Social anxiety				0.227 (0.634)			0.029; 0.864
High anxiety	308	107 (60.5)	201 (62.6)		93 (62.4)	215 (61.8)	
Low anxiety	190	70 (39.5)	120 (37.4)		56 (37.6)	134 (38.4)	
Psychological health				0.000; 0.993			1.948; 0.163
Good	194	69 (39)	125 (38.9)		65 (43.6)	129 (37)	
Poor	304	108 (61)	196 (61.1)		84 (56.4)	220 (63)	

Note. X²: Chi-square; **Boldface:** Significant

Nested Multivariate Logistic Regression of Correlates of Willingness to Pay for COVID-19 Vaccine

Table 3 explored the nested multivariate logistic regression of migrant characteristics associated with the willingness to pay for the COVID-19 vaccine. Model 1, exploring the sociodemographic characteristics, shows that gender minority, aged 35-44 and more than 44 years old, students, high school certificates are less willing to pay for the COVID-19 vaccine. Model 2, premising on the traditional, cultural, and historical attributes, highlights migrants who prefer AM, culture neutral, whose culture is against vaccination and belief is against vaccination are less likely to pay for COVID-19 vaccination. Meanwhile, migrants who prefer vaccines made in their countries were more likely to be WTP for COVID-19 vaccines. Model 3 explored the vaccine behavior of migrants. Those who take a vaccine only if free are less likely to pay for COVID-19 vaccination. Those who believe in vaccine efficacy and have received vaccination before are more likely to be

WTP. In model 4 (psychosocial factors), only those with perceived high seriousness of COVID-19 infection are more likely to pay for COVID-19 vaccination.

The net effect of the models explored as model 5 shows the vital indicators that are collectively influential to the WTP for COVID-19 vaccination among the study population. Females (AoR: 0.44, 95% CI: 0.25-0.77, p<0.01), gender minority (AoR: 0.17, 95% CI: 0.06-0.46, p<0.001), ages 35-44 (AoR: 0.38, 95% CI: 0.15-0.98, p<0.05), students (AoR: 0.41, 95% CI: 0.22-0.77, p<0.01), preferred AM (AoR: 0.21, 95% CI: 0.12-0.36, p<0.001), culture neutral (AOR: 0.25, 95% CI: 0.09-0.63, p<0.01), belief is against vaccine (AoR: 0.21, 95% CI: 0.07-0.65, p<0.01), and want free vaccination (AoR: 0.43, 95% CI: 0.25-0.77, p<0.05) were less likely to be WTP for COVID-19 vaccination.

Table 3. Nested multivariate logistic regression analysis: Determinants of WTP for COVID-19 (N=498); WTP (No=0; Yes=1)

	Model 1	Model 2	Model 3	Model 4	Model 5
	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)
Demographic attributes					
Gender					
Male	1				1
Female	0.71 (0.47-1.09)				0.44 (0.25-0.77)**
Others	0.20 (0.09-0.44)***				0.17 (0.06-0.46)***
Age					
15-24	1				1
25-34	0.69 (0.37-1.32)				0.58 (0.25-1.32)
35-44	0.42 (0.21-0.86)*				0.38 (0.15-0.98)*
44>	0.09 (0.19-0.39)**				0.18 (0.02-2.08)
Education					
University/postgraduate	1				1
College/technical training	1.37 (0.43-4.33)				1.82 (0.37-9.02)
Secondary/high school	0.39 (0.16-0.98)*				0.75 (0.21-2.73)
Employment status					
Employed	1				1
Self-employed	0.68 (0.37-1.24)				0.77 (0.35-1.67)
Students	0.46 (0.27-0.75)**				0.41 (0.22-0.77)**
Unemployed/business	0.46 (0.18-1.15)				1.05 (0.31-3.59)
Income					
>$3,500	1				1
$1,701-3,500	1.03 (0.61-0.174)				1.51 (0.77-2.97)
$300-1,700	0.96 (0.59-1.55)				1.46 (0.79-2.67)
Psychosocial attributes					
Preference for AM					
No		1			1
Yes		0.21 (0.12-0.34)***			0.21 (0.12-0.36)***
Home made vaccine					
No		1			1
Yes		3.20 (2.02-5.09)***	`		3.51 (2.08-5.93)***
Culture is against vaccine					
No		1			1
Neutral		0.31 (0.13-0.68)**			0.25 (0.09-0.63)**
Yes		0.29 (0.11-0.83)*			0.30 (0.09-1.01)
Belief is against vaccine					
No		1			1
Neutral		0.99 (0.47-2.07)			0.93 (0.39-2.2)
Yes		0.24 (0.09-0.63)**			0.21 (0.07-0.65)**
Free vaccine					
No			1		1
Yes			0.61 (0.39-0.94)*		0.43 (0.25-0.77)**
Vaccine has adverse effect					
No			1		1
Yes			0.86 (0.55 – 1.34)		1.51 (0.83-2.75)
Family oppose vaccine					
No			1		1
Yes			1.04 (0.68-1.57)		1.18 (0.68-2.01)
Vaccines efficacy					
No			1		1
Yes			1.80 (1.83-4.29)***		1.63 (0.92-2.88)
Received vaccine before					
No			1		1
Yes			1.59 (1.03-2.48)*		0.95 (53-1.71)
Declined vaccine before					
No			1		1
Yes			0.83 (0.49-1.42)		1.47 (0.71-3.02)

Table 3 (Continued). Nested multivariate logistic regression analysis: Determinants of WTP for COVID-19 (N=498); WTP (No=0; Yes=1)

	Model 1	Model 2	Model 3	Model 4	Model 5
	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)
Vaccines are accessible					
No			1		1
Yes			1.32 (0.88-1.98)		1.21 (0.71-2.05)
Subjective health					
Poor health				1	1
Good health				0.98 (0.62-1.57)	0.54 (0.29-1.01)
Health compared to others					
Poor health				1	1
Good health				0.80 (0.53-1.22)	0.97 (0.56-1.71)
Perceived vulnerability to COVID-19					
Low vulnerability				1	1
High vulnerability				1.09 (0.72-1.66)	0.98 (0.55-1.73)
Perceived severity of COVID-19					
Low severity				1	1
High severity				1.63 (1.10-2.40)*	1.13 (0.65-1.95)
Social anxiety					
High anxiety				1	1
Low anxiety				0.91 (0.61-1.36)	0.79 (0.47-1.36)
Psychological health					
Good				1	1
Poor				0.96 (0.63-1.44)	1.09 (0.63-1.87)

*p<0.05; **p<0.01; ***p<0.001; AM: Alternative medicine; AOR: Adjusted odds-ratio; CI: Confidence interval; Ref: Reference; UOR: Unadjusted odds-ratio; WTP: Willingness to pay

Nested Multivariate Logistic Regression Analysis of Correlates of Perceived Vaccine Efficacy

Table 4 explored the nested multivariate logistic regression of migrant characteristics associated with the perceived vaccine efficacy. Model 1, exploring the sociodemographic characteristics, shows that female migrants are less likely to believe in vaccine efficacy. Model 2, assessing the traditional, cultural, and historical attributes, indicated that migrants who preferred AM and their belief are against vaccination were less likely to believe in vaccine efficacy. However, migrants who prefer vaccines made in their countries were more likely to believe in vaccine efficacy.

Model 3 explored vaccine behavioral indicators of migrants. Those who are WTP for a vaccine, have received COVID-19 vaccine, and believe vaccines are accessible were more likely to believe in vaccine efficacy. Those whose family/relatives are opposed to vaccination are less likely to believe in vaccine efficacy. In model 4 (psychosocial factors), the migrants with subjective better health than others in their age group were less likely to believe in vaccine efficacy. Migrants with high perceived vulnerability and severity of COVID-19 are more likely to believe in vaccine efficacy.

Table 4. Nested multivariate logistic regression analysis of determinants of perceived vaccine efficacy (N=498); perceived vaccine efficacy (No=0; Yes=1)

	Model 1	Model 2	Model 3	Model 4	Model 5
	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)
Demographic attributes					
Gender					
Male	1				1
Female	1.01 (0.66-1.54)				0.89 (0.53-1.49)
Others	0.38 (0.18-0.81)*				0.54 (0.23-1.48)
Age					
15-24	1				1
25-34	0.86 (0.45-1.64)				0.97 (0.46-2.03)
35-44	0.89 (0.44-1.84)				1.16 (0.50-2.69)
44>	0.34 (0.09-1.30)				1.22 (0.20-7.51)
Education					
University/postgraduate	1				1
College/technical training	2.07 (0.55-7.70)				2.02 (0.48-8.52)
Secondary/high school	1.13 (0.42-3.08)				2.68 (0.78-9.24)
Employment status					
Employed	1				1
Self-employed	1.13 (0.61-2.11)				1.72 (0.80-3.69)
Students	0.94 (0.57-1.53)				0.99 (0.56-1.78)
Unemployed/business	0.73 (0.28-1.83)				0.69 (0.23-2.03)
Income					
>$3,500	1				1

Table 4 (Continued). Nested multivariate logistic regression analysis of determinants of perceived vaccine efficacy (N=498); perceived vaccine efficacy (No=0; Yes=1)

	Model 1	Model 2	Model 3	Model 4	Model 5
	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)	AoR (95% CI)
$1,701-3,500	1.31 (0.77-2.24)				1.64 (0.85-3.18)
$300-1,700	0.86 (0.53-1.39)				1.09 (0.62-1.94)
Psychosocial attributes					
Preference for AM					
No		1			1
Yes		0.60 (0.38-0.96)*			0.88 (0.49-1.57)
Home made vaccine					
No		1			1
Yes		1.78 (1.18-2.69)**	`		1.57 (0.95-2.57)
Culture is against vaccine					
No		1			1
Neutral		0.84 (0.40-1.73)			0.51 (0.22-1.18)
Yes		0.96 (0.39-2.36)			1.01 (0.33-3.03)
Belief is against vaccine					
No		1			1
Neutral		0.77 (0.39-1.53)			1.04 (0.47-2.34)
Yes		0.28 (0.12-0.66)**			0.41 (0.15-1.15)^
Free vaccine					
No			1		1
Yes			1.21 (0.74-2.01)		1.36 (0.78-2.41)
Vaccine has adverse effect					
No			1		1
Yes			2.27 (1.46 – 3.56)***		1.51 (0.85-2.66)
Family oppose vaccine					
No			1		1
Yes			0.98 (0.59-1.62)		1.06 (0.60-1.85)
Vaccines efficacy					
No			1		1
Yes			0.30 (0.18-0.49)***		0.27 (0.15-0.47)***
Received vaccine before					
No			1		1
Yes			3.04 (1.89-4.85)***		3.32 (1.94-5.68)***
Declined vaccine before					
No			1		1
Yes			1.25 (0.77-2.04)		1.04 (0.60-1.80)
Vaccines are accessible					
No			1		1
Yes			1.19 (0.66-2.16)		1.19 (0.61-2.29)
Subjective health					
Poor health			1		1
Good health			2.21 (1.42-3.45)***		2.4 (1.52-3.98)***
Health compared to others					
Poor health				1	1
Good health				1.52 (0.93-2.49)	1.49 (0.81-2.75)
Perceived vulnerability to COVID-19					
Low vulnerability				1	1
High vulnerability				1.74 (1.13-2.67)*	1.97 (1.18-3.28)**
Perceived severity of COVID-19					
Low severity				1	1
High severity				1.76 (1.17-2.65)**	1.26(0.74-2.11)
Social anxiety					
High anxiety				1	1
Low anxiety				1.24 (0.81-1.91)	1.40 (0.84-2.32)
Psychological health					
Good				1	1
Poor				1.41 (0.91-2.16)	1.61 (0.96-2.70)

*p<0.05; **p<0.01; ***p<0.001; AM: Alternative medicine; AOR: Adjusted odds-ratio; CI: Confidence interval; Ref: Reference; UOR: Unadjusted odds-ratio; WTP: Willingness to pay

The net effect of the models explored as model 5 shows the vital indicators that are collectively influential to perceived vaccine efficacy among the study population. Those whose families/relatives are opposed to vaccination (AoR: 0.27, 95% CI: 0.15-0.47, p<0.001) and have good subjective health compared to others in their age group (AoR: 0.52, 95% CI: 0.30-0.92, p<0.05) were less likely to believe in vaccine efficacy. Those who have received at least a dose of COVID-19 vaccine

(AoR: 3.32, 95% CI: 1.94-5.58, p<0.001), believe vaccines are accessible (AoR: 2.40, 95% CI: 1.52-3.98, p<0.001) and have high perceived susceptibility to COVID-19 (AoR: 1.97, 95% CI: 1.18-3.28, p<0.01) were more likely to believe in vaccine efficacy

DISCUSSION

This research established the sociodemographic, cultural, vaccine behavior, and psychosocial determinant of WTP for the COVID-19 vaccine and perceived vaccine efficacy among the foreign migrant population in China. This study is particularly necessitated by the problem of vaccine hesitancy, refusal, and the spiraling effect of the COVID-19 global crisis [27,28]. Evidence of the social and psychological determinants of vaccine uptake and hesitancy has gained attention in empirical discussion [29,30].

The study evidence highlighted that students, gender minority groups, and ages 35 and above were less likely to pay for the COVID-19 vaccine than the comparative groups. This exposition presents vaccine intention among gender minority groups and consolidates existing evidence that females are reluctant to take COVID-19 vaccination [31]. The migrants who prefer alternative medicine, culture-neutral or culture-sensitive groups, and those who are belief conscious were less likely to pay for COVID-19 vaccination. In particular, evidence in Malaysia has supported the view that alternative medicines are safer and can potentially be consequential to vaccine hesitancy [32]. Similarly, cultural and belief attributes dampen the WTP for COVID-19 vaccination, leading to vaccine hesitancy [32-34]. Culture and traditional belief systems have consistently dampened the extension of health services to migrants based on the complexity of norms and historical beliefs [35] and, therefore, may influence the willingness of migrants to pay for vaccination. Those migrants who prefer vaccines manufactured in their country are more likely to pay for COVID-19 vaccination. While migrants who prefer vaccines manufactured in their country are more willing to pay to get vaccinated, this perception may negate global monitoring and coordination of immunization and ensure safety among recipients as a centralized system is needed for vaccination of this magnitude [5,36].

The vaccine behavior of the migrants supported preference for free vaccination as an indication of unwillingness to pay for COVID-19 vaccination. The result projects the out-of-pocket vaccination approach as disadvantageous in promoting vaccination. Advocacy for free vaccination remain important to increase vaccine acceptance and may support the unique circumstance of minority groups to ensure their inclusion in health promotion [37,38]. Meanwhile, those who believe in vaccine efficacy and have a vaccination history are more likely to pay for vaccination. Among the psychosocial indicators explored, only perceived severity was significant to understand the WTP for COVID-19 vaccination among the research participants. The high perceived severity of COVID-19 infection increases the likelihood of paying to be vaccinated.

This study further consolidated the understanding that perceived vaccine efficacy is essential to tackle the debacle of misinformation surrounding vaccines that have aggravated vaccine hesitancy and rejection [12,33,39]. The evidence from this study showed that among migrants', gender minority groups were less likely to believe in vaccine efficacy. Gender minority groups have been at the center of health intervention

to reduce their health vulnerabilities like sexually transmitted diseases and increase vaccination as a safety measure [40]. The preference for alternative medicine and personal belief influences migrants' perception of vaccine efficacy. Since the migrants' preference for alternative medicine dampens the acceptance of modern medicine such as vaccines [41], it becomes essential to decompose the complexity associated with people's choices of traditional medicine, especially during a public health crisis.

Furthermore, migrants who prefer vaccines manufactured in their home countries are more likely to believe in vaccine efficacy. Although other researchers have concluded that the vaccine manufacturers do not influence willingness to vaccinate [42], the country where vaccines are manufactured matters in vaccination discourse. The migrant population willing to pay for vaccines also believes in its efficacy. Numerous research has consolidated WTP as determinants of COVID-19 vaccine uptake [43-45]. This exertion means those migrants unwilling to pay for vaccination need further investigation to understand their peculiarity and influencing factors. Identifying these groups for intervention becomes crucial, such as providing free vaccination and re-educating them on the vaccine's medical importance.

The migrant population who have received at least the first shot of COVID-19 vaccination and have knowledge of vaccine accessibility were more likely to believe in vaccine efficacy. Based on reverse premises, the positive perception of vaccine efficacy of these migrants may be attributed to why they have received the COVID-19 vaccine and the knowledge on vaccine accessibility. To ensure global participation in vaccination, it becomes vital to ensure that vaccines are easily accessible, encouraging a positive perception of vaccine efficacy—the assurance of vaccine availability broadening the reduction of hesitancy and reluctance in vaccination [46,47].

More evidence in this study presents migrants whose families or relatives opposed vaccination were less likely to believe in vaccine efficacy. This result follows the trajectory that family systems and influences must be considered while educating minority groups about vaccine efficacy. There are potential divides based on cohesion and unity evidenced in the family. Just like social media influence on misinformation [48,49], the family influence should be closely monitored as a potential determinant of negative perception on vaccine efficacy and other vaccine misconceptions. The other attributes explored among the migrants attested to the subjective belief on vaccine efficacy. The subjective health assessment is critical to global vaccine uptake, especially during the ongoing COVID-19 vaccine roll-out. While those migrants who rated their health status as "good" compared to others in the age group were less likely to believe in vaccine efficacy, the outcome raised the concern of self intuition about health that may not be applicable or viable in infectious disease prevention. Although other studies have found healthy people more willing to participate in vaccination [50], the current study found people with similar attributes with a negative perception of vaccine efficacy. Given the nature of the spread of infectious diseases like the COVID-19, the global vulnerability during the pandemic is unprecedented. As such, the thought of feeling healthier than others is not a defense against being COVID-19 infected.

Lastly, the severity and risk associated with COVID-19 infection are evident in the total global casualty and have gulped enormous resources. Those migrants with high

perceived susceptibility and seriousness of COVID-19 disease were more likely to believe in vaccine efficacy. This result supports the migrants nested in this domain as having the understanding associated with viral infection and risks. The migrant population who have lower perceived susceptibility and seriousness of COVID-19 infection requires keen attention to eradicate the misconception or misinformation on the severity and vulnerabilities of infectious diseases.

This study has some limitations to be considered when adopting the study findings. The data collection method was a convenient sampling approach and may be subject to sampling bias. Assessing the foreign migrant population in the region is complex and involves large-scale implementation. Thus, large-scale research is encouraged among foreign migrants in the region to understand their unique vaccination experiences. The study variables were subjectively measured. All interpretations should be treated accordingly.

CONCLUSION

The current study presents novel research on the foreign migrant population in China to understand their WTP and perceived vaccine efficacy during the ongoing COVID-19 vaccine roll-out. The unique attribute of the migrants and their historical/cultural background present a complex scenario of inclusion and equitable distribution of healthcare to ensure health for all. Therefore, more research is required among foreign migrants to explore their public health position, perception, and attitude, especially during a pandemic. The migrant population who are gender minority, culture and belief sensitive, and have family ties require global support and programs that seek to find these groups through microprograms for reorientation. The other indicators identified in these studies correlating with WTP and perceived vaccine efficacy need further qualitative research that can identify the primary concern of the migrant groups.

REFERENCES

1. Johns Hopkins Coronavirus Resource Center. COVID-19 map. Available at: https://coronavirus.jhu.edu/map.html (Accessed: 12 July 2021).

2. Al-Oraibi A, Martin CA, Hassan O, Wickramage K, Nellums LB, Pareek M. Migrant health is public health: A call for equitable access to COVID-19 vaccines. Lancet Public Health. 2021;6(3):e144. https://doi.org/10.1016/S2468-2667(21)00031-1 PMid:33640075 PMCid:PMC8130913

3. Kaur SP, Gupta V. COVID-19 vaccine: A comprehensive status report. Virus Res. 2020;288:198114. https://doi.org/10.1016/j.virusres.2020.198114 PMid:32800805 PMCid:PMC7423510

4. Villarreal DO, Talbott KT, Choo DK, Shedlock DJ, Weiner DB. Synthetic DNA vaccine strategies against persistent viral infections. Expert Rev Vaccines. 2013;12(5):537-54. https://doi.org/10.1586/erv.13.33 PMid:23659301 PMCid: PMC4317298

5. Akintunde TY, Chen S, Musa TH, et al. Tracking the progress in COVID-19 and vaccine safety research–a comprehensive bibliometric analysis of publications indexed in Scopus database. Hum Vaccin Immunother. 2021;17(11):3887-97. https://doi.org/10.1080/21645515.2021.1969851 PMid: 34613876

6. Whitaker JA, Ovsyannikova IG, Poland GA. Adversomics: A new paradigm for vaccine safety and design. Expert Rev Vaccines. 2015;14(7):935-47. https://doi.org/10.1586/14760584.2015.1038249 PMid:25937189 PMCid: PMC4630804

7. Dubé E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger J. Vaccine hesitancy: An overview. Hum Vaccin Immunother. 2013;9(8):1763-73. https://doi.org/10.4161/hv.24657 PMid:23584253 PMCid:PMC3906279

8. Dubé E, Vivion M, MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: Influence, impact and implications. Expert Rev Vaccines. 2015;14(1):99-117. https://doi.org/10.1586/14760584.2015.964212 PMid:25373435

9. Mahmud S, Mohsin Md, Khan IA, Mian AU, Zaman MA. Knowledge, beliefs, attitudes and perceived risk about COVID-19 vaccine and determinants of COVID-19 vaccine acceptance in Bangladesh. PLoS One. 2021;16(9):e0257096. https://doi.org/10.1371/journal.pone.0257096 PMid: 34499673 PMCid:PMC8428569

10. Razai MS, Osama T, Mckechnie DGJ, Majeed A. Covid-19 vaccine hesitancy among ethnic minority groups. BMJ. 2021;372:n513. https://doi.org/10.1136/bmj.n513 PMid: 33637577

11. Schwarzinger M, Watson V, Arwidson P, Alla F, Luchini S. COVID-19 vaccine hesitancy in a representative working-age population in France: A survey experiment based on vaccine characteristics. Lancet Public Health. 2021;6(4):e210-21. https://doi.org/10.1016/S2468-2667(21)00012-8

12. Loomba S, de Figueiredo A, Piatek SJ, de Graaf K, Larson HJ. Measuring the impact of COVID-19 vaccine misinformation on vaccination intent in the UK and USA. Nat Hum Behav. 2021;5(3):337-48. https://doi.org/10.1038/s41562-021-01056-1 PMid:33547453

13. Geoghegan S, O'Callaghan KP, Offit PA. Vaccine safety: Myths and misinformation. Front Microbiol. 2020;11:372. https://doi.org/10.3389/fmicb.2020.00372 PMid:32256465 PMCid:PMC7090020

14. Goruntla N, Chintamani SH, Bhanu P, et al. Predictors of acceptance and willingness to pay for the COVID-19 vaccine in the general public of India: A health belief model approach. Asian Pac J Trop Med. 2021;14(4):165-75. https://doi.org/10.4103/1995-7645.312512

15. Harapan H, Wagner AL, Yufika A, et al. Willingness-to-pay for a COVID-19 vaccine and its associated determinants in Indonesia. Hum Vaccin Immunother. 2020;16(12):3074-80. https://doi.org/10.1080/21645515.2020.1819741 PMid: 32991230 PMCid:PMC8641577

16. China | International Organization for Migration. Available at: https://www.iom.int/countries/china (Accessed: 29 December 2021).

17. Montag C, Becker B, Gan C. The multipurpose application WeChat: A review on recent research. Front Psychol. 2018;9:2247. https://doi.org/10.3389/fpsyg.2018.02247 PMid:30618894 PMCid:PMC6297283

18. Calculator. Sample size calculator. Available at: https://www.calculator.net/sample-size-calculator.html?type=1&cl=95&ci=5&pp=30&ps=300000&x=79&y=14 (Accessed: 15 January 2022).

19. Abir T, Kalimullah NA, Osuagwu UL, et al. Factors associated with the perception of risk and knowledge of contracting the SARS-CoV-2 among adults in Bangladesh: Analysis of online surveys. Int J Environ Res Public Health. 2020;17(14):5252. https://doi.org/10.3390/ijerph17145252 PMid:32708161 PMCid:PMC7400220

20. Alcántara C, Chen C-N, Alegría M. Do post-migration perceptions of social mobility matter for Latino immigrant health? Soc Sci Med. 2014;101:94-106. https://doi.org/10.1016/j.socscimed.2013.11.024 PMid:24560229 PMCid:PMC4041158

21. De Coninck D, d'Haenens L, Matthijs K. Perceived vulnerability to disease and attitudes towards public health measures: COVID-19 in Flanders, Belgium. Pers Individ Dif. 2020;166:110220. https://doi.org/10.1016/j.paid.2020.110220 PMid:32834279 PMCid:PMC7327450

22. Akintunde T, Chen S, Oyeniran O, et al. Personal sensitivity, self-medication, mask usage, and COVID-19 symptoms in sub-saharan Africans. İst Tıp Fak Derg [J Istanbul Fac Med]. 2022;20(21):1-8. https://doi.org/10.26650/IUITFD.945803

23. Saghazadeh A, Rezaei N. Towards treatment planning of COVID-19: Rationale and hypothesis for the use of multiple immunosuppressive agents: Anti-antibodies, immunoglobulins, and corticosteroids. Int Immunopharmacol. 2020;84:106560. https://doi.org/10.1016/j.intimp.2020.106560 PMid:32413736 PMCid:PMC7205724

24. Tian J, Yuan X, Xiao J, et al. Clinical characteristics and risk factors associated with COVID-19 disease severity in patients with cancer in Wuhan, China: A multicentre, retrospective, cohort study. Lancet Oncol. 2020;21(7):893-903. https://doi.org/10.1016/s1470-2045(20)30309-0

25. The World Health Organization Quality of Life Assessment (WHOQOL): Development and general psychometric properties. Soc Sci Med. 1998;46(12):1569-85. https://doi.org/10.1016/s0277-9536(98)00009-4

26. Akintunde TY, Musa TH, Musa HH, et al. Bibliometric analysis of global scientific literature on effects of COVID-19 pandemic on mental health. Asian J Psychiatr. 2021;63:102753. https://doi.org/10.1016/j.ajp.2021.102753 PMid:34280888

27. Koboldt DC. Best practices for variant calling in clinical sequencing. Genome Med. 2020;12(1):91. https://doi.org/10.1186/s13073-020-00791-w PMid:33106175 PMCid:PMC7586657

28. Zhang J, Zeng H, Gu J, Li H, Zheng L, Zou Q. Progress and prospects on vaccine development against SARS-CoV-2. Vaccines (Basel). 2020;8(2):153. https://doi.org/10.3390/vaccines8020153 PMid:32235387 PMCid:PMC7349596

29. Murphy J, Vallières F, Bentall RP, et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. Nat Commun. 2021;12:29. https://doi.org/10.1038/s41467-020-20226-9 PMid:33397962 PMCid:PMC7782692

30. Tankwanchi AS, Jaca A, Larson HJ, Wiysonge CS, Vermund SH. Taking stock of vaccine hesitancy among migrants: A scoping review protocol. BMJ Open. 2020;10(5):1-6. https://doi.org/10.1136/bmjopen-2019-035225 PMid:32404392 PMCid:PMC7228513

31. Alabdulla M, Reagu SM, Al-Khal A, Elzain M, Jones RM. COVID-19 vaccine hesitancy and attitudes in Qatar: A national cross-sectional survey of a migrant-majority population. Influenza Other Respir Viruses. 2021;15(3):361-70. https://doi.org/10.1111/irv.12847 PMid:33605010 PMCid:PMC8014858

32. Wong LP, Wong PF, AbuBakar S. Vaccine hesitancy and the resurgence of vaccine preventable diseases: The way forward for Malaysia, a Southeast Asian country. Hum Vaccines Immunother. 2020;16(7):1511-20. https://doi.org/10.1080/21645515.2019.1706935 PMid:31977285 PMCid:PMC7482793

33. Knights F, Carter J, Deal A, et al. Impact of COVID-19 on migrants' access to primary care and implications for vaccine roll-out: A national qualitative study. Br J Gen Pract. 2021;71(709):e583-95. https://doi.org/10.3399/bjgp.2021.0028 PMid:33875420 PMCid:PMC8216266

34. Khaled SM, Petcu C, Bader L, et al. Prevalence and potential determinants of COVID-19 vaccine hesitancy and resistance in qatar: Results from a nationally representative survey of qatari nationals and migrants between December 2020 and January 2021. Vaccines (Basel). 2021;9(5):471. https://doi.org/10.3390/vaccines9050471 PMid:34067103 PMCid:PMC8151168

35. Matlin SA, Depoux A, Schütte S, Flahault A, Saso L. Migrants' and refugees' health: Towards an agenda of solutions Henrique Barros, Bent Greve, Walter Ricciardi. Public Health Rev. 2018;39(1):1-55. https://doi.org/10.1186/s40985-018-0104-9 PMCid:PMC6182765

36. Calina D, Docea AO, Petrakis D, et al. Towards effective COVID-19 vaccines: Updates, perspectives and challenges (review). Int J Mol Med. 2020;46(1):3-16. https://doi.org/10.3892/ijmm.2020.4596 PMid:32377694 PMCid:PMC7255458

37. McAbee L, Tapera O, Kanyangarara M. Factors associated with COVID-19 vaccine intentions in eastern Zimbabwe: A cross-sectional study. Vaccines (Basel). 2021;9(10):1109. https://doi.org/10.3390/vaccines9101109 PMid:34696215 PMCid:PMC8538260

38. Ahamed F, Ganesan S, James A, Zaher WA. Understanding perception and acceptance of Sinopharm vaccine and vaccination against COVID-19 in the UAE. BMC Public Health. 2021;21(1):1602. https://doi.org/10.1186/s12889-021-11620-z PMid:34461846 PMCid:PMC8404750

39. Truong J, Bakshi S, Wasim A, Ahmad M, Majid U. What factors promote vaccine hesitancy or acceptance during pandemics? A systematic review and thematic analysis. Health Promot Int. 2022;37(1):daab105. https://doi.org/10.1093/heapro/daab105 PMid:34244738

40. Yasmin F, Najeeb H, Moeed A, et al. COVID-19 vaccine hesitancy in the United States: A systematic review. Front Public Heal. 2021;9:770985. https://doi.org/10.3389/fpubh.2021.770985 PMid:34888288 PMCid:PMC8650625

41. McKeown P, Dunn RA. A 'life-style choice' or a philosophical belief?: The argument for veganism and vegetarianism to be a protected philosophical belief and the position in England and Wales. Liverp Law Rev. 2021;42(2):207-41. https://doi.org/10.1007/s10991-020-09273-w PMid:33487780 PMCid:PMC7811388

42. Kreps S, Dasgupta N, Brownstein JS, Hswen Y, Kriner DL. Public attitudes toward COVID-19 vaccination: The role of vaccine attributes, incentives, and misinformation. npj Vaccines. 2021;6:73. https://doi.org/10.1038/s41541-021-00335-2 PMid:33990614 PMCid:PMC8121853

43. Lin Y, Hu Z, Zhao Q, Alias H, Danaee M, Wong LP. Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China. PLoS Negl Trop Dis. 2020;14(12):e0008961. https://doi.org/10.1371/journal.pntd.0008961 PMid:33332359 PMCid:PMC7775119

44. Nguyen LH, Hoang MT, Nguyen LD, et al. Acceptance and willingness to pay for COVID-19 vaccines among pregnant women in Vietnam. Trop Med Int Heal. 2021;26(10):1303-13. https://doi.org/10.1111/tmi.13666 PMid:34370375 PMCid:PMC8447150

45. Wane A, Dione M, Wieland B, Rich KM, Yena AS, Fall A. Willingness to vaccinate (WTV) and willingness to pay (WTP) for vaccination against peste des petits ruminants (PPR) in Mali. Front Vet Sci. 2020;6:488. https://doi.org/10.3389/fvets.2019.00488 PMid:32010711 PMCid:PMC6974520

46. Piltch-Loeb R, DiClemente R. The vaccine uptake continuum: Applying social science theory to shift vaccine hesitancy. Vaccines (Basel). 2020;8(1):76. https://doi.org/10.3390/vaccines8010076 PMid:32046228 PMCid:PMC7157682

47. Verelst F, Kessels R, Willem L, Beutels P. No such thing as a free-rider? Understanding drivers of childhood and adult vaccination through a multicountry discrete choice experiment. Vaccines (Basel). 2021;9(3):264. https://doi.org/10.3390/vaccines9030264 PMid:33809589 PMCid:PMC7999942

48. Evrony A, Caplan A. The overlooked dangers of anti-vaccination groups' social media presence. Hum Vaccin Immunother. 2017;13(6):1475-6. https://doi.org/10.1080/21645515.2017.1283467 PMid:28406737 PMCid:PMC5489284

49. Broadbent JJ. Vaccine hesitancy: Misinformation on social media. BMJ. 2019;366:I4457. https://doi.org/10.1136/bmj.l4457 PMid:31270071

50. Liang Y, Bai X, Liu X, et al. Hepatitis B vaccination coverage rates and associated factors: A community-based, cross-sectional study conducted in Beijing, 2019-2020. Vaccines (Basel). 2021;9(10):1070. https://doi.org/10.3390/vaccines9101070 PMid:34696178 PMCid:PMC8539675