Original Article

Predictors of the willingness to receive the third dose of COVID-19 vaccine based on the Health Belief Model: A cross-sectional study in South Khorasan province

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ABSTRACT

Coronavirus disease 2019 (COVID-19) infections have re-emerged in several countries due to reduced levels of antibodies provided by vaccines or the rapid emergence of viral variants, such as Alpha, Beta, Gamma, and Delta. A considerable supplementary intervention is recommended, including an additional dose of vaccination. The present study aimed to assess the predictors of the willingness to receive the third dose of the COVID-19 vaccine based on the Health Belief Model (HBM) constructs among people referring to health centers in South Khorasan province. In this cross-sectional-analytical study, 283 people over 18 years old in South Khorasan province were randomly selected using the multi-stage cluster sampling method. The data were collected using a researcher-made questionnaire, including demographic information and health status, knowledge about COVID-19, and the third dose of the vaccine, as well as a questionnaire according to the HBM constructs, which was completed through self-report methods. Finally, the data were analyzed using the Chi-square test and multivariate logistic regression analysis. The mean age of the study participants was 36.57±11.56 years (range of 18-55). The results of multivariate logistic regression analysis demonstrated that gender (*P*=0.012), marital status (*P*=0.038), occupation (*P*=0.013), perceived severity (*P*=0.005), and cues to action (*P*=0.018) had a significant direct effect, while perceived barriers (*P*=0.010) had a significant inverse effect on the willingness to accept the third dose of the vaccine. Moreover, the predictor variables explained about 67.7% of the willingness to receive the third dose of the vaccine. The current study suggested that enhancing the perceived severity of COVID-19, along with healthcare providers' recommendations to receive the vaccine and reducing perceived barriers, can effectively encourage individuals to receive the third dose of the COVID-19 vaccine. These findings can be utilized to develop interventions aimed at promoting the uptake of the booster dose of the COVID-19 vaccine.

Keywords: Barriers, Booster, COVID-19, Vaccine

1. Introduction

According to the World Health Organization, in January 2020, severe acute respiratory syndrome coronavirus was reported as a public health crisis. Later, in March 2021, it was called the COVID-19 pandemic (1,2). The COVID-19 pandemic caused a serious public health burden that put millions of people at risk. As evidenced by epidemiological data, the most common ways of spreading the virus are sneezing, coughing, and droplets from face-to-face contact (3). Vaccines are potentially valuable tools for reducing disease transmission rates and subsequent infections (4,5). Nonetheless, cases of COVID-19, hospitalization, or even death have recently been reported in some people who had received their second dose of the vaccine (6,7). Changes or mutations in the virus reduce the effectiveness of vaccines over time, which may result in pandemic reemergence (8). Therefore, timely vaccination with the booster dose is recommended to increase the neutralizing antibody titer in the body and improve the declining protective efficacy of the vaccine. It can also protect against other later emerging variants (9,10). In order to assess the factors affecting the tendency of individuals to get vaccinated against COVID-19 (11), different standardized instruments have been designed using numerous theories, including the health belief model (HBM) (12). The HBM was applied as the core framework in the present study. It has six domains predicting health behaviors, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. Perceived susceptibility refers to a belief about the possibility of getting a condition. This study investigated the individuals' beliefs affected by the COVID-19 pandemic and the vaccine, as well as their perceptions of the vaccine's side effects and whether or not the vaccine could protect against infection. Feelings about the seriousness of developing the COVID-19 disease referred to perceived severity. The study considered the severity of financial and social consequences, such as social interactions, restricted family interactions, job loss, and reduced income. Individuals are faced with some obstacles, including information and access to vaccination centers (13). In this research, the technical elements of vaccine accessibility were associated with perceived obstacles, while the protection provided by COVID-19 vaccines was linked to perceived advantages. Additionally, an information source or strategy promoting a behavior adoption was identified as cues to action. In a study by Alobaidi and Hashim (2022), the constructs of perceived benefits and barriers of HBM significantly predicted getting a booster dose of the COVID-19 vaccination (14). Along the same lines, in a study by Qin et al., the construct of cues to action was the most important predictor of getting the vaccine (15). To the best of our knowledge, no study has investigated the willingness to receive the third dose of COVID-19 vaccines among people over 18 years of age in South Khorasan province. In light of the aforementioned issues, the present study aimed to assess the predictors of a willingness to receive the third dose of COVID-19 vaccine based on the HBM among people aged over 18 years in South Khorasan province.

2. Materials and Methods

2.1 Study design and setting

The present study was an analytical cross-sectional study conducted in South Khorasan province, Iran.

2.2 Study participant and sample size

The studied population included people aged 18 and over living in the urban areas of South Khorasan province in 2022. The inclusion criteria entailed the age of over 18 years and a history of getting two doses of COVID-19 vaccine. On the other hand, unwillingness to continue cooperating with the research team was considered the exclusion criterion. The sample size was determined at 283 cases according to the frequency of the willingness to receive the vaccine in the study by Rzymski et al. (16), assuming a confidence interval of 95% and d=0.1p - 0.2 p, and using the sample size formula. The study sample was selected by a multi-stage cluster sampling. Firstly, the cities of South Khorasan province were considered clusters. Among these cities, three cities were randomly selected, and then, in each city, random sampling was performed among people over 18 years of age.

2.3 Data collection tools

The data collection tool was a researcher-made questionnaire according to the HBM constructs, which was completed through self-report methods. The questionnaire included three sections. The first section pertained to demographic and health-related information (9 items), including gender, age, marital status, education, occupation, chronic disease, smoking, and history of being infected with COVID-19. The second section was related to the items addressing respondents' knowledge of COVID-19 disease and its vaccine (10 items). The options for responding to the questions were: "Yes" (score 1), "No," and "I don't know" (score 0). The last section consisted of questions about HBM constructs (n=19), including perceived susceptibility (n=3), perceived severity (n=6), perceived benefit (n=6), perceived barriers (n=3), perceived self-efficacy (n=4), cues to action (n=4), and finally, intention construct (n=1). The theoretical construct questions were scored based on a 5-point Likert scale from strongly agree (5) to strongly disagree (1). Before data collection, the reliability and validity of the questionnaire were assessed. A 15-member panel,

including health education experts, was employed to qualitatively confirm face validity and assess the ambiguity of expressions or inadequacies in the meanings of words, the degree of inconsistency, and the level of difficulty. The opinions of the panel members were applied to the questionnaire. After carefully studying the tools, the researchers asked 15 health education experts to provide their viewpoints to qualitatively confirm the content validity. The placement of the questions in their proper place, the use of appropriate words, the importance of the questions, and grammar were also checked. After collecting experts' opinions, the required changes were made to the instrument. The content validity ratio (CVR) was applied to ensure the selection of the best content (question necessity) and quantify the content validity. Moreover, to ensure the proper design of the questions to measure the content, the content validity index (CVI) was utilized. The values of CVI for perceived susceptibility, perceived severity, perceived benefit, perceived barriers, self-efficacy, and cues to action were respectively 0.84, 0.81, 0.85, 0.88, 0.80, and 0.82. The values of CVR for the mentioned parameters were estimated at 0.86, 0.82, 0.88, 0.90, 0.89, and 0.91, respectively. The reliability of the questionnaire was evaluated using test-retest. The values of CVI and CVR were obtained at 0.85 and 0.80, respectively. Furthermore, Cronbach's alpha reliability for the constructs was calculated at 79%.

2.4. Data analysis

After completing the questionnaires, the data were entered into SPSS software (version 26). In data analysis, descriptive indices (frequency, percentage, mean, and standard deviation) and the chi-square test were used to investigate the relationship between demographic variables and willingness or unwillingness to receive the third dose of the COVID-19 vaccine. To assess the predictors of willingness to receive the third dose of the COVID-19 vaccine by adjusting the effect of age, gender, marital status, education, occupation, income level, having a chronic disease, smoking, history of COVID-19 infection, and HBM constructs, multivariate logistic regression analysis was used with Enter method, likelihood ratio (LR), and indicator comparison.

3. Results

The mean age of participants was 36.57±11.56 years (range of 18-55). Most subjects (43.4%) were in the age group of 30-40 years. The majority of participants were female (53.85%) and had a diploma or high school degree (62.8%). Most subjects were non-employees (57.7%) and married (80.6%). Their income levels were nearly the same for both low (35.8%) and high (35.5%). The majority of participants had no chronic disease (78.1%), were non-smokers (91.8%), and had a history of being infected with COVID-19 (81.4%). The two previous doses of the vaccine received by most participants were the Sinopharm vaccine (71.7%), and only 14.7% of cases had received the Iranian vaccine. The willingness to receive the third dose of COVID-19 vaccine among the participants was 48.7%. The reason for the reluctance to accept the third dose of the COVID-19 vaccine in most subjects was the complications caused by the injection of the previous doses of the vaccine.The Chi-square test was conducted to investigate the relationship between demographic variables and willingness to receive the third dose of the COVID-19 vaccine. The results of this test demonstrated that the tendency to receive the third dose of the vaccine was higher in men, the age group under 30 years, married people, with university education, employees, people with high-income status, non-smokers, and those without a history of chronic diseases ($P<0.05$). Nevertheless, there was no statistically significant relationship between the history of being infected with COVID-19 and the willingness to receive the third dose of COVID-19 vaccine ($P>0.05$) (Table 1). The multivariate logistic regression test was employed to investigate the influencing factors on the willingness to receive the third dose of the vaccine in people over 18 years of age. Accordingly, the Hosmer and Lemeshow statistic illustrated a good degree of fit, and in the present regression model, the fit of the model to the data was appropriate ($X2=1.72$, $P=0.988$). Predictive (independent) variables explained about 67.7% of the willingness to receive the third dose of the vaccine (Cox & Snell R Square=0.677; $P<0.0001$). Table 2 summarizes information about beta regression coefficients, standard error, Wald statistic, significant value, odds ratio, and confidence interval in the multivariate logistic regression model with adjustment of the effect of other variables. Based on the data provided in table 2, the demographic variables of gender ($P=0.012$), marital status ($P=0.038$), and occupation ($P=0.013$) had a statistically significant relationship with willingness to receive the third dose of the vaccine ($P<0.05$). Among the constructs of the HBM model, perceived severity ($P=0.005$) and cues to action ($P=0.018$) had a direct and significant effect, whereas perceived barriers showed an inverse and significant effect ($P=0.010$). Other variables examined in the study, including age, income, education, history of chronic disease, perceived susceptibility, perceived benefits, and self-efficacy, did not exhibit a significant effect at the 0.05 level ($P>0.05$) (Table 2).

Table 1: Association of the demographic factors with willingness to receive the third dose of the COVID-19 vaccine

Variable				
	Yes, n (%)	No, n (%)	Total, n (%)	P_{value}
Age				
<30	41(46.6)	47(53.4)	88(31.5)	
30-40	52(43)	69(57)	121(43.4)	0/01
>40	43(61.4)	27(38.6)	70(25.1)	
Gender				
Male	73(53/7)	56(39/2)	129(46/2)	0/01
Female	63(46/3)	87(60/8)	150(53/8)	
Educational level				
Lower than high school diploma/high school diploma	49(36)	126(88.1)	175(62.7)	<0.001
University education	87(64)	17(11.9)	104(37.3)	
Occupational status				
Employed	106(77.9)	12(8.4)	118(42.3)	0.02
Non-employee	30(22.1)	131(91.6)	161(57.7)	
Marital status				
Married	114(83.8)	111(77.6)	225(80.6)	0.12
Single	22(16.2)	32(22.4)	54(19.4)	
Income level				
low	28(20.6)	72(50.3)	100(35.8)	<0.001
middle	53(39)	27(18.9)	80(28.7)	
high	55(40.4)	44(30.8)	99(35.4)	
Chronic disease				
Yes	41(30.1)	20(14)	61(21.9)	0.001
No	95(69.9)	123(86)	218(78.1)	
Smoking				
Yes	5(3/7)	18(12/6)	23(8/2)	0.006
No	131(96/3)	125(87/4)	256(91/8)	
History of being infected with COVID-19				
Yes	109(80.1)	118(82.5)	227(81.4)	0.36
No	27(19.9)	25(17.5)	52(18.6)	
Willingness to receive the third dose of the COVID-19 vaccine	136(48.7)	143(51.3)	279(100)	

Table 2: Factors predicting willingness to receive the third dose of COVID-19 vaccine based on multivariate logistic regression

Variable	Category	β	SE	Wald	P_{value}	Odds ratio	95% CI for odds ratio	
							lower	upper
Age	Less than 30			0.503	0.778			
	30- 40	-0.890	1.281	0.482	0.487	0.411	0.033	5.056
	More than 40	-0.364	1.293	0.079	0.778	0.695	0.055	8.754
Gender	Female							
	Male	2.195	.881	6.209	0.012	8.979	1.598	50.461
Marital status	Single							
	married	1.826	1.069	4.915	0.038	6.208	1.16	50.494
Educational level	Undergraduate			0.760	0.684			
	Diploma	0.972	1.428	0.463	0.496	2.643	0.161	43.391
	College	1.334	1.531	0.760	0.383	3.798	0.189	76.295
Occupational status	Non- Employee							
	Employee and retired	2.897	1.170	6.136	0.013	18.128	1.831	179.475
Income level	low			5.688	0.058			
	middle	-2.548	1.069	5.685	0.051	0.078	0.010	0.635
	high	-1.556	1.210	1.653	0.199	0.211	0.020	2.261
Chronic disease	No							
	Yes	1.815	1.393	1.698	0.193	6.142	0.400	94.198
Smoking	No							
	Yes	2.602	1.715	2.303	0.129	13.496	0.468	389.081
Covid-19 Infected	No							
	Yes	0.334	0.823	0.165	0.685	1.397	0.279	7.006
Vaccine	Non- Iranian							
	Iranian	0.524	1.158	0.204	0.651	1.688	0.174	16.340
Knowledge	High / Low & Moderate	1.507	0.927	2.642	0.104	4.514	0.733	27.788
Susceptibility		1.793	1.079	2.759	0.097	6.007	0.724	49.833
severity		3.953	1.396	8.015	0.005	52.099	3.375	804.206
Perceived benefits		-0.718	1.119	0.411	0.521	0.488	0.054	4.376
Perceived barriers		-2.274	0.960	5.607	0.018	0.103	0.016	0.676
Self- efficacy		-.471	1.024	0.212	0.645	0.624	0.084	4.648
Cues to action		2.640	1.026	6.616	0.010	14.016	1.875	104.786
Constant		-7.283	1.973	13.623	0.000	0.001		

4. Discussion

The present study aimed to assess the willingness to receive the third dose of the COVID-19 vaccine and its predictors based on the HBM constructs among people referring to health centers in South Khorasan province. The obtained results pinpointed that 48.7% of participants were willing to revive the third dose of the COVID-19 vaccine. Different studies have illustrated various rates of acceptance of the third dose of the vaccine. In a study by Abouzid et al., 60.2% of participants accepted the booster dose of the COVID-19 vaccine, while 20.4% were reluctant (17). In a study in China, people aged 18-59 had a higher acceptance rate for the booster dose (84.4%) (18). In the same context, in a study by Qin et al., 93.7% of subjects were willing to receive the booster dose (15). The increase in the acceptance rate of receiving the booster dose may be attributed to people's expectations of overcoming the new challenges posed by recent strains of COVID-19. In a study by Al-Qerem et al. among Jordanian adults, 44.6% of participants who had received the previous doses of the vaccine were willing to receive the booster dose of the COVID-19 vaccine (19). The complications caused by previous doses of the vaccine were among the reasons for the subjects of the present study's reluctance to receive the third dose of the vaccine. In a similar vein, Al-Qerem et al. reported that the participants were not willing to get the booster dose of the COVID-19 vaccine since they believed that it had not been proven scientifically. They also believed that they did not need the third dose of the vaccine since they had been infected with the virus or had developed it recently (19). In China, Lin et al. conducted research on those who were not willing to get the third dose of the vaccine. They reported that participants were worried about the side effects of the vaccine (20). It seems that the low willingness to be vaccinated among the subjects in the present study may be due to mistrust caused by some negative reports about vaccine safety and increased attention to vaccine safety. Regarding the relationship between demographic variables and the willingness to receive the third dose of the COVID-19 vaccine, the results of the present study demonstrated a significant relationship between age and the willingness to receive the third dose of the vaccine, with the willingness to receive the third dose being higher among those under 30 years old. In their study, Lai et al. indicated that young people were more willing to get the booster dose of the COVID-19 vaccine (18-30 vs. 41-50) (18). There was a significant relationship between gender and willingness to receive the third dose of the vaccine; accordingly, men were more likely to receive the third dose of the COVID-19 vaccine. Along the same lines, in a study by Fazel et al. (2021), the probability of accepting the COVID-19 vaccine was lower in women. Nonetheless, the results of a study by Jain et al. (2021) demonstrated that gender had no relationship with the acceptance of the COVID-19 vaccine among young people. Non-acceptance of the third dose of the vaccine among people has been attributed to the lack of sufficient information about the vaccine, the effectiveness of the COVID-19 vaccine, as well as cultural and religious factors (21,22). Furthermore, consistent with the results of a previous study (23), education and occupation showed a significant association with willingness to receive the third dose of the vaccine. People with a higher level of education may have a more comprehensive understanding of the benefits of vaccines, and as a result, they are able to objectively and rationally understand the protective effects of vaccines and are more willing to receive them. In addition, the willingness to receive the third dose of the COVID-19 vaccine was higher among employees compared to non-employees. Compared to other occupational groups, a study on employees of public institutions and civil servants of government agencies suggested that they were more willing to get the vaccine (15). This can be ascribed to their vaccine-related knowledge and their higher probability of being infected with COVID-19. There was no significant relationship between marital status and willingness to receive the third dose of the vaccine. The results of previous studies have pinpointed that being married was associated with a higher willingness to receive the vaccine (24). This result might be due to the fact that almost 81% of the people examined in this study were married. In addition, the higher rate of acceptance of the COVID-19 booster dose among married people may be attributed to higher awareness and perception of the risk to their spouses. Previous studies have elucidated that lower economic levels are associated with higher vaccination intention (25), which is not in line with the results of the present study. People with higher socioeconomic status were more willing to get the third dose of the vaccine in the current study. In accordance with the findings of the present research, in the study by Alobaidi and Hashim, which aimed at finding the determinants of the third dose of the vaccine among the healthcare staff in Saudi Arabia, people in high-income groups intended to be vaccinated (14). This discrepancy in the results of various studies can be attributed to differences in the study community and their demographic variables. Further studies are required to be conducted on the relationship of sociodemographic traits with booster acceptability and vaccination acceptability. The results of the study on the relationships between booster acceptance and sociodemographic traits can be useful in developing booster-targeted immunization programs. In the current study, the acceptance of the third dose of vaccine was

predicted using the HBM. The participants' attitudes regarding the third dose of the COVID-19 vaccine were assessed by a valuable framework, which was HBM. The significant predictors of booster dose acceptance were perceived barriers, perceived severity, and cues to action in the multivariable analysis. Lai et al. stated that the acceptance of COVID-19 boosters was associated with the important dimensions of perceived benefits and perceived barriers to vaccination (18). However, Qin et al. reported that the most significant predictor of vaccine acceptance was cues to action (15). Therefore, the HBM can be a valuable tool for examining people's intentions regarding the willingness to receive the third dose of the COVID-19 vaccine. The willingness to get the vaccine was mainly assessed through a self-report tool that was more subjective. A more objective evaluation index can be considered subsequently to examine the desire for vaccination and its effective factors in a nationally representative group of people over 18 years of age. The acceptance rate may differ across various types of COVID-19 vaccines, and this study did not differ between various types of COVID-19 vaccines. Further research is needed to explore the willingness to receive vaccination for various strains of COVID-19. The present study was cross-sectional; therefore, we cannot confirm the cause of the relationship between predictors and acceptance of the third dose of the COVID-19 vaccine. The findings of the present study illustrated that HBM constructs could be used to explain the third dose of the COVID-19 vaccine. The perceived severity of COVID-19, the consequences of not receiving the booster doses, and the reduction of perceived barriers to receiving the vaccine were found to be among the complications of its injection. The recommendations proposed by healthcare providers can be effective in increasing the acceptance of the third dose of the vaccine. The rate of willingness to accept the booster dose can be assessed using the results of the current study. Moreover, subsequent relevant health education and immunization strategies can be provided by exploring the factors affecting individual vaccination behavior.

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Authors' Contribution
Study concept and design: Z. KH. and H. K. Acquisition of data: M. GH. and M. A. Analysis and interpretation of data: Z. KH. and E. J. Drafting of the manuscript: Z. KH. and MA. Z. Critical revision of the manuscript: H. K. and Z. KH. Statistical analysis: E. J.

Ethics
The Ethics Committee of Birjand University of Medical Sciences approved this study (IR.BMUS.REC.1401.085). Then, we explained the study objectives to the participants, gained their consent, and assured them that their information would be kept confidential.

Conflict of Interest
The authors declare no conflict of interest in this study

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