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What can be learned from pre-service teachers' intentions to vaccinate against COVID-19 and relevant factors for future crises? A cross-sectional survey research

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ABSTRACT

This study aimed to investigate how pre-service teachers' intentions to vaccinate against COVID-19 were related to their perceptions of the causes of COVID-19, which are conspiracy thoughts, perceptions of environmental and faith factors, trust in scientists, and risk perceptions toward COVID-19 vaccines. In this study, a cross-sectional survey research method was used and an online questionnaire was administered to 434 Turkish pre-service teachers from 19 different universities in Türkiye. A multinomial logistic regression analysis was conducted to predict pre-service teachers' vaccination intentions and two multinomial logit models were evaluated. The results indicated that most pre-service teachers had a positive intention to vaccinate against COVID-19. Pre-service teachers with lower risk perceptions about COVID-19 vaccination and scores on conspiracy thoughts, and higher scores on perceptions of environmental factors about COVID-19 vaccination were more likely to have a positive intention of getting COVID-19 vaccination. However, trust in scientists and faith did not have significant relationships with the intention of getting COVID-19 vaccination. Based on our findings we suggest paying attention to increasing environmental perceptions of pre-service teachers, decreasing their beliefs in conspiracy theories and risk perceptions, and increasing trust in scientists, which are believed to contribute to the development of teacher education programs that would more likely equip teacher candidates with features necessary for dealing with global challenges in the world..

Introduction

In 2019, COVID-19 disease spreaded all around the world, infected millions of people and threatened human lives through new variants today. According to the John Hopkins Coronavirus Resource Center, confirmed cases in Türkiye were more than 15 million and 68.70% of the population received at least one dose of vaccination (John Hopkins University and Medicine, 2023). Similar to the COVID-19 pandemic itself, COVID-19 vaccination was unprecedented with its quick development phase after the identification of the virus (Dratva et al., 2021). Vaccination campaigns started around the world and the Turkish government decided to distribute free vaccination to all citizens. Until now, 85% of the Turkish population has taken at least two doses of vaccination according to the Ministry of Health (Republic of Turkey Ministry of Health, 2022). However, not all people have chosen to be vaccinated, and vaccine refusal has become a prominent issue in the global fight against COVID-19 (Patwary et al., 2022). This has also been an important issue in Türkiye. According to the studies, vaccine refusal has increased during the pandemic in the country (Özceylan et al., 2020; Yalçın et al., 2022). When the COVID-19 vaccines came onto the agenda, the decision to be vaccinated or not was thoroughly researched across age groups. Relevant literature explored individuals' vaccine acceptance or refusal within various demographic variables such as gender, age, trust in information resources concerns about vaccine and people's judgements and their risk perceptions regarding COVID-19 (Harapan et al., 2020; Qiao et al., 2020; Wong et al., 2020).

In these highly complicated, risky, and uncertain times like the pandemic, every citizen in society must make difficult decisions. Environmental and health issues especially have serious impacts on individuals' personal and social lives, and people usually delay their decisions about these complex issues until they can fully understand them scientifically, socially or economically (Fensham, 2012). This is why there is pressure on education as to how education systems will respond to these issues and grow students as responsible future citizens (Fensham, 2012). Like the COVID-19 vaccination decisions, students and citizens will have to make difficult decisions about complex issues in the future as well. Their decisions on these science-related societal issues might be influenced by several factors such as beliefs, risk perceptions, or level of trust in information sources such as health authorities and scientists. For instance, the level of trust is related to people's risk perceptions of COVID-19 vaccination and COVID-19 disease (Winterbottom, 2021). These factors play important roles in the decisions of citizens and their intentions to act regarding the COVID-19 vaccination issue, as displayed in the literature (e.g., Karabela et al., 2021). In the previous literature, Lundström et al. (2012) investigated how young people decide whether or not to get vaccinated against Influenza. The researchers explored the factors that influenced their participants' decisions of getting or not getting vaccinated and found that students' daily life discussions, media awareness, and risk assessment played an important role in teenagers' decision to get vaccinated (Lundström et al., 2012). Based on their results, the researchers highlighted the need to make connections between students' daily lives and school science (Lundstörm et al., 2012). Young adults' decisions or intention to get vaccinated against COVID-19 have been investigated in previous studies (e.g., Khuc et al., 2021); however, studies investigating pre-service teachers' (PTs) intention for getting vaccinated and the factors linked to their vaccination intention are very scarce. Teachers play a crucial role in educating their students as future citizens who can make better decisions about complex health issues. In accordance with this view, scientific literacy has long been studied in various contexts (Istyadji & Sauqina, 2023). In fact, as Bybee (2012) emphasized, to fully participate in society, all adults should be scientifically literate. The scientific literacy of pre-service teachers is especially important for increasing not only their awareness about the complexity of current issues but also for increasing the scientific literacy of their future students. Research findings suggest that the socio-scientific issue (SSI) approach is a promising way to achieve this aim (Karakaş, 2022).

Therefore, the subjects of this study were pre-service teachers who were majoring in different disciplines such as mathematics education, science education, or social science education. To understand the pre-service teachers' intention to vaccinate against COVID-19, we focused on several

factors such as perceptions of causes of COVID-19 (environment, conspiracy and faith), risk assessment and trust in scientists. When this study started, COVID-19 vaccines were not offered yet to young adults between 18 and 25 years of age. For this reason, in this study, we investigated pre-service teachers' vaccination intentions against COVID-19: whether they were positive, negative, or indecisive against COVID-19 vaccines and what factors were associated with their intention of getting vaccination. In the previous literature, several factors are described as influencing people's attitudes, decisions or intentions toward vaccines. Some of these factors are related to perceptions about COVID-19, such as conspiracy thoughts, trust in scientists and other authorities, and risk perceptions toward COVID-19 vaccines (e.g., Dratva et al., 2021; Geniş et al., 2020; Qiao et al., 2020). Belief in conspiracy theories is described as one of the important psychological factors against COVID-19. COVID-19 conspiracy theories have become popular during the pandemic (Oleksi et al., 2021). The World Health Organization highlighted this issue with the statement "We are not just fighting an epidemic; we are fighting an infodemic" (WHO, 2020). Vaccine-related behaviours are also related to belief in conspiracy theories. In the literature, it is reported that vaccine conspiracy beliefs included distrust of pharmaceutical companies, medical practices and myths about the side effects of vaccines (Dordevic, et al., 2021). Moreover, Dordevic et al. (2021) stated that belief in anti-vaccine conspiracy theories is directly related to intentions towards vaccination and also correlated with a lack of trust in scientists. Nadelson et al. (2014) emphasized that trust is a complex concept and trust in science and scientists can have a significant impact on policy, funding and legislation. Trust in science has been raised in relation to highly personal issues such as health and vaccinations (Rousseau, et al., 1998). Negative relationships between healthy behaviours and conspiracy theories may be caused by a broad decline in trust in science and medicine (Imhoff et al., 2018). Relevant literature also emphasized that trust in science and scientists affect individuals' decisions of getting vaccinated (e.g., Viswanath et al. 2021). Therefore, trust in science is an important factor affecting intention towards COVID-19 vaccination. Geniş et al. (2020) stated that in addition to conspiracy theories, individuals may perceive environmental factors and faith factors among the causes of COVID-19. Environmental factors such as environmental pollution, air pollution and climate change affected both the occurrence and transmission of COVID-19 around the world (Han et al., 2023). Both environmental and faith factors about the causes of COVID-19 might play an important role in predicting individuals' intentions towards COVID-19 vaccination. The last factor that has been investigated in this study was risk perceptions towards COVID-19 vaccines. Risk perceptions change based on the characteristics of a hazard. COVID-19, for example, was a new disease as scientists and people had limited information about the virus at the beginning and this has caused a high risk-perception (Caserotti, et al., 2021). Previous studies indicated that there is a positive correlation between risk perception and intentions towards COVID-19 vaccines (Caserotti et al., 2021; Fan, et al., 2021). Considering the aforementioned literature, the current study also investigated the relationship between risk perceptions and intention towards COVID-19 vaccination.

The studies mentioned above did not explore the role of perceived causes of COVID-19, trust in science and risk perceptions collectively on intention towards COVID-19 vaccination. Moreover, most of these studies have investigated vaccine acceptance and hesitancy among various groups including university students (e.g., Dratva et al., 2021; Qiao et al., 2020), teachers (e.g., Cahapay, 2022; Gkentzi et al. 2021) and general adult population (e.g., Sallam et al., 2021). Different from these studies, our study specifically focuses on pre-service teachers' intentions towards COVID-19 vaccines. This group represents individuals who are young adults and future educators. Exploring their intentions to vaccinate against COVID-19 is crucial since it will have an influence on the attitudes and behaviours of the young generation. Studying with pre-service teachers is relatively novel in the context of vaccine acceptance research. Therefore, we wanted to draw attention to future teachers' decisions as teachers have a great impact on students' opinions, beliefs, attitudes and actions toward complex issues and their decision-making processes against these issues (Mckeown, 2012; Mikušková, 2018). Unveiling the factors influencing pre-service teachers' intentions to vaccinate against COVID-19 can shed light on their decision-making processes, and the insight gained from the study can be

applied to teacher education programs to raise responsible citizens who can make informed decisions on critical future SSI. To this end, our research would contribute valuable insights as to how perceived causes of COVID-19 (i.e. conspiracy, faith, and environment), trust in scientists, and risk perceptions of COVID-19 have a role on pre-service teachers' intentions to vaccinate against COVID-19. The findings will provide suggestions for educators, policymakers and health professionals seeking to promote vaccine uptake in future educators.

Factors Related to Individuals' Intentions to Vaccinate against COVID-19

Vaccine acceptance or hesitancy is a broad issue studied in different population groups such as the general adult population. Although young adults' attitudes toward vaccines have been investigated in the past, today through the COVID-19 pandemic, the importance of the young population has been better understood (Dratva et al., 2021). This study focused on pre-service teachers who are not only future teachers but also young adults; therefore, it is critical to explore the intention of these groups of people toward vaccination. Public acceptance or refusal of vaccination has been investigated together with many factors in the literature. For example, Dratva et al. (2021) examined Swiss university students' intentions toward COVID-19 vaccination and found that most of the students were unsure or undecided whether to get vaccinated. They also indicated that several factors, which are confidence, collective responsibility, risk perceptions, and trust in public authorities were associated with participants' COVID-19 vaccination intention. In another study from the USA, Qiao et al. (2020) investigated college students' vaccine acceptance together with several factors such as risk perceptions of COVID-19 and negative attitudes toward general vaccination. They found that there was a positive relationship between the severity and fear of COVID-19 and students' vaccine acceptance, and a negative attitude toward general vaccination is associated with low vaccine acceptance. Moreover, in recent studies, researchers examined school teachers' attitudes and intentions toward the COVID-19 vaccine and they found that several factors were associated with teachers' attitudes and intentions. Gkentzi et al. (2021) investigated primary school teachers' attitudes toward Influenza and COVID-19 vaccines in Greece. The authors concluded that teachers had a low level of intention to uptake the COVID-19 vaccine because they were afraid of its side effects. Another study was conducted with Philippine teachers by Cahapay (2022) and examined Philippine teachers' intentions to vaccinate against COVID-19. The study findings showed that teachers were uncertain whether to obtain vaccination against COVID-19 or not because they did not have enough knowledge and they were concerned about the side effects of vaccines.

Karabela et al. (2021) conducted a study in Türkiye to examine public attitudes toward the COVID-19 vaccine (acceptance, hesitancy or refusal) and its relationship to perceptions of the causes of COVID-19 (conspiracy thoughts, environmental factors and faith factors) and level of trust in information sources. The authors found that most of the participants believed conspiracy theories as the reasons for COVID-19 and this was followed by environmental and faith factors, respectively. There was a weak positive correlation among the participants' attitudes toward the COVID-19 vaccine; their perceptions on their perceptions on conspiracy theories and faith beliefs but beliefs in environmental factors were not significantly related to the participants' attitudes toward the COVID-19 vaccine. The authors also found that participants who agreed to be vaccinated did not trust social media sites; instead, they trusted more reliable websites, professionals, and government institutions (Karabela et al., 2021).

Specifically, in this study, we have investigated the relationship between pre-service teachers' intention to vaccinate against COVID-19 and perceptions of causes of COVID-19 including conspiracy thoughts, faith and environmental factors, levels of trust in scientists, and risk perceptions toward COVID-19 vaccines. Conspiracy thoughts are unjustified beliefs that certain events are planned and carried out by secret, malicious, and powerful organizations (Alper et al., 2021). In the COVID-19 pandemic context, conspiracy thoughts are defined as "beliefs that the virus which is commonly seen in the media regarding the epidemic is a biological weapon, and the epidemic is an attempt to sell

vaccines or a political game of developed countries" (Geniş et al. 2020, p., 320). Previous studies have shown that conspiracy thoughts have significant effects on individuals' vaccination attitudes (e.g., Küçükkarapınar et al., 2021). Conspiracy thoughts that are related to human belief systems have negative impacts on individual and societal levels. For instance, it causes negative emotions, social isolation, and unhappiness (Freeman & Bentall, 2017). Believing conspiracy theories such as believing the COVID-19 virus to be a biological weapon, have serious impacts during the pandemic periods and lead to reduced vaccination rates (Geniş et al., 2020). Moreover, believing conspiracy theories causes rejection of scientific innovations and reduces the level of trust in science (Freeman & Bentall, 2017; Geniş, et al., 2020). Faith is another factor that impacts individuals' decisions. The faith dimension refers to the belief that the reason for the pandemic is a "punishment of God due to inflicts against religion or social degradation" (Geniş et al., 2020, p. 310). Additionally, environmental factors are expressed as other possible causes of COVID-19. Environmental factors are described as the reason for the COVID-19 pandemic could be environmental pollution, global warming, or unhealthy lifestyles (Geniş et al., 2020).

In this study, we also tested the relationship between our participants' level of trust in scientists as a source of information and their intentions of obtaining vaccination. According to Nadelson et al. (2014), trust in science and scientists has an important influence on individuals' reactions to socioscientific issues such as climate change and vaccination and affects the learning of science in schools. Even teachers who have low levels of trust in science and scientists may reject teaching science content (Ipsos MORI Social Research Institute, 2011; Nadelson, et al., 2014). Therefore, trust in science and scientists is critically important while learning and teaching science. During the COVID-19 pandemic, individuals' attitudes and intentions to uptake vaccines were influenced by their trust in different authorities. For instance, Viswanath et al. (2021) identified individual and social determinants of COVID-19 vaccine uptake and they addressed the fact that individuals who trust in scientists are more likely to get vaccination for themselves and their children compared with those who have a low level of confidence in scientists. Finally, in the present study risk perceptions toward vaccines were tested as another important variable that may be related to the pre-service teachers' intentions to receive COVID-19 vaccines. Risk perceptions refer to individuals' reactions toward an unknown, uncommonly dangerous situation and play an important role in individuals' potential acceptance of vaccines (Caserotti et al., 2021). In some previous research (e.g., Nan & Madden, 2012) vaccine-related risk perceptions such as finding vaccines less safe and fear of vaccines' side-effects were also related to individuals' intentions to vaccinate or not. On the basis of the literature review above, in this study, the following research question was formulated:

- How are pre-service teachers' perceptions of causes of COVID-19 (i.e. conspiracy, faith, and environment), trust in scientists, and risk perceptions of COVID-19 vaccines associated with their intentions to vaccinate against COVID-19?

Methods

Research Design

Survey studies are classified as longitudinal and cross-sectional (Cohen et al., 2018). A cross-sectional survey involves data collection from a specific population or sample at a particular point in time, providing researchers with useful information about various variables of interest. The primary objective of conducting a cross-sectional study is to gain insights into the prevalence, patterns, and associations among different factors or conditions within the studied population during that single snapshot in time. This design is valuable for examining relationships between variables at this specific moment but does not establish causal connections due to its limited scope - it does not track individuals over an extended period. The research method used in this study is a cross-sectional survey method (Cohen et al.., 2018). We collected data from a specific sample, preservice teachers, at a particular point in time to collect information about how pre-service teachers' perceptions of causes of

COVID-19 (i.e. conspiracy, faith, and environment), trust in scientists, and risk perceptions of COVID-19 vaccines associated with their intentions to vaccinate against COVID-19.

Sample

A total of 434 pre-service teachers responded to the online survey. The sample consists of 76% female and 24% male. This is similar to the gender distribution in education faculties in Türkiye (Assessment, Selection, and Placement Center, 2018). The average age of the participants was 21.6. The pre-service teachers from 19 different universities in Türkiye participated in the online survey, and their subject areas were considerably diverse. The participants' universities were from six geographical regions of the country. Among them, 30.2% were from Central Anatolia, 29.8% were from Eastern Anatolia, 11.8% were from the Mediterranean, 11.1% were from the Black Sea, 9.4% were from the Marmara, and 5.8% were from the Aegean region. In terms of grade level, 19% were first-year students, 30% were sophomores, 30% were juniors, and 21% were seniors. As shown in Table 1 our sample included pre-service teachers from diverse departments.

Table 1

Teacher Education Programs and the Number of Pre-service Teachers

Teacher Education Programs	Number of Pre-service Teachers
Mathematics Teacher Education Program	122 (28.1%)
Science Teacher Education Program	87 (20.1%)
Primary School Teacher Education Program	73 (16.8%)
Early Childhood Teacher Education Program	59 (13.6%)
Social Science Teacher Education Program	24 (5.5%)
Computer Education and Instructional Technology Program	31 (7.1%)
Language Education Program	16 (3.7%)
Guidance and Psychological Counseling Program	14 (3.2%)
Music Education Program	3 (0.7%)
Special Education Program	1 (0.2%)
No response	4 (0.9%)

Data Collection Tools and Procedure

In this study, an online questionnaire was conducted through the Qualtrics online survey software among pre-service teachers enrolled in teacher education programs in different Turkish public universities between April and July 2021. The study was started with the approval of the ethical committees of the universities. An invitation email was prepared and sent to the universities. The invitation email included a weblink of the survey, a QR code to reach the survey, information about the purpose of the study, voluntary participation, and confidentiality. The survey took about 20 minutes to complete. A convenient sampling method was used. The entire questionnaire included 22 items. The questionnaire included four items related to demographic information (i.e., gender, grade level, teacher education program and the name of university), one question asking pre-service teachers' intention to vaccinate against COVID-19, one item on trust in scientists, one item about risk perceptions toward COVID-19 vaccines and 14 items measuring perceptions of causes of COVID-19.

The following sections give information about the different sections of the questionnaire, measuring different variables. The dependent variable in this study is the intention to vaccinate against COVID-19, which was measured through one question: *Do you want to get vaccinated against COVID-19?* Participants' responses to this item were categorized as Yes, No and Undecided. Independent variables in this study are trust in scientists, risk perceptions toward COVID-19 vaccination, and the perceptions of causes of COVID-19 (see Table 2).

Table 2

Information on the Independent Variables of the Study

Independent variable	Questions asked/Sample items in the scales	Range of response
Trust in scientists	● Do you trust scientists as a source of information about COVID-19 vaccines?	1 (never trust) to 5 (trust a lot)
Risk perceptions	● How risky do you think the COVID-19 vaccines are?	1 (no risky) to 10 (too risky)
Conspiracy thoughts (sub-dimension of perception of causes of COVID-19)	● This disease is a political game revealed by developed countries. ● This disease was produced as a biological weapon.	1 (strongly disagree) to 5 (strongly agree)
Environmental factors (sub-dimension of perception of causes of COVID-19)	● Global warming is one of the causes of the pandemic. ● Environmental pollution is one of the important causes of the disease	1 (strongly disagree) to 5 (strongly agree)
Faith factors (sub-dimension of perception of causes of COVID-19)	● This pandemic is the wrath of God against social degradation. ● This pandemic is in our destiny	1 (strongly disagree) to 5 (strongly agree)

Participants' perceptions of the causes of COVID-19 were measured through a scale adapted by Geniş et al. (2020) to COVID-19, which was originally developed by Çırakoğlu (2011) against swine flu. The scale was developed in Turkish, and the authors provided validity and reliability of the scale. The perceptions of causes of the COVID-19 scale evaluated participants' beliefs related to possible causes of the COVID-19 pandemic. The scale included 14 items and 3 sub-dimensions, which are named "Conspiracy Thoughts," "Environmental Factors" and "Faith Factors." Participants responded to the scale on a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The reliability of the original scale was 0.88 and the reliability of sub-dimensions varied between 0.85 and 0.96. In our data, Cronbach's alpha internal reliability coefficient was found as 0.94, 0.85 and 0.82 for the conspiracy thoughts, environmental and faith factors subdimensions, respectively. Confirmatory factor analysis of our data was conducted to validate the factor structure of the instrument. The factor loadings of items responding to factors vary between .49 and .96 (see Figure 1). The results indicated a good fit index (CMIN/df =2.76, p=.00, CFI= .97, GFI= .93 SRMR= .06, RMSEA=.07), which means that perceptions of causes of the COVID-19 scale involves three factors as hypothesized and it is a valid scale to use in our study.

Figure 1

Confirmatory Factor Analysis with Standardized Results of Perceptions of Causes of the COVID-19 Scale
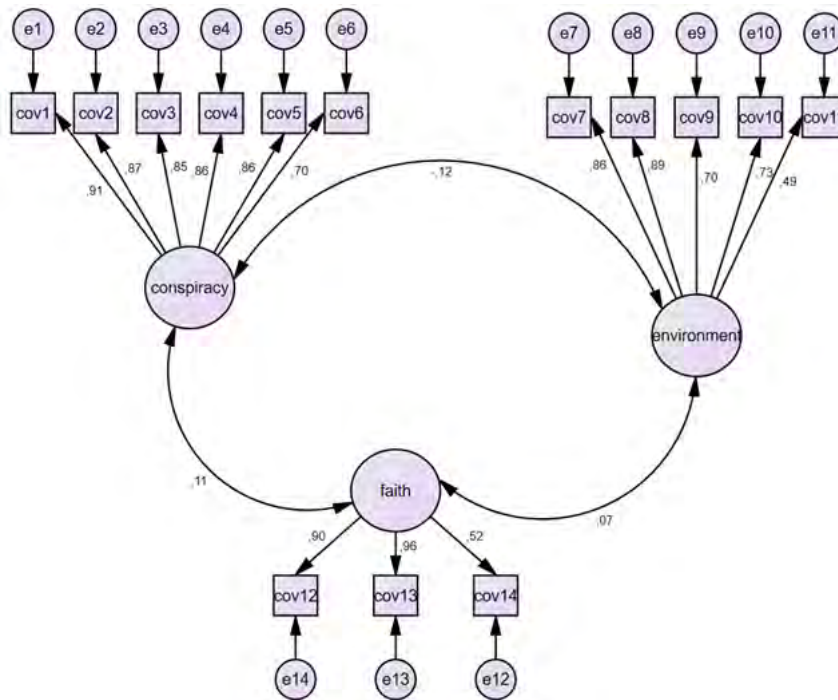
Data Analysis

Data analysis was performed using the IBM SPSS (The Statistical Package for the Social Sciences) 24.0. Descriptive statistics such as percentage, mean, and standard deviation were calculated for the dependent and independent variables. Among the regression tests, multinomial logistic regression analysis is used when the dependent variable includes more than two nominal categories (Field, 2018). The dependent variable in our study included three nominal categories (i.e., yes, no, and undecided); therefore, we used multinominal logistic regression analysis. In this analysis, the maximum likelihood method was used to calculate the parameter coefficients of the model (Field, 2018). One multinomial logistic regression was performed, and because of the analysis, two multinomial logit models were evaluated.

Results

Descriptive Results

The majority (75.1%) of the pre-service teachers had positive intentions to vaccinate against COVID-19. The total percentage of pre-service teachers who were undecided and had negative intentions was 24.9 (see Table 3). In terms of the predictor variables, pre-service teachers' trust in scientists was found to be high (mean value was 4.37 out of five), indicating their trust in scientists in the COVID-19 context. Participants' risk perceptions about COVID-19 vaccination were found to be low (mean value was 3.95 out of 10). Regarding the perceptions of pre-service teachers about the causes of COVID-19, their beliefs about conspiracy thoughts and environmental factors were found to be moderate (mean values were 3.03 and 3.17 out of five, respectively), but their faith scores were relatively low (mean value was 2.40 out of five) (see Table- 4).

Table 3

Descriptive Information on Pre-Service Teachers' Intentions to Vaccinate against COVID-19

Intention	n	%
No	56	12.8
Undecided	53	12.1
Yes	329	75.1

Table 4

Mean Values of the Predictor Variables

Variable	M	SD	Min-Max
Trust in scientists	4.37	0.76	1–5
Risk perception of COVID-19 vaccination	3.95	1.97	1–9
Conspiracy	3.03	0.96	1–5
Environment	3.17	0.88	1–5
Faith	2.40	1.03	1–5

Multinomial Logistic Regression Results

Model Fitting Results

The chi-square statistic was used to assess the overall effectiveness of the model. The chi-square value was 81,181, and its respective p-value was found to be significant (p<.05). This result showed that the model had a significant fit to the data and that relationships between dependent and independent variables in the model were significant (see Table 5).

Table 5

Model Fitting Information

	-2log likelihood	Chi-square	df	p-value
Intercept only	633.804			
Final	552.623	81.181	10	0.000

The chi-square value does not show the effect size measure for the model. Pseudo R-Square measures provide this information on the model (see Table 6) (Field, 2018). Table 6 shows three measures used for effect size, and all three measures indicated weak effect size. In other words, weak correlations were observed between dependent variables and independent variables.

Table 6

Pseudo R-Squares

Cox and Snell	0.171
Nagelkerke	0.222
McFadden	0.128

The classification table (Table 7) shows that the multinomial logistic regression predicted 74.5% of the cases precisely.

Table 7

Classification Table

Observed	Predicted			
	Not having an intention for COVID-19 vaccination (No)	Undecided	Having intention for COVID-19 vaccination (Yes)	Percent Correct
Not having an intention for COVID-19 vaccination	5	3	48	8.9%
Undecided	2	2	48	3.8%
Having intention for COVID-19 vaccination	6	2	318	97.5%
Overall Percentage	3.0%	1.6%	95.4%	74.9%

The Multinomial Logit Models

The study presents two multinomial logit equations with pre-service teachers' intention to vaccinate against COVID-19. Three categories emerged, which are having an intention of getting COVID-19 vaccination, undecided, and not having an intention of getting COVID-19 vaccination. The first multinomial model (Model I) compares pre-service teachers who are undecided and have no intention of vaccination regarding predictor variables of trust in scientists, risk perception of COVID-19 vaccination, and beliefs on causes of COVID-19 (i.e., conspiracy, environment, and faith). The second multinomial logit model (Model II) compares pre-service teachers who have the intention of getting COVID-19 vaccination and not have the intention of getting COVID-19 vaccination regarding the same predictor variables. The first multinomial logit model is presented in Table 8 based on maximum likelihood estimates.

Table 8

Coefficients of Multinomial Logistic Regression- Undecided Versus Not Having the Intention of Getting COVID-19 Vaccination (Model I)

Predictors variables	Multinomial Logit model							
	B	SE	Wald	df	p-value	Odds ratio	95% C.I. for odds ratio	
							Lower Bound	Upper Bound
Trust in scientists	-0.006	0.227	0.001	1	0.981	0.995	0.637	1.553
Risk	0.074	0.102	0.527	1	0.468	1.077	0.882	1.314
Conspiracy	-0.097	0.223	0.191	1	0.662	0.907	0.586	1.405
Environment	0.497	0.222	5.012	1	0.025*	1.643	1.064	2.538
Faith	-0.112	0.194	0.337	1	0.562	0.894	0.612	1.306

The first model compared pre-service teachers who are undecided and do not have the intention of getting COVID-19 vaccination. According to the results, pre-service teachers with high scores on environmental factors about reasons for COVID-19 were more likely to be undecided about being vaccinated than pre-service teachers having a low score on environmental factors with a significant odd ratio of 1.64. In other words, pre-service teachers with high scores on the perception of environmental factors about reasons for COVID-19 vaccination were approximately 1.64 times more likely to be undecided about getting COVID-19 vaccination than their peers with low environmental factors. The rest of the variables' relationship with the intention of COVID-19 vaccination was insignificant in the model comparing undecided and not having the intention of COVID-19 vaccination (see Table 8).

The estimations of the second multinomial logit model comparing participants to get COVID-19 vaccination and not have the intention of getting COVID-19 vaccination are presented in Table 9. The logit model revealed that risk perception about COVID-19 vaccination, conspiracy thoughts, and environmental factors about the reasons for COVID-19 had a significant relationship with the intention of having COVID-19 vaccination. More specifically, pre-service teachers with less risk perceptions about COVID-19 vaccination were more likely to have the intention of getting COVID-19 vaccination than pre-service teachers with high-risk perceptions about COVID-19 vaccination with a significant odd ratio of 0.73. In terms of beliefs about the reasons for COVID-19, participants with low scores on conspiracy thoughts and high scores on environmental factors were more likely to have the intention of getting COVID-19 vaccination. In other words, pre-service teachers who believed that environmental factors such as global warming, can be a reason for the pandemic were more likely to have the intention of being COVID-19 vaccination. Pre-service teachers with the intention of getting COVID-19 vaccination had low scores on conspiracy thoughts. This means that these pre-service teachers do not believe an economic crisis was a reason for the COVID-19 pandemic or that it was produced as a biological weapon. Similar to the first model, trust in scientists and faith did not make a significant contribution to predicting the participants' intention to vaccinate against COVID-19. A summary of the results of the two logit models can be seen in Table 10.

Table 9

Coefficients of Multinomial Logistic Regression- Having Intention of Getting COVID-19 Vaccination Versus Not Having an Intention of Getting COVID-19 Vaccination (Model II)

Predictor variables	Multinomial Logit model							
	B	SE	Wald	df	p-value	Odds ratio	95% C.I. for odds ratio	
							Lower Bound	Upper Bound
Trust in scientists	0.369	0.190	3.769	1	0.052	1.447	0.996	2.101
Risk perceptions	0.315	0.082	14.770	1	0.000*	0.730	0.621	0.857
Conspiracy	-0.525	0.175	9.013	1	0.003*	0.592	0.420	0.833
Environment	0.461	0.176	6.872	1	0.009*	1.586	1.123	2.238
Faith	0.065	0.151	0.187	1	0.665	1.067	0.794	1.435

Table 10

Summary of the Results Obtained from Two Logit Models

Independent variable	Multinomial Logit Model-I	Multinomial Logit Model-II
	(Compares PTs who were undecided vs. PTs who did not have the intention to vaccinate against COVID-19)	(Compares PTs who had intention vs. PTs who did not have the intention to vaccinate against COVID-19)
Conspiracy thoughts	not significant	significant low conspiracy thoughts => more likely to have an intention for vaccination
Environmental factors	significant High environmental factors => more likely to be undecided to get COVID-19 vaccination.	significant high environmental factors => more likely to have an intention for vaccination
Faith factors	not significant	not significant
Trust in scientists	not significant	not significant
Risk perceptions	not significant	significant Low-risk perception about vaccination => more likely to have an intention for vaccination

Discussions and Conclusion

This study examined Turkish pre-service teachers' intentions to vaccinate against COVID-19 and relevant factors associated with their intentions. The results revealed that most of the pre-service teachers (75%) had an intention to vaccinate against COVID-19 and fewer pre-service teachers were undecided (12.1 %) or did not have an intention to vaccinate against COVID-19 (12.8 %). In the literature, the findings of the studies that included teachers and teacher candidates as target groups revealed various and sometimes contradictory results. For instance, most of the teachers in the Philippines were not sure if they should get vaccinated against COVID-19 (Cahapay, 2022). In Greece, school teachers showed a low level of intention to obtain vaccines against COVID-19 (Gkentzi et al., 2021). In a study conducted in Ethiopia, more than half of the teachers expressed their intention to uptake COVID-19 vaccines, but their percentage (54.8%) was considered low for getting herd immunity in the country (Handebo et al., 2021). In another study conducted in Türkiye, 45.5% of the pre-service teachers expressed their willingness to obtain COVID-19 vaccination, and 54.5% of the participants stated that they would refuse vaccines when they were offered to them (Salman et al., 2021). The differences between the findings of these studies, including the findings of our study, in terms of vaccine intentions of teachers and teacher candidates from different countries imply the importance of socio-geographic and contextual factors in individuals' COVID-19 vaccine intentions (Al Shurman et al., 2021). Moreover, differences between our study findings and the findings of Salman et al.'s (2021) study provide further evidence for the importance of contextual factors on individuals' intentions towards vaccines, at least for the COVID-19 vaccines. More specifically, participants of Salman et al.'s (2021) study share some similar characteristics such as being pre-service teachers from various departments of the education faculty of a university. Considering that our participant preservice teachers were enrolled in 19 different universities, the difference between the intentions of the preservice teachers towards vaccines in the two studies may be attributed to socio-demographic factors. Furthermore, the timing of data collection may also be regarded as a contextual factor, especially in the time of COVID-19 years, when information (and misinformation) about COVID-19 spread at an incredible speed. At this point, it is clear that we should equip our teachers in a way that they can access and interpret information about COVID-19 or other similar socioscientific issues (SSI) in a timely and correct way. For that, enhancing their new media literacy levels may be a promising starting point (Irmak et al., 2023). This issue is critical since teachers are in a high-risk group because of their profession. UNICEF's (2020) report suggesting prioritization of teachers for vaccination against COVID-19 also indicates the importance of teachers and their intentions towards vaccination to be able to continue education around the world not only for the COVID-19 pandemic but also for the future crises that may be waiting for us.

The present study also contributes to the literature with its findings regarding the factors relevant to the preservice teachers' intentions towards vaccination (see Tables 8. 9, and 10). While environmental factors (Model I and Model II), conspiracy thoughts (Model II), and risk perceptions (Model II) were found to be related to the preservice teachers' intentions towards the COVID-19 vaccine; trust in scientists and beliefs in faith did not contribute to the prediction of our dependent variable (i.e., intention towards COVID-19 vaccine). These findings have the potential to give us ideas about how to cope with future pandemics. Moreover, they have some potential implications for future research. For instance, there is a discussion about the relationship between climate change and human diseases. It has been reported that climate change contributes to the emergence and transmission of new pathogens because of the changes in environmental and climate conditions and this might lead to future coronavirus cycles (Gupta et al., 2021). Therefore, future teachers need to be prepared for future pandemics, and their perceptions or beliefs regarding the COVID-19 pandemic such as environmental perceptions should be developed. In this study, a factor we examined was the relationship between preservice teachers' intentions towards vaccination and their perceptions of environmental factors as a cause of the COVID-19 pandemic. We found that pre-service teachers with high scores on their perceptions of environmental factors were more likely to have an intention for vaccination compared

to their peers who were undecided (Model I; p=.025) and did not intend (Model II; p = .009) to get vaccinated. However, in the study of Karabela et al. (2021), people's perceptions of environmental factors about the causes of COVID-19 were not found to be among the factors related to their participants' attitudes toward the COVID-19 vaccine. The difference in the findings of our study and the study of Karabela et al. (2021) may stem from the differences in the characteristics of the participants in the two studies. That is, the sample of Karabela et al.'s (2021) study constituted adults from different sectors, not only teachers or pre-service teachers. Therefore, it is probable that environmental science courses and courses related to environmental and sustainability education offered in many programs (e.g., primary teacher education, science education, early childhood education programs) of the education faculties in the country (Council of Higher Education, 2018) played a role in building a relationship between the environmental causes of COVID-19 and the preservice teachers' intention to vaccinate against COVID-19. This implies the need of increasing these kinds of courses in the education faculties.

The findings of the studies continuously add evidence regarding the relationships between environmental factors and pandemics around the globe. For instance, biodiversity loss due to habitat destruction increases the risk of pandemics such as COVID-19 (Tollefson, 2020) and unplanned or wrong policies in land use lead humans to move to natural landscapes and the interaction among people, wildlife, and livestock increase, which cause outbreaks of diseases (Galindo-Gonzalez, 2022; Tollefson, 2020). Therefore, environmental education courses may contribute to pre-service teachers' development of their understanding of the relationship between the health of ecosystems and human health (Yavetz et al., 2014). In that way, pre-service teachers may figure out how environmental problems cause pandemics more clearly. Second, pre-service teachers might become more aware of the effects of environmental issues such as the climate crisis on the COVID-19 pandemic. Lucarelli et al. (2020) found that during the pandemic, people who had higher awareness about the relationship between the climate crisis and the pandemic exhibited more pro-environmental behaviours. From this perspective, pre-service teachers with higher scores on environmental factors may become aware of the climate crisis and other environmental issues, and this may have influenced their intention to get COVID-19 vaccination. Nonetheless, this argument requires further research to test whether higher awareness about environmental issues helps individuals to comprehend the relationships between environmental and health issues.

Another variable that was found to be related to pre-service teachers' intention to get vaccinated against COVID-19 was conspiracy thoughts (Model II; p = .003). We found that pre-service teachers with low scores on conspiracy thoughts were more likely to have intentions towards COVID-19 vaccination. Similar to our findings, Aslantekin-Özçoban et al. (2021) found that participants who believed that COVID-19 was a conspiracy theory tended to refuse to get vaccinated. More specifically, their results indicated that conspiracy beliefs about COVID-19 were influential on the 73.4 % of the midwifery students who participated in the study (N = 1879). This finding and the finding of the present study support Mikušková's (2018) call for the need to develop critical thinking skills in individuals, especially current and prospective teachers. Mikušková (2018) found that rational thinking was related to the conspiracy beliefs of the future teachers who participated in the study. Moreover, teacher candidates who read and watched tabloids more were less inclined to believe in conspiracy theories when compared to their counterparts who read and watched legitimate media (Mikušková, 2018). Based on these results, it can be suggested that pre-service teachers would better stay away from conspiracy theories and instead learn about vaccinations from scientific sources. Moreover, it can be suggested to develop new media literacy levels of teacher candidates to help them comprehend and reason about information presented in various media sources in a more reasonable manner (Irmak et al., 2023). As an implication for further research, researchers may be interested in investigating the relationships of beliefs in conspiracy theories to new media literacy levels and/or rational thinking skills.

In addition to environmental factors and conspiracy thoughts, risk perceptions were found to be related to the preservice teachers' vaccine intentions (Model II; p = .00). Risk factors may include

ideas about the low efficiency of vaccines and their possible side effects (Hamilton et al., 2015). From another point of view, in the COVID-19 context, some researchers (e.g., Weinert et al., 2021) study risk perception as an indicator of risk perception of getting COVID-19. In the present study, in line with the majority of research in the literature, we handled risk perception about the possible risks (e.g., side effects) of COVID-19 vaccination (see Table 2). Findings revealed that pre-service teachers having low-risk perceptions about vaccination were more likely to have an intention for COVID-19 vaccination compared to the ones who had no intention. Hilverda and Vollmann (2021) reported similar findings that indicated there is a significant relationship between risk perceptions and vaccination intention. There are other studies supporting the relationship between risk perceptions and vaccine intention for various vaccines such as the HPV vaccine (e.g., Nan et al., 2015). In light of these research findings, a more general implication for education in general and teacher education, in particular, can be derived. As suggested by Cross (1993), teachers who teach and who will teach science and technology studies should be aware of risk analysis and how to teach risk management to their students. Risk analysis of controversial issues and risk management principles should be incorporated in teaching courses in teacher education programs; thus, future teachers can learn the importance of risk in making decisions and how to teach them to their students. This follows the suggestion of Schenk et al. (2021) to incorporate risk, risk perception, and risk analysis in socioscientific research and education that utilises the SSI approach.

Consistent with the findings of other research (e.g., Aslantekin-Özçoban et al., 2021; Karabela et al., 2021), this study revealed that faith beliefs did not play a role in pre-service teachers' intention to vaccinate against COVID-19 ($p = .56$ for Model I; $p = .67$ for Model II). Generally, if scientific knowledge and religion conflict, many religious people are more likely to trust and follow their religion's doctrines (O'Brien & Noy, 2018). In the COVID-19 case, pre-service teachers did not seem to experience this conflict and made decisions in favour of scientific knowledge. However, larger sample sizes are required to test this hypothesis in depth. Similarly, trust in scientists was not found to be a significant related factor in teacher candidates' intentions towards vaccination in none of the models obtained ($p = .98$ for Model I; $p = .05$ for Model II). Trusting scientists has emerged as a critical component of making well-informed decisions for preserving individual and public health, adhering to COVID-19 protective behaviours, and receiving a COVID-19 vaccination in the fight against the pandemic (Battiston et al., 2020). Our study revealed that although pre-service teachers' trust in scientists was high, it did not significantly contribute to pre-service teachers' intention to get vaccinated. There is a large amount of variation in people's levels of confidence in scientists across countries (Reiss, 2022). One of the factors influencing individuals' level of trust in scientists is accepted to be education level. People with higher levels of education trust scientists more compared to people with lower levels of education (Hamilton et al., 2015; Muğaloglu et al., 2022). The participants of this study were pre-service teachers studying in various teacher education departments. As they have science courses in their programs, this situation may have affected their level of trust in scientists. Similarly, Agley (2020) found that people's trust in scientists was high during the COVID-19 pandemic. In a study with a representative sample of UK people, trust in scientists was negatively correlated with vaccine reluctance (Allington et al., 2021). The sample in our study did not represent all pre-service teachers in Türkiye. Therefore, studies with larger samples may find a significant relationship between trust in scientists and their intention for vaccination.

All in all, the COVID-19 pandemic caused unexpected disruptions in education systems around the globe; hence, one of the crucial steps that needed to be realized was to increase the vaccination of teachers (Cahapay, 2022). Scientists warn that there might be future pandemics, and for this reason, we should take lessons from COVID-19. According to the last report of the World Wide Fund for Nature [WWF] (2022), the climate crisis and disruption of ecosystems because of human impact increase our vulnerability to pandemics. At this point, future teachers' reactions and intentions against vaccines and relevant factors affecting their intentions are crucially important. In our study, we found that environmental factors, risk perceptions and conspiracy thoughts of preservice teachers explain a portion of their intentions towards the COVID-19 vaccine. Nevertheless, it should be kept in

mind that the effect sizes of our statistically significant results were weak and thus further research is required to be able to make more robust implications and suggestions. In future studies, the impact of each factor such as environment, faith, and conspiracy thoughts on pre-service teachers' intentions towards vaccination might be investigated with more diverse samples and other possible reasons related to individuals' intention to have or not to have vaccination might be explored. Moreover, research methods which will allow for a more detailed investigation of the hypothesized relationships would be beneficial and add to the literature.

To prepare pre-service teachers for future pandemics, environmental and science courses in teacher education programs might include discussions and critical reflections to deal with global challenges in the world and develop teachers' environmental perceptions, decrease their beliefs in conspiracy theories and risk perceptions, and increase their trust in scientists. Moreover, good quality vaccine education should be addressed in science education, and teaching about vaccines could help students comprehend relevant biology and science (Reiss, 2022). Even different school subjects might address pandemics and vaccines; therefore, while teaching these topics, cross-curricula collaboration could be developed as proposed by Rönner et al. (2023). Educators have already begun to propose a need for a new pedagogy for education. Zeyer and Kyburz-Graber's (2012) work can be considered among the leading ones of studies which highlight the relationships between environment, health, and science. Researchers who contributed to Zeyer and Kyburz-Graber's (2012) work with their papers on environment, health, and science, as well as their relationships to science education, reveal how science education can and should benefit from the areas of environmental education and science education. Sigit et al.'s (2023) findings also support this argument and imply the potential of integrating environmental and science education for students' development as a whole. Further research focusing on the relationships of these three education areas (i.e., science, environment, health) would highly contribute interesting findings and road maps to education programs including (preservice) teacher education.

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