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Factors associated with COVID-19 vaccine uptake among foreign migrants in China

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ABSTRACT

Background/Purpose: The COVID-19 outbreak created unique policy challenges for vaccinating special groups like migrants. As part of sustainable development goals, the equitable distribution of the COVID-19 vaccine can contribute to ensuring health for all. This study examined COVID-19 vaccine uptake among foreign migrants in China based on sociodemographics, cultural beliefs, past vaccine behaviors, and psychosocial factors.

Design: An online cross-sectional survey was conducted among foreign migrants in mainland China via social media platforms from 21 November through 20 December 2021. Bivariate (unadjusted odd-ratio) and multivariate logistic regression analyses were performed to establish the correlates of COVID-19 vaccine uptake.

Result: Surveyed foreign migrants that are culture neutral (AOR: 2.5, CI: 95%, 1.02–5.90, $p = 0.044$), willing to pay for vaccination (AOR: 2.27, CI: 95%, 1.18–3.98, $p = 0.012$), believe in vaccine efficacy (AOR: 3.00, CI: 95%, 1.75–5.16, $p < 0.000$), have poor psychological health (AOR: 1.96, CI: 95%, 1.14–3.38, $p = 0\ 0.014$), and have higher perceived seriousness of COVID-19 (AOR: 2.12, CI: 95%, 1.26–3.57, $p = 0.005$) are more likely to receive COVID-19 vaccine. Those migrants with a history of declining vaccination (AOR: 0.34, CI: 95%, 0.18–0.65, $p = 0.000$) and middle-income earners $1701–3500 (AOR: 0.43, CI: 95%, 0.23–0.82, $p = 0.010$) are less likely to receive the COVID-19 vaccine.

Conclusion: This study brings a unique perspective to understanding vaccine behavior among international migrants in China. There is an urgent call from the World Health Organization and countries for complete vaccination and efforts to improve vaccine coverage. However, fewer studies have been conducted globally on the vaccination of migrant populations. The current study provides empirical information to increase the knowledge of the correlates of vaccine behavior among immigrants in countries around the globe. Future studies should conduct cross-country comparisons to understand the factors associated with increasing vaccination rates

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among immigrant populations to formulate a strong policy to increase vaccine coverage among immigrant populations across countries.

1. Introduction

The unique composition of the global migrant population created an enormous policy concern toward ensuring all-inclusive participation in the COVID-19 vaccination. While migrants are distinct groups, diverse in their background, culture, beliefs, and experiences [1], the international organization for migration has shown concern about migrants' vulnerabilities during the COVID-19 pandemic [2] and how they could access health services. The COVID-19 vaccines roll-out and the complexities associated with COVID-19 variants require consideration of migrants to ensure their safety and participation in the vaccination program [3]. The approach to solving the complexities of involving migrants in COVID-19 vaccination hinges on inclusion and equitable health promotion [4]. Thus, equitable distribution of the COVID-19 vaccine is crucial to easing the global crisis and ensuring health for all [5]. Additionally, equity in vaccine distribution supports the notion that everyone, regardless of age, socioeconomic status, race, or location, should participate in the global effort to prevent and control the spread of COVID-19. However, significant stumbling blocks were encountered worldwide concerning equitable vaccination.

One concern associated with the equitable distribution of the COVID-19 vaccine is the lack of access to vaccines and healthcare for migrants [6–9]. The hesitancy to receive vaccines and barriers to COVID-19 vaccination among international migrants have also been the subject of debates [10]. Prioritizing COVID-19 vaccination poses health policy problems without understanding the peculiarities, dynamics, and composition of foreign migrants worldwide. Several studies have examined the experiences of migrants in non-Asian regions, finding that short waiting periods and free vaccination influence acceptance, whereas concern about side effects, perceived safety, and the severity of COVID-19 encourages vaccine hesitancy [11]. Situational peculiarities of migrants, specifically stigmatization, have been identified in other studies as factors that hinder their willingness to receive vaccinations [12]. The sensitivity of the global migrant population's position on vaccine uptake consolidated the growing need to examine their circumstances in diverse regions to inform global health policies [13,14]. Despite this research needs, few evidence-based studies have paid attention to culture, beliefs, gender minorities, past vaccination behavior, and multi-level psychosocial indicators that may aid in promoting or discouraging vaccination among migrants [9,15].

Several studies suggest that introducing new vaccines to combat emerging diseases could lead to vaccination hesitancy and refusal [16,17]. In addition, low acceptance rates of the COVID-19 vaccine have been reported in the Middle East (i.e., 23.6% in Kuwait and 28.4% in Jordan) and Africa (i.e., 27.7% in Congo), while some Asian regions have an average acceptance rate of 90% among adults [18]. Like any other vaccine, COVID-19 vaccine hesitancy has been attributed to concern about side effects [19] and misinformation [20]. A preponderance of evidence also suggests that regional COVID-19 vaccine hesitancy, especially in Africa, is primarily due to a multiplicity of distrust and misconceptions about the COVID-19 outbreak [21], concern about side effects [16], and African cultural and religious prejudice [22]. In developed countries, age, gender, ethnicity, and education have been identified as factors contributing to vaccine hesitancy [23]. In South Korea, lack of confidence, fear factors, earnings, and health status were causes of vaccine hesitancy [24]. Considering the robust evidence on COVID-19 vaccination and hesitancy, a global scale-up of vaccine safety information has been proposed [20,25].

In China, the nationwide demand for the COVID-19 vaccine is high. Residents believe the COVID-19 vaccine decreases the risk of infection, and those not concerned about vaccine efficacy are more likely to obtain vaccination [26]. In a comparative study of vaccine hesitancy in the US and Chinese populations, less than 20% of Chinese individuals are vaccine-hesitant, compared to about 30% in the US [27]. Research evidence suggests that 89.5% of the Chinese believed vaccination against COVID-19 would effectively curtail the spread of the disease [28]. Therefore, the willingness of the Chinese population to be vaccinated increased as the pandemic progressed through various waves [29]. Most Chinese people with increased trust in the healthcare system are more receptive to the COVID-19 vaccination [30]. However, in Hong Kong, due to increased concerns about the safety of the COVID-19 vaccine, vaccination acceptance among the working population decreased in the third wave compared to the first wave [31].

According to research among Chinese population, misinformation and an out-of-pocket vaccination approach are the primary psychosocial factors responsible for vaccine hesitancy [32]. To document their unique circumstances and support global intervention, it is necessary to conduct extensive research on the vaccination experience of the migrant population in China. Based on a comprehensive survey of willingness to pay (WTP), vaccination among internal migrants in Shanghai may be hindered by the high cost of vaccination and safety concerns [33]. Considering that the research subjects were internal migrants, the scope of the study was limited; therefore, more study is needed to support the existing evidence regarding the need for continuing support for foreign migrant groups.

This study aimed to identify determinants of vaccination uptake among foreign migrant populations in China based on historical, cultural, social, and psychological factors. There are significant gaps in our understanding of psychosocial factors that may influence the uptake of the COVID-19 vaccine in China due to the diversity of migrants and less research focus among the population. Therefore, the current study examined indicators such as culture, beliefs, past vaccinations, past vaccine refusals, accessibility, personal health, psychological health, and perceived seriousness of COVID-19 infection to enhance migrants' participation in COVID-19 vaccination. This study extends empirical evidence regarding the unique circumstances of migrants towards COVID-19 vaccination and provides templates for developing support for exclusive global vaccination against COVID-19 among the group. The objective of this study was to examine the likelihood that foreign migrants in China will receive vaccination against COVID-19 in light of a variety of sociodemographic characteristics, past vaccination behaviors, cultural and psychosocial factors.

2. Materials and methods

2.1. Study design, population, and sample size

The current research adopted a web-based cross-sectional approach to recruit migrants in China from 21 November through 20 December 2021. The distribution of the migrant population necessitated social media approaches as they are easily accessible via these channels based on convenience and snowballing. Statistics from the international organization for migration reported about one million foreign migrants in China [34]. Similar studies have used social media platforms to recruit a population based on the convenience of accessing people during the pandemic [35–37]. The foreign migrants included in the survey were students, ex-pats, and business owners. The number of foreign migrants in China was estimated at 1.4 million [38], and sample size (n) was evaluated using an online-based sampling estimator [39]. The sample size was 498, with a population proportion of 60% and a margin of error of 4.38% at a 95% confidence interval [40]. The recruited migrant population was nested in foreigner groups on WeChat, and the invitation was sent for voluntary participation. As the total population of students, ex-pats, and business owners is unknown, the distribution of these groups is not proportional. The total number of migrants recruited comprised 37.1% students, 43% ex-pats, and 19.9% business owners. Data were collected from foreign groups by targeting groups of students, ex-pats, and business owners.

2.1.1. Ethics approval and consent to participate

The study was conducted following the Helsinki Declaration and was approved by the School of Public Administration Review Board of Hohai University (reference No: CCF_000027). Informed consent was obtained from all participants involved in the study as requirement for filling research questionnaire and participation.

2.2. Measure

2.2.1. Outcome variable

Supported by previous studies, the outcome of interest was based on the current vaccination status if respondents received at least one dose of the COVID-19 vaccine. The measure was premised on a dichotomous variable (No = 0 or Yes = 1), "have you received the first dose of the COVID-19 Vaccine?" [41,42]. The binary step supports the exploration of the likelihood of receiving COVID-19 vaccination.

2.2.2. Predictor variables

Multiple indicators were conceptualized based on literature to examine the determinant of COVID-19 vaccination among the study population. The questionnaire development were guided by existing literature exploring the determinants of psychosocial and health behaviors. Essential socio-demographic characteristics such as gender identity, age, education, employment, and earning status were captured from previous studies examining socioeconomic determinants of vaccine behaviors [43,44]. Subjective cultural and psychosocial indicators were preference for traditional medicine over modern, vaccine development in an individual country, culture, and personal belief in the COVID-19 vaccine guided by literature on culture and COVID-19 vaccination [45]. Other measurement like free vaccination, WTP, experience with vaccine adverse effects, and relatives/family opposing vaccination were examined as explored in similar studies [46,47]. Further consideration was given to the history of vaccination against flu and hepatitis, past refusals, and vaccine accessibility [48]. Questions addressing personal health [49], perceived sensitivity [50], the seriousness of COVID-19 [51], social anxiety, and psychological health [52] were sourced from existing empirical evidence. Questionnaire information are detailed in Supplementary File 1.

2.3. Data management and analysis

Using percentage distribution and Chi-square estimations, a bivariate analysis was conducted. The analytical measures were premised on both Unadjusted Odds Ratio (UOR) and Adjusted Odds Ratio (AOR) to appraise the unconditional and conditional influence of the predictors (socio-demographic and psychosocial indicators) on the outcome variable (COVID-19 Vaccine uptake) among the foreign migrant population. The UOR explored the independent influence of the predictors on the outcome variables, whereas the AOR result presents the total net effect of all the predictors on vaccine uptake in the study population. The bivariate and multivariate logistic models' outcome results were presented as Odds ratios (and confidence intervals), where an outcome above/below 1 is a comparative category of a specific attribute that indicates a higher/lower probability of a result. We benchmarked statistical significance as $p < 0.05$. The analysis was conducted using SPSS version 25 and STATA 17 statistical computing software.

3. Results

3.1. Socio-demographic attributes

The data characteristics of the study population (N = 498) were included in the analysis. The age distribution shows that most participants were 25–34 (55.8%), while males were 47.6% and females were 45.2%. Meanwhile, the education level of the majority was university/postgraduate (92%). Students represented in the survey were 37.1%, and those employed were 43% (Table 1).

Based on chi-square analysis, socio-demographic attributes such as gender, education, and earnings were associated with COVID-

19 uptake (Table 2). Other facilitators of COVID-19 vaccine uptake were further presented in the table.

3.2. Bivariate and multivariate logistic regression

The data analysis and the independent effects (UORs) of the determinants of vaccine uptake indicated that gender minorities (others), secondary/high school, earning less than $3,500, and preferred traditional medicine over modern medicine were less likely to have received COVID-19 vaccines. Similarly, those with culture and beliefs against vaccination and a history of vaccine refusal were less likely to be vaccinated. Those migrants more likely to be vaccinated have higher perceived Seriousness of COVID-19, good health status, believe vaccines are accessible and efficacious, have received vaccination before, WTP, and will receive COVID-19 vaccine if made freely available (Table 3).

In Table 3, the net effect of the predictors projects a different scenario based on the outcomes of the AOR. The foreign migrants, based on multivariate estimates who are less likely to be vaccinated earn between $1701–3500 (AOR: 0.43, CI: 95%, 0.23–0.82, $p = 0.010$) and have a history of declining vaccination (AOR: 0.34, CI: 95%, 0.18–0.65, $p = 0.000$). Those foreign migrants who are likely to be vaccinated are those who are culture neutral (AOR: 2.5, CI: 95%, 1.02–5.90, $p = 0.044$), WTP for vaccination (AOR: 2.27, CI: 95%, 1.18–3.98, $p = 0.012$), believe in vaccine efficacy (AOR: 3.00, CI: 95%, 1.75–5.16, $p < 0.000$), received vaccine before (AOR: 2.13, CI: 95%, 1.23–3.67, $p = 0.001$), good personal health status (AOR: 1.91, CI: 95%, 1.06–3.40, $p = 0.029$), better health compared to same age-group (AOR: 1.79, CI: 95%, 1.02–3.15, $p = 0.044$), high perceived Seriousness to COVID-19 (AOR: 2.12, CI: 95%, 1.26–3.57, $p = 0.005$) and have poor self-rated psychological health (AOR: 1.96, CI: 95%, 1.14–3.38, p = 0 0.014).

4. Discussion

This study contributes to the empirical evidence concerning the behavioral, psychosocial, and cultural determinants of vaccine uptake among foreign migrants in China. The mutations and variants of COVID-19 have led to health experts recommending a global vaccination program to increase resistance and immunity to COVID-19 infection [53]. An evaluation of foreign migrants' multi-level attributes was conducted based on perceptions about their culture, beliefs, past vaccinations or refusals, accessibility, personal health, psychological health, and perceived severity of COVID-19 infection. Based on the recruited population, the study found that less than 17% of migrants had a history of vaccine refusal, and 30.7% had not received COVID-19 vaccines. This result shows the low vaccination refusal among the research population, although it is problematic to compare hesitancy among foreign migrants and the Chinese people based on limited research evidence among the former group. Foreigners who are culture neutral, WTP, believe in vaccine efficacy, have poor psychological health, and have a higher perception of COVID-19's seriousness were more likely to receive the COVID-19 vaccine. In contrast, migrants with a history of declining vaccination and those with an average income ($1701 - $3500) are less likely to receive the COVID-19 vaccine.

Foreign migrants with average incomes were less likely to receive COVID-19 vaccination than those with above-average incomes. The findings of this study are in agreement with those found among Chinese citizens, who may not receive health care services if they earn a low income [54]. However, the findings of the current study differ from those obtained from research conducted in Russia, since the majority of COVID-19 vaccine recipients were low-income earners in the region [55]. The level of financial security plays an important role in determining the intent to be vaccinated, and average earners may feel too burdened to bear the cost of vaccination, especially if vaccines are not readily available. This study supports the evidence that high income is associated with an increased WTP for vaccinations [56]. Research evidence show that vaccine refusals predate the COVID crisis, which explains the consistency of our findings [57]. This study indicates that those who have previously refused vaccinations are less likely to have received COVID-19 vaccines. Negative perceptions about vaccines may lead to vaccine refusal [58]. However, one-time vaccination of migrants,

Table 1
Characteristics of Migrants participants in China N = 498.

Variables	Attributes	Freq. (%)
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)
	Gender minorities	36 (7.2)
Earning/Month	$3500+	202 (40.6)
	$1700–3500	128 (25.7)
	$300–1700	168 (33.7)
Employment	Employed (Ex-pats)	214 (43)
	Self-employed (Business Owners)	75 (15.1)
	Students	185 (37.1)
	Unemployed/Business	24 (4.8)
Education	University/Postgraduate	458 (92)
	Technical Training	18 (3.6)
	Highschool	22 (4.4)

Table 2
Characteristics of Study Participants and facilitating factors of COVID-19 vaccine uptake among Migrants population in China (N = 498).

Variables	Categories		Vaccine Uptake		$X^{2(p\text{-}value)}$
			No	**Yes**	
		Total(498)%	**(N = 153)%**	**(N = 345)%**	
Gender					7.206*
	Male	237 (47.6)	66 (43.1)	171 (49.6)	
	Female	225 (45.2)	69 (45.1)	156 (45.2)	
	Others	36 (7.2)	18 (11.8)	18 (5.2)	
Age					3.229
	15–24	68 (13.7)	19 (12.4)	49 (14.2)	
	25–34	278 (55.8)	84 (54.9)	194 (56.20)	
	35–44	141 (28.3)	44 (28.8)	97 (28.1)	
	44>	11 (2.2)	6 (3.9)	5 (1.4)	
Education					6.258*
	University/Postgraduate	458 (92)	135 (88.2)	323 (93.6)	
	College/Technical Training	18 (3.6)	6 (3.9)	12 (3.5)	
	Secondary/Highschool	22 (4.4)	12 (7.8)	10 (2.9)	
Employment					2.599
	Employed	214 (43)	65 (42.5)	149 (43.2)	
	Self-employed	75 (15.1)	25 (16.3)	50 (14.5)	
	Students	185 (37.1)	59 (38.7)	126 (36.5)	
	Unemployed/Business	24 (4.8)	4 (2.6)	20 (5.8)	
Earning/Month	$3500	202 (40.6)	47 (30.7)	155 (44.9)	9.178*
	$1701–3500	128 (25.7)	48 (31.4)	80 (23.2)	
	$300 - 1700	168 (33.7)	58 (37.90	110 (31.9)	
Preference for TM					9.708**
	No	371 (74.5)	100 (65.4)	271 (78.6)	
	Yes	127 (25.5)	53 (34.6)	74 (25.5)	
Home Made Vaccine					3.296
	No	234 (48.8)	84 (54.9)	159 (46.1)	
	Yes	255 (51.2)	69 (45.1)	189 (53.9)	
Culture oppose Vaccine					32.920***
	No	387 (77.7)	102 (66.7)	285 (82.6)	
	Neutral	59 (11.8)	17 (11.1)	42 (12.2)	
	Yes	52 (10.4)	34 (22.2)	18 (5.2)	
Belief oppose Vaccine					36.583***
	No	371 (74.5)	92 (60.1)	279 (80.9)	
	Neutral	65 (13.1)	22 (14.4)	43 (12.5)	
	Yes	62 (12.4)	39 (25.5)	23 (6.7)	
Free Vaccine					5.819*
	No	361 (72.5)	122 (79.7)	239 (69.3)	
	Yes	137 (27.5)	31 (20.3)	106 (30.7)	
WTP					28.890***
	No	175 (35.3)	80 (52.6)	95 (27.6)	
	Yes	321 (64.7)	72 (47.4)	249 (72.4)	
The vaccine has Adverse effect					
	No	375 (75.7)	114 (74.5)	261 (75.7)	0.074
	Yes	123 (24.7)	39 (25.5)	84 (24.3)	
Family Oppose Vaccine					3.513
	No	190 (38.2)	49 (32)	141 (40.9)	
	Yes	308 (61.8)	104 (68)	204 (59.1)	
Vaccines Efficacy					46.719***
	No	149 (29.9)	78 (51)	71 (20.6)	
	Yes	349 (70.1)	75 (49)	274 (79.4)	
Past Vaccination (HPV/Flu etc.)					26.295***
	No	143 (28.7)	68 (44.4)	75 (21.7)	
	Yes	355 (71.3)	85 (55.6)	270 (78.3)	
Refused Vaccine Before					34.389***
	No	415 (83.3)	105 (68.6)	310 (89.9)	
	Yes	83 (16.7)	48 (31.4)	35 (10.1)	
Vaccines are Accessible					10.454**
	No	173 (34.7)	69 (45.1)	104 (30.1)	
	Yes	325 (65.3)	84 (54.9)	241 (69.9)	
Personal Health					19.991***
	Poor Health	138 (27.7)	63 (41.2)	75 (21.7)	
	Good Health	360 (72.3)	90 (58.8)	270 (78.3)	
Health compared to others					8.898**
	Poor Health	256 (51.4)	94 (61.4)	162 (47)	

(*continued on next page*)

Table 2 (*continued*)

Variables	Categories		Vaccine Uptake		$X^{2(p\text{-}value)}$
			No	**Yes**	
		Total(498)%	**(N = 153)%**	**(N = 345)%**	
	Good Health	242 (48.6)	59 (38.6)	183 (53)	
Perceived Sensitivity to COVID-19					1.273
	Low Sensitivity	133 (26.7)	46 (30.1)	87 (25.2)	
	High Sensitivity	365 (73.3)	107 (69.9)	258 (74.8)	
Perceived Seriousness of COVID-19					25.655***
	Low Seriousness	176 (35.3)	79 (51.6)	97 (28.1)	
	High Seriousness	322 (64.7)	74 (48.4)	248 (71.9)	
Social Anxiety					0.016
	High Anxiety	308 (61.8)	94 (61.4)	214 (62)	
	Low Anxiety	190 (38.2)	59 (38.6)	131 (38)	
Psychological Health					0.458
	Good	194 (39)	63 (41.2)	131 (38)	
	Poor	304 (61)	90 (58.8)	214 (62)	

*p < 0.05, **p < 0.01, ***p < 0.001; TM: Traditional Medicine, WTP: Willingness to Pay, Other: Gender minorities.

especially those who have previously received hepatitis B or flu vaccines, is likely to increase their uptake of the COVID-19 vaccine.

Contrary to narratives concerning attributes of vaccine refusers, the underpinning cultural factor can serve as a bridge to understanding some complexity in vaccine hesitancy among the immigrant, given that they are a composition of culturally diverse groups. Culture based on vaccine acceptability has been proposed as a potential attribute of *anti*-vaxxers related to ideologies and how it may affect global herd immunity [59]. Additionally, based on the findings of our study, culture-neutral people are more likely to be vaccinated than those who are culturally inclined. Furthermore, it is imperative to note that cultural beliefs (i.e., not opposing vaccination) may not necessarily promote vaccination compared to cultural neutrality. There is evidence that specific cultural values contribute to hesitancy among certain individuals regarding other vaccinations, such as the Human Papillomavirus (HPV) vaccine [60].

The WTP for vaccination and perceived efficacy have also been investigated among diverse groups and regions to promote vaccination participation [61,62]. Several studies have revealed that foreign migrants in China with WTP for vaccination are more likely to have received the COVID-19 vaccine than those with no WTP [63]. Disseminating information about vaccine efficacy globally can reduce vaccine hesitancy by considering the benefit of vaccination [26]. Vaccination against COVID-19 is more likely to be undertaken by individuals who believe that vaccines provide adequate protection against infection. Without knowing vaccine functions and clarifying misconceptions about vaccines, people from diverse backgrounds may not understand vaccine efficacy [25].

The subjective health of vaccine recipients takes prominence in encouraging vaccination. Evidence suggests that hindrances to vaccination are associated with self-rated health statuses [64]. The role of personal health status in decision-making has been demonstrated to be important in determining health behaviors among diverse populations [65]. The likelihood of receiving vaccinations was higher among foreign migrants who rated their subjective health status as good and felt healthier than others in their age group. Vaccination rates were higher among foreign migrants who rated their subjective health status as good and felt healthier than their peers in their age group. There is an agreement between the findings of this study and those of other studies that report that self-rated health is a determinant of vaccine acceptance in the elderly population of Singapore and among local Chinese residents [66,67]. Thus, healthy individuals consistently strive to maintain their health and are willing to invest in it. The likelihood of non-vaccination is high among people who feel they are not as healthy or do not compare with others [24]. One might speculate why unhealthy individuals would not desire to receive a vaccination that would improve their health status. Several other studies have shown that self-rated health does not predict readiness to receive COVID-19 vaccination among different racial groups [68]. However, attempts should be made to address the unhealthy population of society immediately, assuming that reducing ignorance about vaccination as a protective measure will result in improved health outcomes.

Depending on a person's health status, age, and immune response, as well as changing global perceptions regarding COVID-19's severity, COVID-19's perceived seriousness varies widely [69]. When infected with COVID-19, one faces financial hardship as well as an increased risk of mortality. The perception of the seriousness of COVID-19 is an important factor in empirical discourse. Foreign migrants who believe COVID-19 infection can be severe are more likely to receive vaccination than those who believe it is not painful. The evidence suggests that COVID-19 is a serious disease, and it is important to take steps toward vaccination to mitigate the consequence [70]. COVID-19 has caused psychological distress that cannot be ignored [71]. In the context of the COVID-19 crisis, there is an interaction between mental health status and the willingness to participate in vaccination. Consequently, foreign migrants living in China with psychological distress were more likely to receive COVID-19 vaccinations. Studies have indicated that those with little or no fear of COVID-19 are more likely to hesitate to receive vaccinations [24]. In addition, people who display psychological resistance and distrust authoritative information are more likely to be vaccine-hesitant in countries such as the United Kingdom and Ireland [72]. Consequently, the current study focusing on the psychological health of foreign migrants revealed a high level of despair and depressive symptoms among the study group that led to the purchase of the COVID-19 vaccine. In addition, we argue that vaccination prevents psychological trauma resulting from infectious diseases [73].

This study identifies some critical factors contributing to vaccine uptake among foreign migrant residents in China. However,

Table 3
Bivariate and multivariate analysis of psychosocial determinants of COVID-19 vaccination (N = 498).

	Bivariate		Multivariate	
	UOR (95% CI)	p-value	AOR (95% CI)	p-value
Socio-demographic Attributes				
Gender				
Male	1		1	
Female	0.87 (0.58–1.30)	0.506	0.96 (0.57–1.59)	0.863
Others	0.39 (0.19–0.79)	**0.009**	1.01 (0.37–2.77)	0.989
Age				
15-24	1		1	
25-34	0.89 (0.49–1.61)	0.713	1.07 (0.51–2.24)	0.852
35-44	0.85 (0.45–1.62)	0.630	0.83 (0.36–1.92)	0.665
44>	0.32 (0.45–1.19)	0.088	1.45 (0.19–10.91)	0.714
Education				
University/Postgraduate	1		1	
College/Technical Training	0.84 (0.31–2.27)	0.725	0.67 (0.18–2.51)	0.555
Secondary/Highschool	0.34 (0.15–1.83)	**0.017**	0.68 (0.21–2.16)	0.508
Employment Status				
Employed	1		1	
Self-employed	0.87 (0.49–1.53)	0.634	0.84 (0.40–1.75)	0.638
Students	0.93 (0.61–1.4)	0.744	0.70 (0.38–1.27)	0.246
Unemployed/Business	2.18 (0.72–6.63)	0.169	1.75 (0.48–6.35)	0.392
Earning				
$3500	1		1	
$1701–3500	0.51 (0.31–0.82)	**0.006**	0.43 (0.23–0.82)	**0.010**
$300-1700	0.58 (0.37–0.91)	**0.017**	0.67 (0.36–1.22)	0.190
Transcultural Attributes				
Preference for TM				
No	1		1	
Yes	0.52 (0.34–0.78)	**0.002**	1.14 (0.61–2.12)	0.677
Home Made Vaccine				
No	1		1	
Yes	1.42 (0.97–2.09)	0.070	1.06 (0.64–1.77)	0.809
Culture oppose vaccine				
No	1		1	
Neutral	0.88 (0.48–1.62)	0.691	2.5 (1.02–5.90)	**0.044**
Yes	0.19 (0.10–0.35)	**0.000**	0.83 (0.28–2.44)	0.738
Belief oppose vaccine				
No	1		1	
Neutral	0.65 (0.37–1.13)	0.128	0.67 (0.30–1.49)	0.332
Yes	0.19 (0.11–0.34)	**0.000**	0.43 (0.15–1.21)	0.110
Vaccine behavior				
Free Vaccine				
No	1		1	
Yes	1.75 (1.11–2.76)	**0.017**	1.52 (0.83–2.81)	0.171
Willingness to pay (WTP)				
No	1		1	
Yes	2.91 (1.96–4.33)	**0.000**	2.27 (1.18–3.98)	**0.012**
The vaccine has Adverse effect				
No	1		1	
Yes	0.94 (0.61–1.46)	0.785	0.91 (0.52–1.58)	0.728
Family Oppose Vaccine				
No	1		1	
Yes	0.68 (0.46–1.01)	0.062	0.81 (0.48–1.35)	0.420
Vaccines Efficacy				
No	1		1	
Yes	4.01 (2.66–6.05)	**0.000**	3.00 (1.75–5.16)	**0.000**
Received Vaccine Before				
No	1		1	
Yes	2.88 (1.91–4.33)	**0.000**	2.13 (1.23–3.67)	**0.007**
Refused Vaccine Before				
No	1		1	
Yes	0.25 (0.15–0.40)	**0.000**	0.34 (0.18–0.65)	**0.001**
Vaccines are Accessible				
No	1		1	
Yes	1.90 (1.29–2.82)	**0.001**	1.38 (0.83–2.29)	0.213
Psychosocial Attributes				
Personal Health				
Poor Health	1		1	
Good Health	2.52 (1.67–3.80)	**0.000**	1.91 (1.06–3.40)	**0.029**

(*continued on next page*)

Table 3 (*continued*)

	Bivariate		Multivariate	
	UOR (95% CI)	p-value	AOR (95% CI)	p-value
Health compared to Others				
Poor Health	1		1	
Good Health	1.79 (1.22–2.65)	**0.003**	1.79 (1.02–3.15)	**0.044**
Perceived Sensitivity to COVID-19				
Low Sensitivity	1		1	
High Sensitivity	1.28 (0.84–1.95)	0.260	0.91 (0.52–1.57)	0.725
Perceived Seriousness of COVID-19				
Low Seriousness	1		1	
High Seriousness	2.73 (1.83–4.05)	**0.000**	2.12 (1.26–3.57)	**0.005**
Social Anxiety				
High Anxiety	1		1	
Low Anxiety	0.98 (0.66–1.44)	0.900	1.12 (0.66–1.88)	0.677
Psychological Health				
Good	1		1	
Poor	1.14 (0.78–1.69)	0.499	1.96 (1.14–3.38)	**0.014**

*p < 0.05, **p < 0.01, ***p < 0.001, CI: Confidence Interval, Ref −1: reference; UOR: Unadjusted Odds-ratio; AOR: Adjusted Odds-ratio; TM: Traditional Medicine, WTP: Willingness to Pay, Other: Gender minorities.

certain limitations should be considered when using the findings. Due to the cross-sectional nature of the study and the snowballing approach used to recruit participants, the cross-sectional design and data represent a subset of the total number of foreign migrants in China. Several vital details about the migrant population have been omitted in order to maintain the confidentiality of participant records. These details include the country of origin and the length of stay. To better understand the vaccine behavior of migrants, future research should examine more psychosocial variables. Nevertheless, the study's results offer valuable insight into the dynamics of migrants, which may contribute to improving health policy interventions.

4.1. Policy implication

The study's results suggest that attributes such as culture neutrality, willingness to pay, and confidence in the efficacy of vaccines can promote vaccination among foreigners, particularly regarding global health and policy. Migrants with poor subjective health may require health-promoting interventions to identify their health needs to facilitate their transition into good health. Governments, global health stakeholders, and policymakers can pay attention to these factors to improve vaccine uptake among migrants in host countries. Income and previous vaccination refusal should be considered when addressing hesitancy among migrants at the global level. As part of universal health coverage, policy decisions must ensure that migrant populations are considered part of the COVID-19 vaccine roll-out. To improve their vaccine participation for health equity, foreign migrants with a history of vaccine refusal require further investigation to understand the reasons for past refusal.

The study underscores the need for global policy to support minority and unique groups in health promotion programs to improve their experiences and quality of life. To encourage vaccine participation, policies centered on the cost-effective vaccine should be implemented for minority groups. To increase positive knowledge of vaccine efficacy, vaccination awareness, and education are necessary worldwide and in migrant communities. Efforts should be intensified to disseminate vaccine safety information, and micro-level strategies should be adopted to improve the reach of vaccine safety information, especially among minority groups and hard-to-reach population groups. It is imperative to pay attention to migrants who may not have access to health and social services as they do in their home countries to ensure they are supported through the COVID-19 crisis.

6. Conclusions

This study provides insight into vaccine behavior among foreigners in China during the roll-out of COVID-19 vaccines. Migrant populations must be targeted by considering cultural attributes, income status, and vaccination history. The study findings and the unique circumstance of the study population indicate that critical psychosocial factors such as psychological health, personal health, perceived seriousness, and willingness to pay are essential domains to reduce vaccine hesitancy and negative perceptions and increase vaccine uptake globally and among unique populations, including migrants studied in this study. Vaccination rates are higher among migrants in China if they are culture neutral, willing to pay for the COVID-19 vaccine, believe the vaccine is effective, have poor psychological health, perceive the outbreak of COVID-19 as being more severe, and are more likely to engage in vaccination practices. The likelihood of foreign migrants receiving at least one shot of the COVID-19 vaccine is also lower among those with a history of refusing vaccination and who earn an average income. Further research should be conducted on the migrant population to better understand salient concerns about vaccination through interviews and other variables not addressed in this study.

Author contribution statement

Tosin Yinka Akintunde: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data;

Contributed reagents, materials, analysis tools or data; Wrote the paper.

Ji-Kang Chen, Stanley Oloji Isangha, Muhideen Sayibu,: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Elhakim Ibrahim: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Taha Hussein Musa: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that no conflict of interest in respect of this manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e17567.

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