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Psychological Factors of COVID-19 Vaccination Uptake Among Citizens of Bosnia and Herzegovina: The Application of Health Belief Model*

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The present study investigated which factors are associated with COVID-19 vaccination uptake under the framework of Health Belief Model among the citizens of Bosnia and Herzegovina. A total of 820 people participated in the study. The findings suggest that while perceived barriers are negatively related, perceived benefits and cues to action are positively related to vaccination uptake. Additionally, older individuals, parents and the ones living in urban areas are more likely to take the vaccine. These results can be used by government organizations, medical institutions, campaign managers, physicians, and health activists when seeking to spread the word about vaccines.

Keywords: COVID-19, vaccination, Health Belief Model

Highlights

- The Health Belief Model was adopted and tested for predicting COVID-19 vaccination uptake in Bosnia and Herzegovina.
- Perceived benefits were the strongest predictive factor of vaccination uptake, such as travel benefits and community protection.
- Perceived severity and susceptibility did not prove to be significant components of HBM.
- Age, life in urban residence, and parenthood were predictive factors of vaccination uptake.

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Given that medical systems around the world have been unable to combat the COVID-19 virus at a rate that would save more lives, it appears that the COVID-19 vaccination is the only available treatment in preventing deadly consequences (Yu et al., 2021). Relatedly, it is critical to convince vaccine-resistant people to receive the vaccine in order to reduce the virus's spread, stop the emergence of variants, and develop herd immunity.

Health Belief Model is one of the most broadly applied theories in understanding health and illness prevention related behaviors (Mo & Lau, 2015). According to the model, two factors that influence health-related behavior, such as vaccine uptake, are1) the desire to avoid sickness or, alternatively, to recover from illness, and 2) the conviction that a particular health activity would prevent or cure illness (Rosenstock, 2000). However, the decision is frequently influenced by how person views the advantages and disadvantages of engaging in healthy behaviors (Champion & Skinner, 2008). The present study aims to investigate the difference between people who got vaccinated as opposed to ones who didn't in the context of Bosnia and Herzegovina, under the framework of HBM.

Despite its widespread use in a variety of health-related behaviors, the HBM was created and tested largely in Western countries (Mo & Lau, 2015). There is cultural variety in terms of health ideas, beliefs and practices, as well as national differences in terms of institutional trust (Kreuter, Lukwago, & Bucholtz, 2003). Nevertheless, there are few studies that directly tested HBM's effectiveness and factor relevance among the people of Bosnia and Herzegovina (e.g., Jankovic et al., 2020). Therefore, the second aim of this study is to investigate the predictive power of HBM and its factors to COVID-19 vaccination among the citizens of Bosnia.

The current study offers new insights on what drives some people to take the vaccine while others refuse it, even though they share the same cultural background and are subjected to the relatively same information. Methodologically, study differs from previous ones because it bypasses the intention-behavior gap (Wang et al., 2022). Most of the previous studies only questioned people's attitudes towards vaccination or intention to proceed with it (e.g., Gulion & Kergall, 2021; Malik et al., 2020; Mercadante & Law, 2021). Almost none focused explicitly on the behavior. The time frame in which the current study was conducted grants us to inspect behavior rather than intention, since most of the people who intended to get vaccinated by the moment of the data collection had the opportunity to do so. The practical value of the current study stems from implementation of given knowledge in the creation of effective public health awareness campaigns so we can communicate the message, address the concerns, and eventually build herd immunity in hopes of fighting the virus.

Health Belief Model

The Health Belief Model proved its effectiveness in many health-related issues (e.g., Drayton et al., 2002; Nöthling & Kagee, 2013; Wdowik et al., 2001), while the most notable ones are influenza vaccination (Fall, Izaute & Chakroun-

Baggioni, 2018), papillomavirus vaccination (Gerend & Shepherd, 2012), and most recently in terms of SARS-CoV-2 vaccination and preventative behaviors (Di Giuseppe et al., 2020; Shahnazi et al., 2020; Wong et al., 2020). The HBM accurately predicts health behaviors by concentrating on individual beliefs and attitudes (Janz & Becker, 1984).

Beliefs are long-term personality traits that impact behavior and can be learned through primary socialization. Beliefs may also be changed, and they can vary among the people of similar backgrounds (Abraham & Sheeran, 2015). The idea of incorporating beliefs was derived from Lewin's theory of goal setting, which assumes that a person's behavior is dependent upon two factors: the merit of a certain outcome, caused by an individual's behavior, and the person's estimate of the occurrence of that outcome (Maiman & Becker, 1974). In more simpler terms it is assumed that certain beliefs make certain behaviors more or less appealing (Abraham & Sheeran, 2015).

The model also addresses the importance of various socio-demographic, socio-psychological, and structural factors that may have an impact on perceptions and, as a result, indirectly affect health-related behavior (Champion & Skinner, 2008). For instance, sociodemographic characteristics, notably educational achievement, are thought to influence behavior indirectly by changing the perception of vulnerability, severity, benefits, and barriers.

All HBM factors are divided into three separate parts: modifying factors (sociodemographic and psychological characteristics), followed by individual beliefs (severity, susceptibility, barriers and benefits) and finally action (cues to action and action itself). However perceived severity and susceptibility integrate into perceived threat (Champion & Skinner, 2008). The big advantage of this model is also its limitation, since constructs are not clearly defined, the researcher may determine how to measure them (Abraham & Sheeran, 2015). Therefore, each factor will be discussed separately in the context of the current study, with the reference to the COVID-19 vaccination uptake in Bosnia and Herzegovina.

Perceived Threat: Perceived Susceptibility & Perceived Severity of the Threat

The perceived threat is meant to be interpreted as a combination of susceptibility and severity of the health threat (Mercadante & Law, 2021; Strecher & Rosenstock, 1997), although many authors choose to focus on each factor individually (e.g., Guillon & Kergall, 2021; Zampetakis & Melas, 2021). The present study will take into consideration both factors as predictors of the perceived threat.

Perceived susceptibility relates to people's perceptions about their chances of contracting an illness or condition. For instance, one must believe there is a chance of getting infected with a virus before being willing to receive a vaccine against it. Perceived severity refers to feelings of seriousness of COVID-19. Essentially, it is a personal assessment of the negative impact that medical conditions can have on an individual's health (e.g., pain, death, etc.) if left unattended, as well as potential social repercussions (e.g., effects of disease on social family life) that come with the condition (Champion & Skinner, 2008).

The model assumes that perceived susceptibility is a better predictor of preventive health actions (Brewer et al., 2007; Strecher et al., 1997), which would imply that we can expect it to be a solid predictor of COVID-19 vaccination. Empirical findings are however not so clear. For instance, some studies indeed found that people who perceived virus as greater threat reported higher intention to get vaccinated (Glöckner et al., 2021; Guillon & Kergall, 2021; Malik et al., 2020; Ward et al., 2020) and also engaged more in other preventative behaviors (Dryhurst el a., 2020; Harper et al., 2020). However, several studies reported that both perceived severity and perceived risk of infection, were not significant predictors of vaccination intention (Faasse & Newby, 2020; Mercadante & Law, 2021). Other studies noted perceived threat as merely slightly important (Karlsson et al., 2021).

While the majority of studies found a positive relationship between perceived threat and COVID-19 vaccination uptake (e.g., Guillon & Kergall, 2021; Malik et al., 2020), the present study considers the methodological difference between previous studies and the current one. Past studies merely measured people's intention to vaccinate while the former is able to capture people's behavior of whether an individual did or did not get vaccinated. The factual vaccination might contribute to the change of perceived threat, that is both perceived susceptibility and severity. The vaccine helps to mitigate the symptoms of virus infection that is perceived severity, while it also decreases the chances of infection, which could potentially be reflected in the decrease of perceived susceptibility (Lipsitch & Dean, 2020). However, there is no reason to believe that perceived threat is not positively associated with COVID-19 vaccination uptake, but it is expected that this relationship will be somewhat weaker than in the vast majority of previous studies.

Perceived Benefits

Perceived benefits refer to the individual's assessment of the advantages that the certain action undertaken to decrease the health danger brings (Champion & Skinner, 2008). Those with optimum perceptions of susceptibility and severity are unlikely to adopt any advised health intervention unless they see it as possibly advantageous in terms of minimizing the danger. Perceived benefits imply that in order for a person to be willing to take COVID-19 vaccine, first he or she must believe that the vaccine will decrease the danger or severity of the disease.

Empirical evidences conclusively found not only this effect across many studies and different cultural contexts, but also found perceived benefits to be the strongest predictor among all HBM factors of COVID-19 vaccination (Karlsson et al., 2020; Mercadante & Law, 2021; Sherman et al., 2020; Wong et al., 2020). Additionally, Zampetakis and Melas (2020) report that perceived benefits moderate the relationship between perceived severity and susceptibility, in a sense that perceived severity is a stronger predictor of vaccination intention among individuals that exhibited low perceived susceptibility and high perceived benefits. These findings corroborate people's confidence in the vaccine's safety and the importance of benefits.

Guillon and Kergall (2021), found the connection between COVID-19 vaccination intention and future preference, suggesting that people who are more present oriented are less in favor of vaccination. These results point to the need for the emphasis of short-term benefits (e.g., travels) within campaigns and policies. Relatedly, COVID-19 vaccination impacted many areas of life, like job security, socialization habits, travel policies, etc., studies ought to consider not only health benefits.

Based on the theoretical basis of the model and its constructs, it can be expected that like in many other studies, the perceived susceptibility, severity of the threat (Glöckner et al., 2020; Guillon & Kergall, 2021; Malik et al., 2020; Ward et al., 2020) and benefits constituted as individual beliefs (Karlsson et al., 2020; Mercadante & Law, 2021; Sherman et al., 2020; Wong et al., 2020) will be in positive association with vaccination uptake.

> **H1a:** The perceived threat (the perceived susceptibility, perceived severity of the threat) and perceived benefits are positively related to COVID-19 vaccination uptake.

Further along, based on the previous studies that found benefits to be the strongest and the most stable factor of all HBM constructs (e.g., Sherman et al., 2020; Wong et al., 2020), the same finding is expected to occur in the present study.

> **H1b:** The perceived benefits are the strongest predictor of COVID-19 vaccination uptake.

Perceived Barriers

Perceived barriers are defined as any potentially unfavorable characteristics of a health action. In other words, any physical or psychological consequence of health-related action (Champion & Skinner, 2008). Based on this idea, it could be expected that the lower the perceived barriers are (the stronger the effects of benefits), the more likely it is for a person to engage in preventative behavior.

Perceived barriers seemed to be the second most important predictor of COVID-19 vaccination intention (Guillon & Kergal, 2021; Mercadante & Law, 2021; Wong et al., 2020; Zampetakis & Melas, 2020). Like other constructs in HBM, the barriers are also subjected to modification depending on the context of the study. Likewise, different studies introduce different ideas about what these barriers might be. Some address the financial barriers (Wong et al., 2020), some address fear of needles (Sherman et al., 2021), others focus on health-related issues (Guillon & Kergall, 2021; Mercadante & Law, 2021; Wong et al., 2020;), while some address institutional trust and even conspiracy theories (Guillon & Kergall, 2021).

The present study takes into account health-related barriers since these concerns are universal, followed by the institutional trust due to the particular national context of Bosnia and Herzegovina which is often characterized with the low institutional trust (Pasovic & Efendic, 2018; Whitt, 2010). Financial

and other logistic reasons are not in the focus of this study, considering that vaccines are free of charge and available to all citizens of Bosnia. Nevertheless, the following hypothesis was set:

> **H2:** The perceived barriers are negatively related to COVID-19 vaccination uptake.

Cues to Action

Cues to action are defined as any trigger that can potentially drive an individual to take health-related action. Hochbaum (1958) believed that readiness to act (perceived susceptibility and benefits) could only be heightened by other variables, such as cues to act. Those can include anything in the range of physical occurrences, or environmental events to media coverage. Cues to action are not as empirically investigated as other factors in the HBM, mainly due to the fact that they can be anything from simply sneezing to seeing certain posters (Champion & Skinner, 2008).

Nevertheless, many studies on the topic of the 2021 COVID-19 vaccination incorporated cues to action as one of the factors. For instance, Guillon and Kergall (2021), concentrated on medical history, particularly if a person got vaccinated for influenza vaccination, whether they experienced any virus-related symptoms, or whether they knew someone who was infected. Others addressed social triggers, such as whether people were given advice from relatives or medical experts (Wong et al., 2021). Regardless, the predictive importance of cues to action is proven within these studies (Guillon & Kergall, 2021; Wong et al., 2021).

The present study will focus only on medical issues regarding COVID-19 virus. Even though the importance of social cues is not ignored, it is beyond the scope of this study. Social cues could refer to all information received from doctors, medical staff, government, friends and family and even media. However, this study tackles the trust in these entities only under the title of barrier rather than concentrating on the information source as cues to action. Given that all of these entities advocated for vaccination at some point, it is assumed that there would be little variation in opinions depending on who provided the information, i.e., which source was the cue, instead we focus on whether or not the source could be trusted.

> **H3:** Cues to action are positively related to COVID-19 vaccination uptake.

Risk Preference

From the perspective of psychology, risk preference is used to explain people's tendency to engage in rewarding activities that also carry the danger of potential loss (Steinberg, 2013). The construct carries predictive value, it stands for psychological trait that can predict behavior, which is what makes it relevant and categorized under modifying factors within the present study (Mata et al., 2018). Like many other psychological attributes, it is not entirely constant, it

might be susceptible to systematic alteration as a result of ether external factors, momentary shocks or it can change with different phases of life (Caspi, Roberts, & Shiner, 2005).

Unlike an economy that traditionally focuses on the financial domain regarding risk preferences, psychology extends the idea to other domains such as social sphere, health, leisure, career, etc. (Dohmen et al., 2011). However, empirical evidence suggests that the risk preferences across domains are stable, indicating that risk preference is in fact a psychological trait that deviates more or less depending on context-specific questions (Arslan et al., 2020; Dohmen et al., 2011). Due to methodological reasons, in the spectrum of risk preference, people are usually categorized as either risk averse, risk neutral or risk loving (Dohmen et al., 2011). Risk aversion refers to preference for outcomes with low uncertainty over those with high uncertainty (Diamond & Stiglitz, 1973), while individuals' risk aversion behavior can be defined as a decision taken to escape the risk or uncertainty by responding to the situation (Montesano, 1985).

In that sense, risk aversion can influence decisions to get vaccinated in two alternative directions: some people might get vaccinated due to fear of illness repercussions (to minimize the risk of deadly outcome), while others might choose not to get vaccinated due to the fear of the vaccine's negative side effects. Previous studies on the topic of influenza vaccination, concluded that risk aversion is positively related to vaccination intention (Massin et al., 2015; Tsutsui, Benzion, Shahrabani, & Din, 2010, 2012).

While the findings might be conclusive when it comes to influenza vaccination, the current case of COVID-19 vaccination, raises a lot of follow up concerns. Global concern, novelty of the vaccine, huge public and media coverage are some of the factors that led to doubts regarding the vaccine's safety (Chadwick et al., 2021; Talabi et al., 2021). Fast information flow in the era of digital transparency gave birth to conspiracy theories and myths regarding vaccine's effectiveness, which raised the concerns of vaccines being an uncertain solution (Coudeville et al., 2020; Romer & Jamieson, 2020; Ullah et al., 2021). Not to mention that politicization of the issue did not instill trust in people (Bolsen & Palm, 2021; Limaye, Sauer, & Truelove, 2020; Ward, Alleaume, & Peretti-Watel, 2020). Interestingly, the effect was noted in some of the recent studies in which risk seeking people were more likely to have intention to receive COVID-19 vaccine (Guillon & Kergall, 2021; Trueblood, Sussman, & O'Leary, 2021).

This study builds on the knowledge that the novelty of the current COVID-19 vaccine facilitated feelings of uncertainty (Coudeville et al., 2020). The state in which taking a novel vaccine seems as a rather riskier choice than non-taking it. The COVID-19 virus has been around us for three years now, and a lot of possible side effects are known, while the vaccination side effects are yet to be determined. This simply implies that the uncertainty of vaccine is greater than the uncertainty of the virus, and so between the two alternatives the riskier choice is the vaccine. Therefore, the following hypothesis is set:

H4: Risk aversion is negatively related to COVID-19 vaccination uptake.

Method

Participants

The inclusion criteria required participants to be adult residents of Bosnia and Herzegovina. Since the study is time and place bound, the residency in the past two years was an important prerequisite to be included in the study.

A total of 943 participants took the survey, however 117 were excluded due to incomplete surveys, while an additional 6 participants were excluded based on an open question in which they provided information about medical barriers[1] (e.g., brain tumor or breastfeeding). After summarizing the valid data, a total sample size of 820 was used for further analysis. The sample consisted of 52.8% vaccinated and 47.2% non-vaccinated people.

The participants varied in age from 18 to 74 years old (M = 34.10; SD = 10.32), with 78.5% of them being female. People from all economic classes were included in the sample, though at varying percentages: 9.5% stated that they belonged to the low income group, 8.2% to the middle-lower group and the vast majority of 54.3% said they belonged to the middle income group, followed by 23.3% in the middle-upper group and 4.8% reported that they belonged to the high income group. Further along, 0.1% reported having no high school, 37.9% of participants reported having a high school level of education, 45.2% reported having a bachelor's degree, 15.5% having a master's degree, while 1.2% holding a PhD. Regarding participant's parenthood status, 54.1% reported having children, while 83.2% lived in urban areas as opposed to rural (16.8%).

Procedure

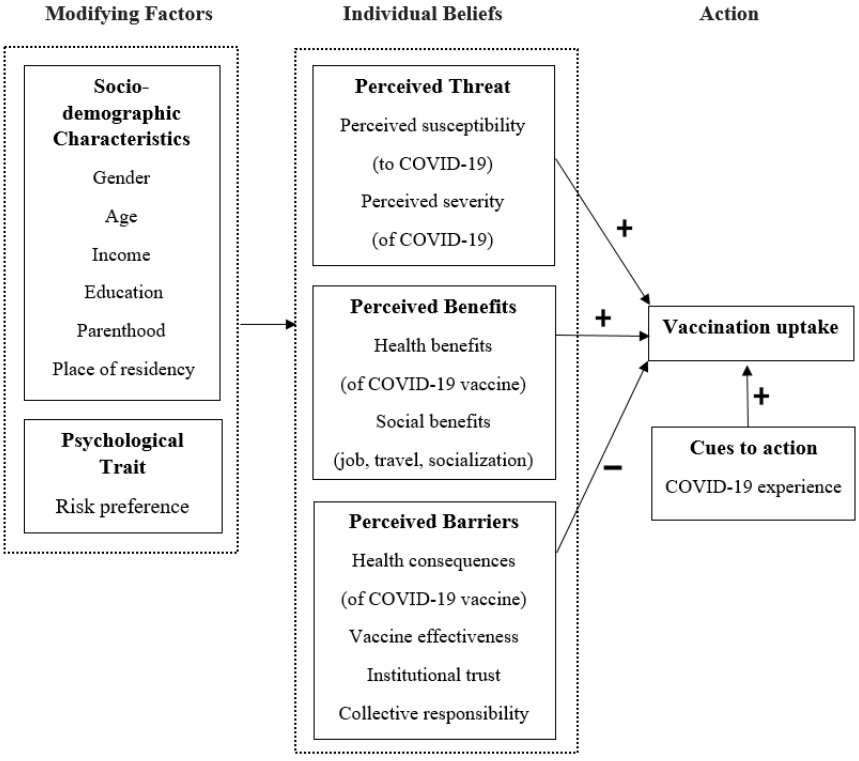
The survey was created using the online survey tool, 1ka, and distributed via social media networks (e.g., Facebook). The data was collected from November 6th to November 24th, 2021, adhering to the convenience sampling method. The questionnaire was back translated from English to Serbo-Croatian (the local language) and vice versa with the assistance of three translators. The survey was anonymous, and if participants required, the study results were reported to them via email.

Measures

The survey consisted of two one-item scales, Individual Action and Cue(s) to Action, and 4 multiple-item scales Perceived Threat – Perceived Susceptibility and Perceived Severity of the Threat, Perceived Barriers, Perceived Benefits, and Risk Preference, (see Appendix A for key to instrument). Figure 1. depicts HBM in the context of the present study, with the proposed indicators of the variables and the assumed relationships between the concepts.

1 No other type of barrier such as logistical, financial, legal or other was reported.

Figure 1.
The Health Belief Model and COVID-19 Vaccination Uptake



Note. Figure 1 depicts HBM in the context of the present study, with the proposed indicators of the variables and the assumed relationships between the concepts. The model was borrowed and adapted from Champion and Skinner (2008).

Individual Action

Individual action refers to the vaccination, which is a dependent variable. It is assessed from a single question, "Have you been vaccinated against COVID-19?". The response was a binary "Yes" or "No". The question implies that only one dose is enough to be considered as vaccinated, considering the time frame of the study.

Risk Preference

The measure of individual risk preference was the "Risk Attitude Scale", a three-item scale borrowed from Massin et al., (2015). It is a self-reported attitude towards risk in three domains: daily life, finance and health. The response scale was an 11-point Likert scale, ranging from 0 to 10, 0 being "not at all inclined to take risks" and 10 being "totally inclined to take risks". Accordingly, based on their individual risk attitudes, subjects were divided into three categories: risk seeking, risk neutral and risk averse.

Perceived Threat: Perceived Susceptibility & Perceived Severity of the Threat

Perceived health threat was assessed with a six-item scale, that is two subscales. One subscale refers to "Perceived Susceptibility" to Covid-19, it is a three-item scale adapted from Farooq et al., (2020), and it consists of the statements "I am vulnerable to contracting COVID-19 more than other people", "I think I am more likely to get COVID-19, than other people", and "I am at risk of catching COVID-19 more than other people" (α = .9). The second subscale refers to the "Perceived Severity" of the COVID-19 pandemic, also a three-item scale, adapted from Zheng, Jiang, and Wu (2021). The scale includes the statements "The negative impact of COVID-19 is very high", "The negative impact of COVID-19 can be life-threatening", and "The negative impact of COVID-19 is a serious threat for someone like me".

Perceived Benefits

The perceived benefits of getting vaccinated were measured with a six-item scale. Three items were borrowed from Gulion and Kergall (2021): "Getting vaccinated against COVID-19 would be a good way to protect myself against COVID-19', "Getting vaccinated against COVID-19 would be important for the health of others in my community", and "Vaccination against COVID-19 will help end the current pandemic". An additional three items were constructed in accordance with the context of the study: "Getting vaccinated against COVID-19 is important because it allows me to travel without restrictions", "Getting vaccinated against COVID-19 is important because it allows me to continue working in my job", and "Getting vaccinated against COVID-19 is important because it allows me to socialize with my family and friends that are at risk of contracting the virus".

Perceived Barriers

The perceived barriers to vaccination are assessed with a nine-item scale. Five reflect a person's trust in institutions: "I trust in government/vaccine manufacturers/science/media/ medical institutions ... regarding vaccination". The first three items were borrowed from Gulion and Kergall (2021), while items about the media and medical institutions as well as item "My health will be damaged if I get vaccinated against COVID-19", were additionally added to capture as many relevant barriers as possible. Also, the items "I am confident that COVID-19 vaccine is safe and effective", and "If everyone else gets vaccinated against COVID-19 then I don't have to", were borrowed from Neufeind et al., (2020). Additionally, in this scale, there is an open statement with the instruction to either skip or name specific reasons why it is impossible for a person to get vaccinated. The statement went as follows: "There are other medical, financial, logistic or legal reasons I personally can't get vaccinated. If so, please specify what the reason would be, if not please skip this statement".

Cues to Action

Cues to action were assessed with the binary question "Have you been sick with COVID-19?", after which, only if the response was "No", a subsequent question, "Do you know anyone in your immediate social network that was sick with COVID-19?" was asked. The response scale was a three-category scale, with options "Yes", "No", and "I don't know".

Data Analysis

Data analysis was conducted via an IBM SPSS 27 and Jamovi (CFA and moderation regression), in five steps. In the first step, after data screening (missing data and outliers), the Confirmatory Factor Analysis (CFA) was done. In the second step, the predictive power of Individual Beliefs (Perceived Susceptibility, Perceived Severity of the Threat, Perceived

Benefits and Perceived Barriers) was tested through Simple Logistic Regression. In the third step, the predictive power of Cues to Action and Risk Preference was assessed through the Chi Squared Test of Association. In the fourth step, Hierarchical Linear Regression was conducted to see which factor within the model is the strongest predictor. Moreover, in the fourth step, control variables were tested as predictors of vaccination uptake. Gender, place of residence and parenthood through Chi-square, while the variables age and SES (education and income) through Simple Logistic Regression, considering these were continuous variables. Finally, it was explored, through Moderation Regression, whether there is a moderation effect of demographic characteristics on the relationship between the individual beliefs and COVID-19 vaccination uptake.

Results

Confirmatory Factor Analysis (CFA) & Reliability of the Scales

Initially, CFA was performed on 23 items, expected to load into 4 factors of HBM: Perceived Threat, Perceived Benefits, Perceived Barriers and Risk Preference (indicator of Psychological Differences). Essentially, all factors were included except the single-item variables: Cues to Action and Action. However, after running CFA, it was decided to treat Perceived Susceptibility and Perceived Severity of the Threat as individual variables, instead of 2 subscales. Additionally, Perceived Barriers items: "I trust in B&H's government regarding COVID-19 vaccination", and "Getting vaccinated against COVID-19 is important because it allows me to continue working my job", didn't suit the data (the factor loading was < .4) and were excluded from further analysis. Finally, the Goodness of Fit Index suggested that 21 items divided into 5 factors[2] suit the data satisfactorily: X^2 (df)= 699 (195), $p < 0.001$, CFI=0.97, RMSEA = 0.06 (0.05-0.06), TLI = 0.96. Descriptive statistics with reliability of the scales are presented in Table 1, while the factor loadings for each item are depicted down below in Table 2.

Table 1
Descriptive Statistics and Cronbach's Alpha for Health Belief Model Scales

Scales	M	SD	Cronbach's α
Risk Preference	2.57	.65	.78
Perceived Susceptibility	2.63	1.50	.90
Perceived Severity of the Threat	4.92	1.43	.79
Perceived Benefits	4.26	2.01	.95
Perceived Barriers	4.95	1.75	.91

Note. Risk Preference is defined as a three-level variable (1 – risk averse; 2 – risk neutral; 3 – risk seeking).

2 Risk Preference, Perceived Susceptibility, Perceived Severity of the Threat, Perceived Benefits and Perceived Barriers.

Table 2
Factor Loadings for Each Item Within HBM Questionnaire

Constructs/Items	Loadings
Risk Preference	
How likely are you to take the risk in the different domains of daily life?	.74*
How likely are you to take the risk in the management of your personal finances?	.79*
How likely are you to take the risk regarding your medical behavior for your own health?	.68*
Perceived Susceptibility	
I am more vulnerable to contracting COVID-19 than other people.	.73*
I think I am more likely to get COVID-19, than other people.	.97*
I am at risk of catching COVID-19 more than other people.	.91*
Perceived Severity of the Threat	
The negative impact of COVID-19 is very high.	.65*
The negative impact of COVID-19 can be life-threatening.	.92*
The negative impact of COVID-19 is a serious threat for someone like me.	.71*
Perceived Benefits	
Getting vaccinated against COVID-19 is a good way to protect myself against COVID-19.	.95*
Getting vaccinated against COVID-19 is important for the health of others in my community.	.97*
Getting vaccinated against COVID-19 helps end the current pandemic.	.96*
Getting vaccinated against COVID-19 is important because it allows me to travel without restrictions.	.7*
Getting vaccinated against COVID-19 is important because it allows me to socialize with family and friends that are at risk of contracting disease.	.87*
Perceived Barriers	
My health will be damaged if I get vaccinated against COVID-19.	.79*
I am confident that COVID-19 vaccine is safe and effective.	.95*
If everyone else gets vaccinated against COVID-19 then I don't have to.	.54*
I trust in B&H medical institution's ability to handle COVID-19 health pandemic, help me if I get infected and how they handle the process of vaccination against COVID-19.	.57*
I trust in science findings regarding COVID-19 health pandemic.	.89*
I trust in pharmaceutical companies that manufacture COVID-19 vaccines.	.91*
I trust in the media and the information they provide regarding the importance of COVID-19 vaccination.	.68*

Note. * $p < .001$

Individual Beliefs & COVID-19 Vaccination Uptake

Logistic regression was used to test if the beliefs (Perceived Severity of the Threat, Perceived Susceptibility, Perceived Benefits and Perceived Barriers) significantly predicted participants' willingness to get vaccinated (Vaccination Uptake). The results of the regressions indicated that two out of four predictors are statistically significant. More precisely, it was found that Perceived Benefits are positively related to Vaccination Uptake, $R^2 = 0.46$, $B = 1.27$, $p < .001$, $OR = 3.56$, 95% CI [3.03, 4.18], while the Perceived Barriers are negatively related to COVID-19 Vaccination Uptake $R^2 = 0.41$, $B = -1.52$, $p < .001$, $OR = 0.21$, 95% CI [.18, .26]. Among benefits unrestricted travel ($M = 4.79$, $SD = 2.09$) and protecting community ($M = 4.32$, $SD = 2.23$) are strongest predictors of vaccination uptake while amongst the barriers lack of trust in media ($M = 5.52$, $SD = 1.56$) and medical institutions ($M = 4.8$, $SD = 1.81$) are strongest obstacles. Collective responsibility undoubtedly took the last place among barriers ($M = 2.73$, $SD = 1.78$),

To further study the question of which predictor between Perceived Benefits and Perceived Barriers is the stronger predictor of Vaccination Uptake, a Hierarchical Linear Regression Analysis was conducted (see Table 3). For the first block, the predictor variable Perceived Benefits was used as a predictor. The results of the first block revealed a model to be statistically significant ($p < .001$). Additionally, the R^2 value of (.528) associated with this regression model suggests that the independent variable, Perceived Benefits accounts for 52.8% of the variation in the dependent, Vaccination Uptake variable. This, on the other hand, means that the 47.2% of the variation in Vaccination Uptake can't be explained by the variable, Perceived Benefits.

Table 3
Hierarchical Linear Regression Presenting Perceived Benefits and Perceived Barriers as Predictors of Covid-19 Vaccination Uptake

Predictors	Vaccination Uptake	
	Model 1, Standardized β	Model 2, Standardized β
Perceived Benefits	.726***	.502***
Perceived Barriers		– .251***
R^2	.528	.540
F	918.690***	
ΔR^2		.013
ΔF		22.471***
VIF		5.011

Note. *** $p < .001$

For the second block analysis, the predictor variable, Perceived Barriers was added to the analysis. The results of the second block hierarchical regression analysis revealed a model to also be statistically significant ($p < .001$). The two predictors can account for 54% of the variance. The R^2 change value of (.013)

suggests that the addition of the second independent variable, Perceived Barriers, to the first block accounts for an additional 1.3% of the variation of the variable Vaccination Uptake. This means that 46% of the variation cannot be explained by both independent variables.

Looking at the unique individual contribution of the predictors, the results show that both Perceived Benefits ($\beta = .726$, $t = 30.31$, $p < .001$) and Perceived Barriers ($\beta = -.251$, $t = -4.740$, $p < .001$) positively predict Vaccination Uptake, however Perceived Benefits are the stronger predictor.

Variance inflation factors (VIF) measure for multicollinearity amounts to 5.011 (tolerance .25), meaning that the correlation between Perceived Benefits and Perceived Barriers can be tolerated based on the upper limit of 10, suggested by Hair et al., (1995).

Cue to Action & COVID-19 Vaccination Uptake

The results of the Chi Squared Test of Association show a statistically significant association between the previous infection of an individual that is Cue to Action and Vaccination Uptake in the study sample ($x^2(2, N = 824) = 7.75$, $p = .021$). Cramer's V value was .1, which indicates that there is a significant but weak association between these variables.

Psychological, Demographic Characteristics & COVID-19 Vaccination Uptake

The results of the Chi Squared Test of Association show no significant association between Risk Preference and Vaccination Uptake ($x^2(2, N = 824) = 3.12$, $p = .21$).

There was no statistically significant association between variables Gender and Vaccination Uptake (x^2 (1, $N = 824$) = 2.59, $p = .11$), neither between variables SES (income and education) and Vaccination Uptake (x^2 (4, $N = 824$) = 2.39, $p = .66$).

However, the results did indicate a statistically significant association between Parenthood Status and Vaccination Uptake.. In other words, contrary to the assumption, people with children were more likely to get vaccinated against COVID-19, than people without children (x^2 (1, $N = 824$) = 13.83, $p < .001$). The Cramer's V amounts to .13, which suggests that the strength of the association between variables is weak.

The association between Place of Residency and Vaccination Uptake was also statistically significant. In other words, it was assumed people from urban areas were more likely to get vaccinated against COVID-19, than people from rural areas (x^2 (1, $N = 824$) = 23.67, $p < .001$). Cramer's V amounts to 0.17, which suggests that the strength of the association between variables is rather weak.

A Simple Logistic Regression analysis was conducted to examine the effects of Age on Vaccination Uptake, resulting in a statistically significant model (see Table 4). The findings revealed that older participants exhibited a higher probability of receiving the COVID-19 vaccine compared to their younger counterparts. This aligns with the initial hypotheses, with $R^2 = .05$, B = .05, $p < .001$, $OR = 1.05$, 95% CI [.03, .06]. In essence, for each additional year of age, participants were 1.05 times more likely to be vaccinated, with 95% CI [1.03, 1.06].

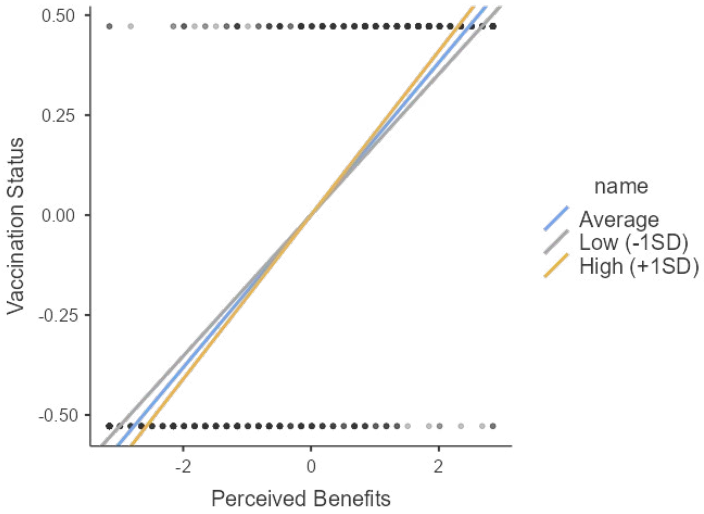
Table 4
Logistic Regression Analysis for Age Predicting the Likelihood of Vaccination Uptake

						95% CI	
Variable	B	SE	Z	p	OR	LL	UL
Age	.05	.01	6.38	.000	1.05	1.03	1.06

Note. CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

Finally, it was explored whether there is a moderation effect of demographic variables on the relationship between Perceived Benefits, Barriers, and Vaccination Uptake. The Moderation Regression run in Jamovi, showed that interaction between Perceived Benefits and SES was statistically significant (B = .0217, SE = .00964, 95% CI [.00276, .0406], $p < .05$). In other words, as the socioeconomic status of an individual increases the strengths of the positive association between Perceived Benefits and Vaccination Uptake increases (see Figure 2). No other moderation effect was found.

Figure 2
Moderation Effect of SES on the Relationship Between Perceived Benefits and Vaccination Uptake



Note. Simple Slope Plot depicting the effect of the predictor variable Perceived Benefits on the dependent variable Vaccination Uptake at different levels of the moderator SES. As the socioeconomic status of an individual increases the strengths of the positive association between Perceived Benefits and Vaccination Uptake increases.

Discussion

The aim of the present study was to investigate the factors associated with COVID-19 vaccination uptake in the framework of HBM, among the population of Bosnia and Herzegovina.

The results of the study suggest that three out of five factors of HBM are significantly related to vaccination uptake. To narrow it down, the study shows that Perceived Benefits, Perceived Barriers and Cues to Action have a significant effect on vaccination status. The individual beliefs (benefits and barriers) together can account for 54% of the variance in vaccination status, while no such conclusion could be made regarding Perceived Susceptibility and Perceived Severity of the threat. When it comes to individual beliefs solely, Perceived Benefits proved to be the undoubtedly strongest predictor among the HBM constructs, which is in line with previous studies (Guillon & Kergal, 2021; Sherman et al., 2020; Wong et al., 2020; Karlsson et al., 2020; Mercadante & Law, 2021; Zampetakis & Melas, 2020), suggesting that in order for a person to take the vaccine, he or she should feel that the vaccine has health benefits in terms of decreasing a person's vulnerability to the disease. However, a person might also acknowledge benefits such as unrestricted socialization, travel or even contribution to the community. In fact, among listed benefits, unrestricted travel and protecting the community seem to be the strongest drivers of vaccination, which is in line with previous findings (e.g., Kaufman et al., 2021).

Additionally, it was found that socio-economic status further strengthens the relationship between benefits and vaccination acceptance. This is the expected result, partially considering the operationalization of perceived benefits since some of the questions relate to perks like traveling, which is generally more affordable for people with higher income.

Perceived Benefits are followed by Perceived Barriers as the second strongest predictor, which is, once again, in line with previous studies (Zampetakis & Melas, 2020; Wong et al., 2020; Mercadante & Law, 2021; Guillon & Kergal, 2021). This finding confirms the idea that in order for a person to engage in certain health preventative action, he or she must feel that the benefits of this action outweigh the possible barriers the action brings. Among the barriers, lack of trust in the media and medical institutions seem to be the biggest obstacles to getting vaccinated, which is somewhat expected considering the context of the study. To be precise, as mentioned earlier, Bosnia is a country with low institutional trust, which is somewhat reflected within this study as well (Pasovic & Efendic, 2018; Whitt, 2010). Lastly, collective responsibility ("If everyone else gets vaccinated against COVID-19, then I don't have to.") undoubtedly took the last place among barriers, supporting the idea that when structuring pro-vaccination campaigns, the collective benefit should be emphasized. However, one should always be aware of social desirability bias when interpreting the results. Nevertheless, this study corroborates the idea of altruistic vaccination behavior and the importance of the motives behind it (Neumann-Böhme et al., 2019).

No statistically significant correlation was established between perceived severity and perceived susceptibility to the disease, consistent with findings reported in several prior studies (Faasse & Newby, 2020; Mercadante & Law, 2021, Wong et al., 2021). Interestingly, even though people perceived a very high severity of the threat (M = 4.92, SD = 1.43), they did not perceive themselves as particularly vulnerable to the infection (M = 2.63, SD = 1.50). This finding

is not new to the field of research, other studies also showed the same results (e.g., Karlsson et al., 2021). One plausible explanation for this effect could be optimism bias (Walter et al., 2022). Another important mention is that people who got vaccinated changed their susceptibility, which is expected.

To test whether the later explanation could account for this effect, a non-parametric Kruskal-Wallis test was done to compare the mean scores on Perceived Severity (H (1) = 139.940, p <0.001) and Susceptibility H (1) = 39.185, p <0.001) scales between the vaccinated and unvaccinated people. The test showed a significant difference between the groups, however the test showed not only that people who were vaccinated perceived a higher severity of the threat (*Mean rank* (vaccinated) = 504.98; *Mean rank* (non-vaccinated) = 309.08) but also a higher perceived susceptibility (*Mean rank* (vaccinated) 460.90; *Mean rank* (non-vaccinated) = 358.38) to the virus. In other words, people who generally saw a greater threat in the virus also perceived themselves to be more vulnerable to the virus when compared to their non-vaccinated counterparts. Therefore, the latter explanation cannot account for not finding a significant relationship between perceived threat and vaccination uptake within the model. Even though the perceived threat is not a significant predictor within the model, a separate statistical analysis did prove the difference between the groups when it comes to a perceived threat, suggesting alternative explanations for failing to reach the significance within the model. Overall, the conclusive finding is that just because people think a threat could have devastating consequences, it does not mean that they will also engage in preventative behaviors solely based on that.

This, however, calls into question numerous campaigns in which authorities attempted to persuade people to get vaccinated by stressing how serious the illness is or how widespread it is, as people have an optimistic bias and believe they are unlikely to contract the illness, even if they perceive it to be dangerous. Overall, the findings suggest that emphasizing the advantages of vaccination in public health awareness initiatives would be highly advantageous. Additionally, it is advisable to address people's concerns, in a sense, to break down the barriers (e.g., build institutional trust, emphasize collective responsibility and address medical concerns regarding vaccination).

Further along, Cues to Action proved to be positively but slightly related to vaccination acceptance. The weak connection is expected due to the narrow operationalization of such a wide construct, which is also one of the study's limitations.

Risk preference, a personality trait as defined within this study, shows no statistically significant connection to vaccination status. The present study can neither confirm positive connection between risk seeking and vaccination uptake (Guillon & Kergall, 2021; Trueblood, Sussman, & O'Leary, 2021), nor can it prove that just like an influenza vaccination, risk aversion is associated with vaccination acceptance (Massin et al., 2015; Tsutsui, Benzion, Shahrabani, & Din, 2010, 2012). The study fails to answer the question whether some people might get vaccinated due to potential side-effects (to minimize the risk of deadly outcome) or are people more afraid of the vaccine's side effects, so they choose against vaccination.

Like many other studies that use convenience sampling, or the snowball strategy, the present study lacks enough balance in the sample. Risk preference is one of the variables that has undergone sample disproportion (risk seeking, N = 542 /risk neutral, N = 210 /risk averse, N = 72), which could account for lack of associations. Nevertheless, even though disproportions in the sample are expected to some extent, it is unusual that 66.1% of the sample falls under the category of risk seeking individuals. While it is not impossible, it is highly unlikely, which could point to errors in construct operationalization or standardization of questions, such as "daily risk", which in turn suggests another limitation of the study.

Moreover, gender and SES are no exception to errors in sample distribution. The current study falls short of adding to the body of evidence that supports the notion that women are more reluctant to vaccination (Dror et al., 2020; Guillon & Kergall, 2021; Malik et al., 2020). The disproportion between the females (78.54 %) and males in the sample points again to the sampling errors. The same goes for the SES since 54.25 % of people fall into the middle-income category, while the rest of the sample (45.25 %) falls under the four remaining categories.

Older participants were more likely to get vaccinated, which is in line with previous studies (Malik et al., 2020; Mercadante & Law, 2021; Sherman et al., 2021; Wong et al., 2021). This effect could be explained by the nature of the virus itself, considering the virus led to a greater perceived threat in the older population, and so the health benefits become more salient (Centers for Disease Control and Prevention, 2020).

The study found that people with children were more likely to get vaccinated. This study refuted findings that parents are more COVID-19 vaccine hesitant (Dror et al., 2020; Paul, Steptoe, & Fancourt, 2021). This finding could potentially indicate that the greater risk for parents was not in getting vaccinated but rather in the repercussions of the virus. In other words, if there is a connection between risk and vaccination, it could mean that risk averse people were more likely to get vaccinated, considering that parents are generally a more risk averse group (Görlitz & Tamm, 2015).

Finally, people from urban areas are more likely to get vaccinated, which is in line with previous studies (Fisher et al., 2020; Khubchandani et al., 2021; Sun & Monnat, 2021). Although this may be because of logistical considerations, such as the fact that persons from rural regions must travel longer to receive vaccination, it is extremely unlikely that this is the case for the current sample, given that it was gathered mostly online. Instead, it is more plausible that people from rural areas just perceive themselves to be less at risk, since they live further from cluster zones. Additionally, a rural place of residency is connected to lower income, lower levels of education, lower health awareness, as well as lower trust in medical institutions (Williams & Efendic, 2021).

Limitations and Future Research

Like many other studies the current study is not without limitations. First and foremost, the operationalization of Risk Preference, as well as Cues to Action is to be revised. Unrealistic proportion of the risk seeking individuals in the sample points to the flaws in standardization of the measurement. Further along, the reliability of one-item scale could be brought to question. The original idea was to focus on personal experience as cue (personal infection and knowing someone who got infected). However, since the present study is very time sensitive, in the period that went by between the theoretical operationalization of construct and data collection, many people already knew someone who got infected in their social circle, which explains the zero variance on this item. The item could have been adjusted to the question such as: "Do you know someone who died in your immediate social circle?". This way the connection would probably be more impactful.

Second, the study lacks proper balancing of the sample, which directly impacted possible important findings regarding risk preference and vaccination perception. Additionally, poor balancing also impacted gender and SES disproportion.

Finally, it is important to take these results with caution, considering the study measures vaccination action rather than cognitive or emotional attitudes towards vaccination. This could confound the general conclusion, since maybe people felt rather pressured to vaccinate rather than to accept it. It is not clear why items regarding job security and government trust failed to be part of the final analysis, however it might be due to the lack of people's trust in the study itself, considering how sensitive these topics are. The act of vaccination could have changed their views to mitigate the negative feelings of being pressured into action, that is to avoid cognitive dissonance. It is debatable whether these results would be applicable to future vaccinations, in the early stages at least.

Considering the virus has been somewhat mitigated, future research could investigate people's perception of vaccination over time, willingness to get revaccinated after many restrictions are lifted, and to check the consistency in people's beliefs.

Practical Implication

The primary takeaway from the current study is that simply informing people that they are likely to get the disease or even that they may pass away from the virus is insufficient to persuade them to take preventative action like getting vaccinated. Addressing the vaccine's safety and efficacy would be a little more persuasive step, however if we take the political nature of the issue into account, this step is hardly effective at the volume it needs to be for nations with poor institutional trust like Bosnia. With that being said, it seems as if the best way for governments to persuade their citizens to get vaccinated is through emphasizing the benefits, especially benefits that you as an individual can provide for your community, while on the more "selfish" note the perks of

traveling, socialization, etc. As an example, pro-vaccination campaigns might emphasize the importance of protecting others, the more vulnerable members of society. These findings are rather optimistic than pessimistic.

Nevertheless, besides understanding how we can stimulate vaccination, the present study also identifies the profile of a person that isn't likely to get vaccinated, giving us an important insight for which demographic groups the messages should be targeted towards, which in turn tells us what kind of message should be created. In this particular case, the message should be directed at younger people without children and coming from rural areas.

While not all predictions were proven, they do not come as a surprise considering the adaptability of the model, or in other words, the variability of some of the model's constructs. When applying HBM as a theoretical basis of a study, it is important to be constantly reminded of the instability of such an undefined model which is at the same time one of the perks of using it. This, in a practical sense, would be the advice for future research that when it comes to studying phenomena such as a pandemic or a disease that happens periodically (e.g., not like diabetes), under the frameworks of undefined HBM, time constraints shouldn't be disregarded since they can alter the people's responses and so lead to unsupported assumptions.

Conclusion

To sum up, the present study found perceived benefits, perceived barriers and cues to action to be predictable factors of HBM, considering they are significantly related to COVID-19 vaccination uptake. While there is a connection between perceived severity, susceptibility and vaccination uptake, they did not prove to be significant components of HBM. Additionally, being older, living in urban areas and having a child means a person is more likely to be vaccinated. However, the current study cannot claim that HBM is fully applicable in regard to COVID-19 vaccination among the sample of Bosnia and Herzegovina.

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Psihološki faktori vakcinacije protiv virusa COVID-19 među građanima Bosne i Hercegovine: Primena modela zdravstvenih uverenja

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Aktuelna studija istražuje faktore povezane sa COVID-19 vakcinacijom u sklopu modela zdravstvenih uverenja među građanima Bosne i Hercegovine. U istraživanju je učestvovalo ukupno 820 osoba. Rezultati sugerišu da dok su percipirane barijere negativno povezane, percipirani benefiti i pozivi na akciju su pozitivno povezani sa spremnošću na vakcinaciju. Dodatno, starije osobe, roditelji i oni koji žive u urbanijim područjima su spremniji da prime vakcinu. Ovi rezultati mogu biti korišćeni od strane državnih i medicinskih institucija, vođa kampanja, lekara, i zdravstvenih aktivista u cilju širenja informacija o vakcinama.

Ključne reči: COVID-19, vakcinacija, model zdravstvenih uverenja

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Appendix A
Key to Instrument

Variable	Question wording (items)	Response options
Action (Vaccination)	Did you get vaccinated against COVID-19?	Yes/no
Cues to Action	Have you been sick with COVID-19?	Yes/no
Perceived Severity of the Threat	The negative impact of COVID-19 is very high.	1– strongly disagree to 7– strongly agree
	The negative impact of COVID-19 can be life-threatening.	
	The negative impact of COVID-19 is a serious threat for someone like me.	
Perceived Susceptibility	I am more vulnerable to contracting COVID-19 than other people.	
	I think I am more likely to get COVID-19, than other people.	
	I am at risk of catching COVID-19 more than other people.	
Perceived Benefits	Getting vaccinated against COVID-19 is a good way to protect myself against COVID-19.	1– strongly disagree to 7– strongly agree
	Getting vaccinated against COVID-19 is important for the health of others in my community.	
	Getting vaccinated against COVID-19 helps end the current pandemic.	
	Getting vaccinated against COVID-19 is important because it allows me to travel without restrictions.	
	Getting vaccinated against COVID-19 is important because it allows me to socialize with family and friends that are at risk of contracting disease.	
Perceived Barriers	My health will be damaged if I get vaccinated against COVID-19.	1– strongly disagree to 7– strongly agree
	I am confident that COVID-19 vaccine is safe and effective. (r)	
	If everyone else gets vaccinated against COVID-19 then I don't have to.	
	I trust in B&H medical institution's ability to handle COVID-19 health pandemic, help me if I get infected and how they handle the process of vaccination against COVID-19. (r)	
	I trust in science findings regarding COVID-19 health pandemic. (r)	
	I trust in pharmaceutical companies that manufacture COVID-19 vaccines. (r)	
	I trust in the media and the information they provide regarding the importance of COVID-19 vaccination (r)	
	There are other medical, financial, logistic or legal reasons I personally can't get vaccinated. (open question)	
Risk Preference	How likely are you to take the risk in the different domains of daily life?	0 – not at all inclined to take risks to 10 – totally inclined to take risks
	How likely are you to take the risk in the management of your personal finances?	
	How likely are you to take the risk regarding your medical behavior for your own health?	