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ORIGINAL RESEARCH

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Investigating preferences of the covid-19 vaccine among individuals in Iran: Discrete choice experiment analysis

Sanaz Parvizi | **Mohsen Mehrara** | **Ali Taiebnia**

Faculty of economics, University of Tehran, Tehran, Iran

Correspondence
Sanaz Parvizi, Faculty of economics, university of Tehran, Tehran, Iran.
Email: sanaz.parvizi@yahoo.com

Abstract

Background and Aims: This study aimed to estimate the preferences for COVID-19 vaccines among a sample of Iranian adults and to understand the sources of preference heterogeneity.

Methods: A web-based survey was conducted from April to July 2021; out of 1747 participants, 678 completed the survey. Seven key attributes were selected, namely effectiveness, risk of severe side effects, risk of mild side effects, number of doses, duration of protection, location of manufacture, and price. Additionally, conditional logit and mixed logit models were used to analyze the data.

Results: The results of this study indicate that vaccine effectiveness, protective duration, the risk of side effects, and price are the most important factors that influence vaccine preferences. Furthermore, we identified heterogeneity in preferences, indicating that not all individuals respond in the same way to vaccine attributes.

Conclusion: The majority of Iranians prefer to get the Covid-19 vaccine. Policymakers should consider these findings when implementing successful programs. This study contributes to the literature by estimating Iranian respondents' preferences for the Covid-19 vaccine and identifying the heterogeneity in their preferences for vaccine attributes. The findings may also inform future research and policies related to Covid-19 vaccination programs in Iran.

KEYWORDS
COVID-19, discrete choice experiment, preferences, vaccine

1 | INTRODUCTION

In December 2019, a pandemic virus named 2019-NovCoV by the World Health Organization (WHO) caused intense respiratory syndrome pneumonia, first reported in China.[1] This pandemic has had a significant negative impact on human life.[2] As of February 21, 2023, there have been over 757 million confirmed cases of Covid-19, including nearly 7 million deaths worldwide.[3] As a result, vaccination has been considered a crucial tool to prevent the pandemic.[4,5] Efforts are underway to produce a coronavirus vaccine to stop the spread. Currently, there are various vaccine candidates in development, with some in clinical trials.[6,7] As of February 21, 2023, almost seven different vaccines have been distributed to countries worldwide, with more than 13 billion vaccine doses administered.[8]

Although Covid-19 vaccines are safe and effective at preventing people from getting ill, and can also help save people from serious illness if they get Covid-19, scientists are still trying to determine how long Covid-19 vaccines protect them against the virus. Therefore, the WHO recommends that people who have been fully vaccinated continue to use all available tools, such as wearing masks, staying six feet apart from others, avoiding crowds, and washing hands, until more information becomes available.

While it is true that many countries have opened up their economies and lifted some COVID-19 restrictions, the pandemic is still ongoing and continues to have a significant impact on public health, economies, and societies around the world. Additionally, there are ongoing concerns about new variants of the virus and the potential for future outbreaks. Given this ongoing impact, understanding individuals' preferences for the COVID-19 vaccine remains a critical area of research. Vaccine hesitancy and low vaccine uptake have been identified as major challenges in controlling the spread of COVID-19,[2] and understanding the factors that contribute to these phenomena is essential in designing effective public health campaigns and vaccination programs. Additionally, as new vaccines and boosters become available, understanding individuals' preferences for different vaccine attributes can inform decisions about vaccine distribution and allocation.

Multiple studies have been conducted regarding individuals' preference for vaccination against hepatitis B virus,[9,10] seasonal influenza,[11] and human Papillomavirus (HPV),[12–15] which investigated various factors that influence individuals' decisions to choose vaccination programs. These factors include individuals' characteristics (age, education level, gender, and income) and the vaccine's side effects, effectiveness, duration of protection, cost, and the number of doses. Our objective of this study is to understand which factors related to the vaccine's attributes and individuals' characteristics affect the public's preference for the COVID-19 vaccine in Iran.

2 | METHODS

Our study aimed to investigate the COVID-19 vaccination preferences of individuals, and we utilized a discrete choice experiment (DCE) that is grounded in the random utility theory. This theory assumes that participants will select the option that maximizes their utility from among the available choices.[5,12,16]

In general, the DCE method is commonly used in healthcare research to understand how individuals make choices between different options with varying attributes.[5,13,17–20] In the context of the COVID-19 vaccine, the DCE can help to identify which attributes of the vaccine are most important to individuals when deciding whether or not to get vaccinated, and how different levels of these attributes may affect their preferences. Some studies have used DCE to examine factors that determine preference for COVID-19 vaccination.[7,21]

The DCE method allows researchers to create hypothetical scenarios that vary in terms of different attributes and levels, and then present these scenarios to participants to choose between. By analyzing the choices made by participants, researchers can estimate the relative importance of each attribute and level and estimate preference heterogeneity and explore how different groups of people value different attributes of a product or service.[15,17]

While there are other methods available for studying preferences and decision-making, such as conjoint analysis or contingent valuation, DCEs offer several advantages. For example, DCEs allow researchers to examine the importance of each attribute in the decision-making process and preference heterogeneity.

2.1 | Attributes and their levels

To use the DCE method, it is crucial to select the vaccine attributes and their levels.[18] The attributes and levels were identified based on prior studies, which were not limited to COVID-19[6,7,21] but also included other topics such as seasonal influenza,[11,18] HPV,[12–15] and hepatitis B.[9,10] Additionally, the vaccine experts were utilized as a source of information for this purpose. Based on the collected data, we selected seven key attributes, namely effectiveness, risk of severe side effects, risk of mild side effects, number of doses, duration of protection, location of manufacture, and price. Table 1 provides a comprehensive list of these attributes and their respective levels.

Vaccine effectiveness is defined as the percentage of vaccinated individuals who have developed immunity to the virus. The risk of severe side effects is expressed as the number of incidents per 1,000,000 individuals, while the risk of mild side effects is reported as the number of incidents per 10 individuals. The number of doses is described in three levels: one dose, two doses, and more than two doses. Duration of protection refers to the length of time that

TABLE 1 Attributes and their levels.

Attributes	Effectiveness	Risk of severe side effects	Risk of mild side effects	Number of doses	Duration of protection	Location of manufacture	Price
Levels	60%	1/1,000,000	1/10	One dose	6 Months	Import product	Free
	80%	10/1,000,000	3/10	Two doses	12 Months	Domestic product	2,000,000 IIR
	95%	100/1,000,000	5/10	More than 2 Doses	Lifetime		4,000,000 IIR
	99%						6,000,000 IIR

vaccinated individuals are protected against the virus. The location of manufacture indicates where the vaccine was produced. Price is the amount of money that individuals are required to pay to obtain the vaccine.

2.2 | DCE design and questionnaire

The combination of seven attributes and their levels results in $4^2*3^4*2 = 2592$ hypothetical Covid-19 vaccination profiles. It would not be feasible to present all of these profiles to individual respondents. Therefore, we used a D-efficient partial profile design to ensure that only the primary impacts of the vaccine attributes were considered in the study.[6,7,10,22,23] This design allowed us to create a smaller set of hypothetical vaccination profiles that still captured the most important attributes and levels. The final experimental design included 40 choice tasks, but some of them were deleted to reduce the burden on respondents and to ensure that the survey could be completed in a reasonable amount of time. The remaining 36 tasks were divided into 3 blocks, with each block containing 12 choice tasks. In addition, each choice task consists of two alternative vaccination programs and no vaccination option. Figure 1 was shown an example of a choice task.

The questionnaire consisted of three main sections. The first section aimed to earn information about respondents' knowledge and experience with the Covid-19 pandemic, as well as their previous experience with vaccination. The second section included questions about the respondents' demographic and socioeconomic status. The final section presented respondents with a DCE design. Respondents were randomly assigned to one of three blocks, each containing 12 choice tasks that presented seven attributes and corresponding levels. The choice tasks were designed to allow respondents to select one of the vaccination programs presented to them in the DCE.[6,7,21]

2.3 | collect data and sample size

The data for this study was collected through an online survey (https://www.porsline.ir), which is considered the most effective online questionnaire platform in Iran. The survey was conducted between April and July 2021, targeting Iranian citizens aged over 18 years who were living in Tehran province.

Online surveying was chosen as the preferred method for several reasons. First, it offers greater convenience to respondents as they can complete the survey from anywhere at any time with an internet connection, resulting in a larger and more diverse sample. Second, it is often more cost-effective compared to other survey methods such as telephone or mail surveys since there are no printing or postage costs and no need to hire interviewers.

Thirdly, online surveys can be distributed and data collected quickly, especially if an incentive is offered to respondents. This can be advantageous in rapidly changing situations such as the COVID-19 pandemic. Fourthly, online surveys can produce high-quality data if designed and conducted correctly. Finally, they can save time and reduce errors as responses can be automatically collected, organized, and analyzed using software programs.

The sample size used in our study was determined according to the research standards proposed by Johnson and Orme. Specifically, we used the equation $N > 500\ c/(t*a)$, where c represents the number of analysis cells, t is the number of choice tasks, and a is the number of alternatives. In our study, c, t, and a were 4, 12, and 3, respectively. Based on these values, we estimated the minimum required sample size to be 56 respondents. However, we believe that a larger sample size would have strengthened the statistical power of our analysis. Therefore, we are confident that our sample size (678) was sufficient to achieve our research goals.[5,7,17,19]

2.4 | Statistical analyses

The present study tries to investigate individuals' preferences for the COVID-19 vaccine To accomplish this, we used two widely-used models in choice modeling: the conditional logit and mixed logit models. We chose to use the conditional logit model to estimate the impact of each vaccine attribute on the probability of selecting a particular alternative. However, we recognized that the conditional logit model assumes homogeneity in preferences across individuals, which may not be realistic in the context of COVID-19 vaccine uptake. To address this potential issue, we also used the mixed logit model, which allows for individual-level heterogeneity in preferences. By using both models in our

Q1	Vaccine A	Vaccine B	No vaccine
Effectiveness	60%	95%	0%
risk of severe side effects	100 per 1000000 individuals	100 per 1000000 individuals	0
risk of mild side effects	5 per 10 individuals	5 per 10 individuals	0
Number of doses	More than 2 doses	1doses	0
duration of protection	lifetime	12months	0
location of manufacture	Domestic	Imported	0
Price	4000000	4000000	0
Which one do you prefer?	☐	☐	☐

FIGURE 1 Example of a choice task.

analysis, we identified the key factors that influence vaccine uptake and gained a more nuanced understanding of the underlying decision-making process related to COVID-19 vaccination.

The person's utility was estimated by:

$U_{ij} = \beta_0 + \beta_1$ Effectiveness80$_{ij}$ + β_2 Effectiveness95$_{ij}$ + β_3 Effectiveness99$_{ij}$ + β_4 Risk severe side effect10$_{ij}$ + β_5 Risk severe side effect 100$_{ij}$ + β_6 Risk mild side effect3$_{ij}$ + β_7 Riskmildsideeffect5$_{ij}$ + β_8 Ndoses2$_{ij}$ + β_9 morthan2$_{ij}$ + β_{10}DurationProtection12ij + β_{11} Duration Protection Lifetime $_{ij}$ + β_{12} Location Manufacture Domestic$_{ij}$ + β_{13}Price$_{ij}$

where U_{ij} is the utility of the individual for alternative j, β_0 is the constant reflecting the individual's utility for selecting vaccination relative to no vaccination. β_1–β_8 are the coefficients of each vaccine attribute. According to previous studies, all attributes were represented as dummy variables while the price was defined as a continuous variable.[5,10,12,15]

All statistical analyses were performed using Stata software version 16. The level of statistical significance was set at $p < 0.05$. The individual characteristics, which were categorical data, were presented as frequencies and percentages (*n*, %). To determine whether a standard deviation of attributes is statistically significant, we used a hypothesis test such as a *T*-test.

3 | RESULTS

3.1 | Individuals' characteristics

Table 2 shows the information of individuals who answered the questionnaire. About 70% (465 out of 678) of the respondents were female, while 30% (213 out of 678) were male.

In terms of age, Of the 678 respondents, 168 (about 24%) were between 18 and 29 years old, 269 (about 40%) were between 30 and 39 years old, 164 (about 26%) were between 40 and 49 years old, 64 (about 9%) were between 50 and 59 years old, and 13 (about 1%) were 60 years old or above.

According to education, Out of the total sample of 678 respondents, 41 (approximately 6%) reported having no formal education or a diploma, 112 (approximately 18%) had a diploma, 264 (approximately 40%) held a bachelor's degree, 175 (approximately 26%) had a master's degree, and 68 (approximately 10%) reported having a PhD degree. Additionally, approximately 52% (355 people) were employed, while the remaining 48% (323 people) were either students or retired.

69% of respondents were married, while 31% were single. More than half of the respondents (66%) had children, while 34% did not have children.

In terms of income monthly, most respondents (about 42%) had a monthly income between 50 and 100 million IRR. 234 (about 31%) had a monthly income less than or equal to 50 million IRR, 280 (about 42%) had a monthly income between 50 and 100 million IRR, and 164 (about 27%) had a monthly income greater than 100 million IRR. (US $ 1 = 502,510 IRR).

Regarding health insurance, More than 80% of the respondents (about 83%) reported having health insurance, while 121 (about 17%) reported not having health insurance.

3.2 | Estimation of preferences for covid-19 vaccine

The results from the conditional logit model have shown in Table 3. The results of the analysis showed that all the coefficients of the

TABLE 2 Individuals' characteristics.

	N	%
Gender		
Male	213	30
Female	465	70
Age		
18–29	168	24
30–39	269	40
40–49	164	26
50–59	64	9
≥60	13	1
Education		
≤diploma	41	6
Diploma	130	18
Bachelor	264	40
Master	175	26
PHD	68	10
Income monthly		
≤50,000,000	234	31
50,000,000–10,000,000	280	42
≥10,000,000	164	27
	N	%
Job		
Employed	355	52
Others (students, retired)	323	48
Marital status		
Married	452	69
Single	226	31
Child		
Yes	433	66
No	245	34
Health insurance		
Yes	557	83
No	121	17

TABLE 3 Results from conditional logit.

Attributes	Coefficients	Standard error	z	p Value	95% confidence interval
Effectiveness80	0.401	0.049	8.230	<0.001	0.305–0.496
Effectiveness95	0.522	0.058	9.020	<0.001	0.409–0.635
Effectiveness99	0.455	0.057	8.010	<0.001	0.343–0.566
Risk mild side effect 3/10	−0.064	0.049	−1.290	<0.001	−0.160 to 0.033
Risk mild side effect 5/10	−0.151	0.052	−2.920	0.004	−0.253 to −0.050
Risk sever side effect 10/1,000,000	−0.186	0.053	−3.530	<0.001	−0.290 to −0.083
Risk sever side effect 100/1,000,000	−0.450	0.047	−9.620	<0.001	−0.541 to −0.358
Ndoses2	0.222	0.048	4.640	<0.001	0.128–0.316
More than 2 doses	0.014	0.048	0.280	0.78	−0.081 to 0.108
Duration protection12 months	0.215	0.047	4.600	<0.001	0.124–0.307
Duration protection lifetime	0.543	0.052	10.380	<0.001	0.441–0.646
Price	−0.098	0.019	−5.270	<0.001	−0.134 to −0.061
Location manufacture domestic	−0.048	0.035	−1.380	0.17	−0.117 to 0.020
Nonvaccination	−0.685	0.077	−8.840	<0.001	−0.836 to -0.533

TABLE 4 Results from mixed logit.

Attributes	Coefficient	Standard error	Z	p Value	95% Confidence interval	Standard deviation	T Value
Effectiveness80	0.480	0.060	8.060	<0.001	(0.363–0.596)	0.645	0.744
Effectiveness95	0.618	0.069	8.990	<0.001	(0.483–0.753)	0.163	3.791
Effectiveness99	0.531	0.067	7.870	<0.001	(0.399–0.663)	0.217	2.446
Risk mild side effect3/10	−0.092	0.060	−1.530	<0.001	(−0.209 to 0.025)	0.247	−0.373
Risk mild side effect5/10	−0.163	0.063	−2.590	0.01	(−0.287 to −0.040)	0.083	−1.962
Risk sever side effect10/1,000,000	−0.216	0.065	−3.340	0.001	(−0.343 to −0.089)	0.060	−3.609
Risk sever side effect100/1,000,000	−0.520	0.066	−7.910	<0.001	(−0.649 to −0.391)	0.000008	−70,756.4
Ndoses2	0.248	0.062	4.020	<0.001	(0.127–0.369)	0.685	0.362
More than 2 doses	−0.047	0.058	−0.820	0.41	(−0.160 to 0.066)	0.328	−0.144
Duration protection 12 months	0.222	0.057	3.900	<0.001	(0.110–0.333)	0.110	2.018
Duration protection lifetime	0.647	0.071	9.100	<0.001	(0.508–0.786)	0.631	1.024
Price	−0.160	0.023	−6.850	<0.001	(−0.206 to −0.114)	0.004	−40.115
Location manufacture domestic	−0.081	0.042	−1.940	0.05	(−0.163 to 0.001)	0.829	−0.098
Nonvaccination	−0.836	0.110	−7.580	<0.001	(−1.052 to −0.619)		

Note: The *T* Value is calculated as the coefficient divided by the standard deviation, and the critical t-value is obtained from a t-distribution table with degrees of freedom equal to the sample size minus one (*df* = 677 in this case). The critical t-values of 95% and 99% confidence levels are 1.96 and 2.58. A variable is considered statistically significant at 5% or 1% level if its *T* value is smaller than the critical *T* value and nonsignificant otherwise.

attributes had the expected signs and were significant, except for more than 2 doses ($p = 0.78$) and the Location of Manufacture ($p = 0.17$). The statistically insignificant coefficient for more than 2 doses suggests that this attribute did not have a significant impact on respondents' decision-making. Similarly, the statistically insignificant coefficient for the location of manufacture suggests that respondents were not influenced by the location of manufacture when choosing a COVID-19 vaccine.

TABLE 5 Results from mixed logit with main interactions.

Variable Name	Coefficient	Std. Error	z	*p* Value	95% Confidence interval (lower)	95% Confidence interval (upper)
Effectiveness80	0.409	0.068	6.01	<0.001	0.276	0.543
Effectiveness95	0.580	0.079	7.34	<0.001	0.425	0.735
Effectiveness99	0.600	0.091	6.58	<0.001	0.422	0.779
Risk mild side effect3/10	−0.116	0.060	−1.94	0.053	−0.234	0.001
Risk mild side effect5/10	−0.230	0.065	−3.52	<0.001	−0.358	−0.102
Risk sever side effect10/1,000,000	−0.216	0.066	−3.27	0.001	−0.345	−0.087
Risk sever side effect100/1,000,000	−0.485	0.061	−7.90	<0.001	−0.606	−0.365
Ndoses2	−0.632	0.187	−3.38	0.001	−0.998	−0.265
More than 2 doses	−0.061	0.061	−0.99	0.320	−0.181	0.059
Duration protection 12 months	0.181	0.058	3.12	0.002	0.067	0.294
Duration protection lifetime	0.631	0.078	8.06	<0.001	0.478	0.785
price	−0.115	0.026	−4.44	<0.001	−0.166	−0.064
Location manfacture domestic	−0.109	0.044	−2.49	0.01		
Interaction Items						
Gender*effectiveness80	0.033	0.091	0.36	0.72	−0.145	0.210
Age*effectiveness80	0.006	0.052	0.11	0.91	−0.096	0.107
Education*effectiveness80	0.146	0.043	3.42	0.001	0.062	0.230
Working*effectiveness80	−0.102	0.087	−1.16	0.24	−0.273	0.070
Maritalstatus*effectiveness80	0.306	0.137	2.24	0.02	0.038	0.574
Child*effectiveness80	−0.124	0.140	−0.89	0.37	−0.398	0.150
Income*monthly effectiveness80	0.156	0.060	2.58	0.01	0.037	0.274
gender*effectiveness99	0.132	0.105	1.26	0.21	−0.073	0.338
Age*effectiveness99	−0.001	0.059	−0.01	>0.99	−0.116	0.115
Education*effectiveness99	0.177	0.052	3.39	0.001	0.075	0.279
Working*effectiveness99	0.177	0.104	1.69	0.09	−0.028	0.381
Martialstatus*effectiveness99	0.357	0.156	2.30	0.02	0.053	0.662
Child*effectiveness99	−0.263	0.159	−1.66	0.097	−0.575	0.048
Income*emonthly effectiveness99	0.125	0.070	1.78	0.08	−0.013	0.262
Gender*risk mild side effect3/10	0.218	0.076	2.85	0.004	0.068	0.368
Age*risk mild side effect3/10	0.109	0.044	2.50	0.01	0.024	0.195
Education*risk mild side effect3/10	0.220	0.036	6.07	<0.001	0.149	0.290
Working*risk mild side effect3/10	−0.030	0.073	−0.42	0.68	−0.174	0.113
Martial status*risk mild side effect3/10	0.189	0.114	1.66	0.09	−0.035	0.414
Child*risk mild side effect 3/10	−0.107	0.118	−0.91	0.36	−0.338	0.123
Income*monthly risk mild side effect3/10	0.044	0.048	0.90	0.36	−0.051	0.138
Gender*risk mild side effect5/10	−0.135	0.113	−1.19	0.23	−0.356	0.087
Age*risk mild side effect5/10	−0.079	0.065	−1.22	0.22	−0.207	0.048
Education*risk mild side effect5/10	−0.051	0.053	−0.96	0.33	−0.154	0.053

TABLE 5 (Continued)

Variable Name	Coefficient	Std. Error	z	p Value	95% Confidence interval (lower)	95% Confidence interval (upper)
Working*risk mild side effect5/10	−0.032	0.108	−0.29	0.77	−0.244	0.181
Martialstatus*risk mild side effect5/10	0.545	0.171	3.18	0.001	0.210	0.881
Child*risk mild side effect5/10	−0.021	0.175	−0.12	0.90	−0.364	0.321
Income*monthly risk milds ide effect5/10	0.027	0.072	0.37	0.71	−0.114	0.168
Gender*Ndoses2	0.191	0.092	2.07	0.04	0.010	0.372
Age*Ndoses2	0.048	0.052	0.91	0.36	−0.054	0.150
Education*Ndoses2	0.190	0.046	4.13	<0.001	0.100	0.280
Working*Ndoses2	−0.120	0.090	−1.32	0.19	−0.298	0.058
Martioal*Ndoses2	0.326	0.139	2.34	0.02	0.053	0.600
Child*Ndoses2	−0.418	0.147	−2.84	0.004	−0.706	−0.130
Income monthly*Ndoses2	0.047	0.060	0.78	0.43	−0.071	0.166
Gender*Duration protection 12 month	−0.062	0.074	−0.83	0.40	−0.207	0.084
Age*Duration protection 12 months	−0.028	0.042	−0.66	0.51	−0.112	0.055
Education*Duration protection 12 month	0.016	0.034	0.47	0.64	−0.051	0.084
Working*Duration protection 12 month	0.026	0.071	0.36	0.72	−0.114	0.166
Martial*Duration protection 12 month	0.266	0.111	2.39	0.02	0.048	0.484
Child*Duration protection 12 months	0.146	0.11	1.28	0.20	−0.078	0.369
Income*Duration protection 12 month	0.134	0.047	2.84	0.004	0.041	0.227
Gender*Duration protection lifetime	0.165	0.083	1.99	0.05	0.002	0.328
Age*Duration protection lifetime	0.035	0.047	0.74	0.46	−0.057	0.127
Education*Duration protection life	0.134	0.039	3.45	0.001	0.058	0.209
Working*Duration protection lifetime	−0.033	0.081	−0.41	0.69	−0.191	0.125
Martial*Duration protection lifetime	0.392	0.123	3.18	0.001	0.150	0.633
Child*Duration protection lifetime	−0.281	0.127	−2.21	0.03	−0.530	−0.032
Income*Duration protection lifetime	0.091	0.053	1.71	0.09	−0.013	0.196
Gender*nonvaccination	−0.184	0.070	−2.62	0.009	−0.322	−0.046
Education*nonvaccination	−0.029	0.041	−0.71	0.47	−0.109	0.051
Working* nonvaccination	−0.065	0.069	−0.93	0.35	−0.201	0.071
Martialstatus*nonvaccination	−0.639	0.112	−5.73	<0.001	−0.858	−0.421
Child*nonvaccination	0.397	0.111	3.57	<0.001	0.179	0.615
Income*nonvaccination	−0.175	0.043	−4.04	<0.001	−0.260	−0.090

The statistically significant negative value of the non-vaccination ($\beta_0 = -0.685$, $p < 0.001$) in the model suggests that, on average, respondents expressed a preference for getting the COVID-19 vaccine.

The coefficients for the effectiveness and duration of protection parameters were positive and statistically significant, indicating that respondents preferred vaccines that had a more effective and longer duration of protection. The negative coefficients for price and side effects implied that respondents preferred vaccines with fewer side effects and lower prices.

To understand preference heterogeneity, the mixed logit model was used. The results with the main effects are presented in Table 4. In this model, almost all attributes are significant at the 5% level, except for more than 2 doses and the location of manufacture like in the conditional logit model. On the other hand, the mixed logit model report standard deviations on the coefficients. The estimated standard deviation of attributes is significant at 5% and 1% levels except for effectiveness95 (T. value = 3.791),risk Sever Side Effect10/1,000,000 (T. value = −3.609), risk Sever Side Effect100/1,000,000 (T. value = −70,756.4), and Price (T. value = −40.115), indicating that heterogeneity existed among respondents for these attributes of the coronavirus vaccine. Social-demographic characteristics are used to understand sources of preference heterogeneity Table 5. The findings indicate that females, individuals with higher incomes, and parents without any children were more likely to receive a COVID-19 vaccine.

Individuals with higher education and income levels and those who are married tend to have higher levels of effectiveness. Additionally, the coefficient estimates for some interaction terms are positive and significant, indicating that individuals who belong to certain groups (e.g., females, older individuals, and individuals with higher education) may have a higher preference for a COVID-19 vaccine with a lower risk of mild side effects.

The coefficient estimate for the interaction between Gender and N2doses is 0.191, with a *p* value of 0.04, suggesting that gender plays a role in people's preferences for a COVID-19 vaccine with more doses. Specifically, it seems that females are more likely than males to prefer a vaccine with a higher number of doses. Similarly, the coefficient estimate for the interaction between Education and N2doses is 0.190, with a *p* value of less than 0.001, indicating that education level may also impact vaccine preference. In this case, individuals with higher levels of education are more likely to prefer a vaccine with more doses. On the other hand, the coefficient estimate for the interaction between Child and N2doses is −0.418, with a *p* value of 0.004, implying that having children in the household may decrease one's preference for a vaccine with more doses.

The Education*Duration Protection lifetime coefficient suggests that individuals with a higher education level prefer a vaccine with a longer duration of protection. Another hand, the coefficient estimate for the interaction between marital status and Duration of Protection lifetime is 0.392, with a *p* value of 0.001, suggesting that individuals who are married may have a higher preference for a COVID-19 vaccine with a higher level of the duration of protection.

4 | DISCUSSIONS

This study aimed to investigate the COVID-19 vaccination preferences of individuals using a DCE grounded in the random utility theory. Seven key attributes were selected based on prior studies, namely effectiveness, risk of severe side effects, risk of mild side effects, number of doses, duration of protection, location of manufacture, and price. Data was collected through an online survey targeting Iranian citizens aged over 18 years who were living in Tehran province. Additionally, we used two widely-used models in choice modeling: the conditional logit and mixed logit models. The results of the conditional logit model showed that the effectiveness and duration of protection had a positive effect on respondents' vaccine choices, while the price and side effects had a negative impact on preferences. Moreover, the mixed logit model revealed that preference heterogeneity exists among respondents for several vaccine attributes. Our study found that socialdemographic characteristics play a role in vaccine preferences. For instance, females, individuals with higher incomes, and parents without any children were more likely to receive a COVID-19 vaccine. Moreover, individuals with higher education and income levels tend to have higher levels of effectiveness. The results also revealed that certain groups, such as females, older individuals, and those with higher education, may have a higher preference for a vaccine with a lower risk of mild side effects. Our study also found that females and individuals with higher education were more likely to prefer a vaccine with more doses while having children in the household decreased one's preference for such a vaccine. Additionally, individuals who are married may have a higher preference for a COVID-19 vaccine with a higher level of the duration of protection.

Overall, our findings are consistent with the existing literature on vaccine acceptance for COVID-19 and other diseases. Several studies have used DCEs to understand preferences for COVID-19 vaccination in various countries, including China, Ecuador, and Australia.[2,6,21] Additionally, DCEs have been used to study preferences for vaccinations for other diseases, such as HPV, hepatitis B, and influenza.[9–15] Overall, DCEs appear to be a useful tool for understanding vaccine preferences and can help inform public health policies and interventions.

Our findings on the factors that influence COVID-19 vaccine acceptance align with previous research conducted by Sarasty et al.[2] Dong et al.[6] Leng et al.[7] and Borriello et al.[21] These studies found that vaccine effectiveness, protective duration, side effects, and cost were the most important factors influencing vaccine acceptance. Additionally, References[11–15] examine factors influencing vaccine acceptance for other diseases such as influenza and HPV vaccines. These studies also found that vaccine effectiveness, protective duration, side effects, and cost were important factors influencing vaccine acceptance.

Furthermore, the findings regarding preference heterogeneity are also in line with previous research that has shown that social-demographic characteristics, such as gender, education, and income level, can influence vaccine preferences.[5–7]

4.1 | Limitation

It is important to acknowledge a limitation of this study. Our study did not investigate other factors that may influence vaccine preferences, such as the sources of information and beliefs that affect vaccine decision-making, the impact of misinformation, and the role of community context.

5 | CONCLUSIONS

Our study revealed that a high percentage (82%) of Iranians who participated in our survey expressed a preference for receiving the Covid-19 vaccine. We found that respondents' utility for the vaccine was positively influenced by parameters such as vaccine effectiveness and duration of protection. However, we also observed that side effects and price had a negative impact on respondents' willingness to receive the vaccine. Additionally, Our analysis highlighted significant heterogeneity in preferences for the vaccine's attributes among the Iranian population.

Our findings have important implications for policymakers and healthcare professionals. The high level of vaccine acceptance observed among the majority of respondents suggests that Iran has a favorable environment for implementing successful vaccination campaigns. However, the significant heterogeneity in preferences for the vaccine's attributes and concerns about side effects and price highlight the need for tailored communication and education strategies that address the specific concerns of different segments of the population. Such efforts can help increase vaccine acceptance and uptake, thereby contributing to the control of the pandemic in Iran.

AUTHOR CONTRIBUTIONS

Sanaz Parvizi: Conceptualization; data curation; formal analysis; investigation; methodology; resources; software; validation; visualization; writing—original draft; writing—review and editing. **Mohsen Mehrara**: Conceptualization; formal analysis; investigation; methodology; validation; visualization. **Ali Taiebnia**: Conceptualization; formal analysis; investigation; methodology; validation; visualization.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

TRANSPARENCY STATEMENT

The lead author Sanaz Parvizi affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The authors have adhered to established standards, including the 2013 revision of the Declaration of Helsinki, for collecting and reporting data. Moreover, the individuals who participated in the surveys did so voluntarily and gave their full consent.

ORCID

Sanaz Parvizi http://orcid.org/0000-0001-5837-9971

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