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Personality Traits and COVID-19 Vaccination Status in Slovakia: The Role of Trust in Health Institutions, and COVID-19 Pseudo-Science and Conspiracy Beliefs

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The present study focuses on the Big Five personality traits as predictors of COVID-19 vaccination status in the population of Slovakia. The sample consisted of 1838 inhabitants of Slovakia (47% men, 53% women, mean age 45.41 years) recruited through an online panel of a research agency. Participants were administered the Big Five personality test BFI-2-S, and items regarding vaccine pseudo-science, conspiracy beliefs, and trust in medical institutions. They also reported their COVID-19 vaccination status. The results showed that after controlling for gender, age, education, and social status, agreeableness and negative emotionality predicted the vaccination status; in both cases, lower levels of the trait predicted not being vaccinated. The effect of agreeableness on vaccination status was mediated by low levels of COVID-19 pseudo-science and conspiracy beliefs and higher trust in medical institutions.

Key words: COVID-19 vaccination, Big Five personality traits, COVID-19 pseudo-science, conspiracy, trust in medical institutions

In 2020, the world was hit by the rapid spread of the SARS-CoV-2 virus, which causes the respiratory disease COVID-19. The rate of the spread of the disease reached a pandemic level, and it became a serious world problem not only in terms of health but also in economic and political terms, as it caused the death of millions of people around the world (Howard, 2022). Immediately after the spread of the SARS-CoV-2 virus, health researchers began to look for a solution to the pandemic through vaccination. In 2020, the first clinical trials of a vaccine against the disease COVID-19 were initiated, and in 2021, global vaccination against this disease was made available over the globe (Murphy et al., 2021).

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Vaccines against COVID-19 were shown to be effective against a severe course of the disease and became a dominant tool in the fight against COVID-19 health consequences (Halstead, McKay, & Lewis, 2022).

Despite these facts and the successes of vaccines in the prevention of COVID-19 health consequences, pronounced vaccination hesitancy, and even vaccination refusal was observed in the affected population. Even before the COVID-19 pandemic, The World Health Organization identified vaccine hesitancy as one of the 10 greatest threats to public health (WHO, 2019). With the onset of the COVID-19 pandemic, the problem of vaccination hesitancy became even more serious. In many countries, vaccination hesitancy has become the principal barrier to vaccination, which has resulted in an ineffectively low vaccination rate. Slovakia with approximately 50 % of people vaccinated against COVID-19, belongs to countries with the lowest COVID-19 vaccination rate in the European Union (WHO, 2022). Hence an obvious need has arisen to understand the factors that influence vaccination hesitancy or willingness to get vaccinated, in order to identify the types of people who are less likely to get vaccinated and to understand the sources of their reluctance (Halstead, McKay, & Lewis, 2022).

Vaccination hesitancy can be defined as having concerns about vaccines, regardless of an actual vaccine receipt (Dudley et al., 2020), and it is considered to be a key factor in vaccination behavior (Howard, 2022). There are many sources and factors of vaccination behavior at the individual, societal, and cultural levels (Salerno et al., 2021). In this study, the focus is on the Big Five personality factors, which have been linked to vaccination behavior in many previous studies (Halstead, McKay, & Lewis, 2022). The Big Five approach categorizes personality characteristics into five broad traits: *Extraversion*, characterized by sociability, assertiveness, and enthusiasm; *Agreeableness*, which includes traits like cooperativeness, empathy, and kindness; *Conscientiousness*, reflecting organization, dependability, and goal-oriented behavior; *Neuroticism or Negative Emotionality*, associated with emotional instability, anxiety, and moodiness and *Openness to Experience*, which encompasses creativity, imagination, and curiosity (Soto & John, 2017). The Big Five model is widely used in psychological research, providing a robust framework for understanding and predicting individual differences in behavior, cognition, and emotions across various contexts (Soto, 2019).

Vaccination behavior is understood as a part of a broader health-related behavior, and previous research has linked this behavior with conscientiousness in particular (e.g., Bogg & Roberts, 2004; Takahashi et al., 2014). Conscientiousness is generally understood as the propensity to be self-controlled, responsible to others, hardworking, orderly, and rule-abiding (Jackson & Roberts, 2017), and its relation to health and health behavior is usually explained through self-regulation processes, e.g. conscientious people are better in fulfilling health goals, better in resisting risky behavior, etc. (Hampson et al., 2016). Recent research focusing specifically on vaccination against COVID-19 confirmed that conscientiousness was associated with vaccination attitudes and behavior in both self-reports and naturally occurring behaviors (Li, 2022).

Several studies focused on COVID-19 vaccination hesitancy found a negative effect of extraversion on willingness to be vaccinated (Adamus, Čavojová, & Ballová Mikušková, 2022; Halstead, McKay, & Lewis, 2022, Howard, 2022). Adamus et al. (2022) speculate that more extraverted people have different information search patterns and, thus, they may encounter more disinformation about vaccination. This was confirmed by Kohút et

al. (2021), who found a link between extraversion and negative emotional response to the COVID-19 situation. They argue that extraversion can increase reliance on interpersonal sources of information, and can facilitate feelings of threat, especially when this is the dominant emotion shared in the society.

On the other hand, negative emotionality/neuroticism was found to positively predict vaccination willingness (e.g., Halstead, McKay, & Lewis, 2022; Roshchina, Roshchin, & Rozhkova, 2022). This can be explained through the effect of negative emotionality on disease anxiety and on the following effort to protect oneself against the disease. Similarly, a positive effect of agreeableness on vaccination willingness was found in previous studies (e.g., Lin & Wang, 2020). Weikl et al. (2022), suggested that individuals with high agreeableness might be more prone to follow social norms, which in turn positively affects their health behavior, including vaccination. On the contrary, individuals low in agreeableness might tend to engage in hazardous behaviors including confrontation with or violation of rights of others.

There are also other personality traits outside the Big Five model which correlate with vaccination hesitancy. The HEXACO model enhances the Big Five by adding a sixth trait: Honesty/Humility. This trait is defined as the tendency to be fair and genuine in dealing with others, in the sense of cooperating and being fair to others even when given a chance to exploit them without repercussions (Ashton & Lee, 2007). Ngo, Petrides, and Vernon (2023) found that honesty/humility is higher in vaccinated people compared to non-vaccinated people. The authors believe that people with high honesty/humility are more aware of social norms and expectations and they readily adhere to them. This increases a sense of responsibility towards the community and the belief that vaccination against COVID-19 serves the community's best interests.

Previous research showed that vaccine hesitancy is predicted also by schizotypy (e.g., Haakonsen & Furnham, 2023). Schizotypy is a personality characteristic, which includes nonclinical expression in the content of thought (ranging from odd beliefs and magical ideation to full-blown delusions), perceptual oddities in all senses (ranging from illusions to hallucinations), and suspiciousness and paranoia (Kwapil & Barrantes-Vidal, 2015). It is related to the general tendency or proneness to psychotic-like experiences and behaviors, sometimes named disintegration (Knežević, Lazarević, & Zorić, 2022). The schizotypal and disintegration traits including lack of social input due to social isolation, bizarre experiences and cognition, and paranoid ideas of reference increase belief in conspiracies and suspicious interpretation of events, which may explain why these people reject vaccination more often (Haakonsen & Furnham, 2023; Knežević et al., 2023).

In general, the effect of personality traits on different cognitive, emotional or behavioral variables can be direct or indirect (e.g., Zelenski & Larsen, 2002; Kim et al., 2016). A direct effect means that personality traits' attributes influence another variable straightforwardly without the intervention of other psychological variables. In this case, neuroticism with a higher level of anxiety can cause a higher tendency to get vaccinated as a mean to ensure greater safety. An indirect effect means that a personality trait exerts an influence on another, mediating variable, which in turn affects the target variable. An example of such an indirect effect can be extraversion resulting in more social contact with other people, which means better access to unfounded information about vaccination including conspiracy theories and pseudoscience. To provide a more complex picture of how personality traits can affect vaccination hesitancy, three variables were identified,

which are frequently connected to COVID-19 vaccination, namely COVID-19 conspiracies, pseudoscience, and general trust in medical institutions.

Concerning COVID-19 conspiracies, a lot of research confirmed its negative relationship with willingness to be vaccinated against COVID-19 (e.g., Earnshaw et al., 2020; Jennings et al., 2021). Salam et al. (2021) explained this relationship by the fact that the adoption of conspiracy beliefs could enhance the concerns about the perceived safety of the vaccine and the uncertainty regarding the benefits of COVID-19 vaccines. On the other hand, Enders et al. (2022) found that beliefs in COVID-19 conspiracy theories and misinformation are not only related to COVID-19 vaccine hesitancy and refusal but also strongly associated with the other variables theorized to drive COVID-19 vaccine hesitancy and refusal. These findings suggest that belief in conspiracy theories and misinformation might not always be an exogenous cause, but rather a mediator of the factors that lead to vaccine hesitancy and refusal. In this paper, I focus on personality traits, and indeed, some personality traits such as openness (positively) or agreeableness and conscientiousness (negatively) are related to conspiracy beliefs (e.g., Galliford & Furnham, 2017; Ozimek, 2022). Based on this knowledge, I assume that conspiracy beliefs can act as mediators of the relationship between personality traits and vaccination hesitancy.

Similar results are usually found for pseudoscience beliefs. Practicing pseudoscientific activities to avoid COVID-19 has been found to be related to higher COVID-19 vaccination hesitance (Teoanovic et al., 2020). That is mainly due to heightened anxiety and risk perception concerning vaccines, which plays a role here (e.g., Chavda et al., 2022). Pseudoscientific beliefs are also related to personality traits, especially extraversion (Fasce & Picó, 2019). In the case of pseudoscientific beliefs, I am assuming a mediation effect similar to that of conspiracy beliefs, as these kinds of beliefs are highly correlated and therefore considered as a part of so-called epistemically unwarranted beliefs (e.g., Huete-Pérez et al., 2022). Specific personality traits can enhance the belief in pseudoscience and this way increase vaccination hesitancy.

Finally, trust in institutions including those active in health care is related to vaccination intentions, i.e. those with higher trust have lower vaccination hesitancy (Giles et al., 2009; Jamison et al., 2019). This can be explained by the fact, that a lack of trust in science and medical institutions increases the rejection of medical research, thereby increasing the perceived risk and decreasing a feeling of safety concerning vaccines (Dordevic et al., 2022). On the other hand, trust is also predicted by personality traits, especially agreeableness (Freitag & Bauer, 2016; Hermes et al., 2022). Based on this, I am assuming that trust, and specifically, trust in medical institutions can also act as a mediation variable between personality traits and vaccination hesitancy.

Current Study

As current research suggests, personality traits can be an important factor in vaccination willingness. This study aims to explore and replicate the results of previous studies about the relationship between Big Five personality traits and the COVID-19 vaccination status in a specific country with a low vaccination rate. As stated above, the vaccination rate in Slovakia is one of the lowest in the European Union; in addition, the level of conspiracy beliefs is high. I believe it is important to study sources of vaccination hesitancy in the sample of such countries in order to confirm or disconfirm previous results in this specific environment. Based on earlier research,

it is hypothesized that conscientiousness, agreeableness, and negative emotionality will be positive predictors of being vaccinated against COVID-19 whereas extraversion will be a negative predictor. The study also explores the possible indirect role of personality on COVID-19 vaccination status, through COVID-19 conspiracies, pseudoscience, and general trust in medical institutions.

Method

Sample

The sample consisted of 1838 Slovak inhabitants who were recruited through an online panel of a research agency. 47% of them were men and 53% were women. Their age ranged from 18 to 85 years with a mean age of 45.41 years. Concerning education, 4.7% had primary education, 72.3% had secondary education, and 23% had degrees from higher education. All participants provided informed consent before participating in the study. The data were collected in October 2021, in a period when no age or other restrictions were applied to vaccination against COVID-19 in Slovakia. This means everyone who wanted it had an opportunity to be vaccinated against COVID-19. The data collection included a variety of data related to the COVID-19 pandemic, however, for the purpose of this study, only the reported measures and items were chosen.

Measures

Big Five Inventory 2 Short (BFI-2-S, Soto & John, 2017, Slovak version Kohut et al., 2020) was used to measure Big Five personality traits. The inventory has 30 items, with each domain (Extraversion, Agreeableness, Conscientiousness, Negative Emotionality and Open-Mindedness) having 6 items. Every domain is composed of three facets with 2 items; however, these facets were not analyzed separately, and only the domains based on six items were included in the analyses. Items are answered on a five-point Likert-type scale (from 1 – disagree strongly to 5 – agree strongly). The internal consistency of the domains in the current sample was 0.68 for extraversion, 0.68 for agreeableness, 0.73 for conscientiousness, 0.78 for negative emotionality, and 0.64 for open-mindedness.

Vaccination status was measured by a single item asking whether the participant is vaccinated against COVID-19. The item was: *Which of the following best matches your vaccination status against COVID-19?* Initially, participants could choose from 4 responses: not vaccinated, not vaccinated but planning to do so, vaccinated by only one dose of a 2-dose vaccine, and fully vaccinated. However, due to a very low number of participants selecting the second and third options, the variable was dichotomized into 2 categories: not vaccinated (including plans to do) and vaccinated (once or twice). This approach allowed for a clearer analysis, reducing potential biases and ensuring that the sample size was sufficient for meaningful statistical comparisons across groups.

Trust in medical institutions was measured by the items from the institutional trust measure developed by Adamus et al. (2024). For the purpose of this study, only 3 items related to health institutions were used. The basic question was: *Below are some of the institutions responsible for fighting the COVID-19 pandemic. To what extent do you personally trust each of the mentioned institutions?* The following institutions were listed: the Slovak Ministry of Health, the European Medicines Agency, and health professionals. The response scale had ten points from 1 (totally distrust) to 10 (totally trust). The Cronbach alpha for the three-item scale was 0.86.

Pseudoscience beliefs related to COVID-19 were measured by three items representing common pseudoscience beliefs related to COVID-19 in Slovak society. Two of the items were taken from the COVID-19 Unfounded Beliefs Scale (Teličák & Halama, 2022) and one item was original. The original item dealt with vaccination pseudoscience, specifically *Vaccines against the disease COVID-19 contain substances that cause infertility or abortion.* The items were responded to on a 5-point Likert-type scale (totally disagree/totally agree). The Cronbach alpha for the composite scale was 0.75.

Conspiracy beliefs related to COVID-19 were measured by 3 items representing the common conspiracy related to COVID-19 present in Slovakia. Two of the items were taken from the COVID-19 Unfounded Beliefs Scale (Teličák & Halama, 2022) and one item was original. These items were related to the origin of the coronavirus (*The virus that causes COVID-19 was secretly developed in laboratories as a biological weapon*), the meaning of the pandemic (*The COVID-19 pandemic is artificially induced in order to spread fear and subsequently control the population*) and vaccination (*Governments want to achieve monitoring of their population by mandatory vaccination against COVID-19*). The items were responded to on a 5-point Likert-type scale (totally disagree/totally agree). The Cronbach alpha for the scale was 0.88.

Analysis

Binary logistic regression analysis was used to estimate the effect of the traits on vaccination status. The model used vaccination status as the binary outcome and personality traits as the predictors. The model included four demographic variables (gender, age, education, and social status) as controlling covariates. Regression-based mediation analysis using the PROCESS macro for SPSS (Hayes, 2018) was used to estimate the mediation effect. The model was built as parallel mediation with personality traits as predictors, vaccination status as the outcome, and COVID-19 conspiracies, pseudoscience, and trust in medical institutions as parallel mediators. As the model includes a binary outcome, logistic regression was used to estimate model coefficients. Data file and codes for analyses performed in the study are publicly available at https://osf.io/t9mna/?view_only=36c911ef52e9454599adef067cd90182.

Results

Before conducting a logistic analysis, assumptions tests (multicollinearity test, the effectiveness of the predicted classification, Hosmer-Lemeshow test, and Omnibus Tests of Model Coefficients) were performed. They confirmed that all required assumptions were met. The performed binary logistic analysis model used vaccination status as the dependent variable, four demographic variables as control covariates, and Big Five traits as predictors. The results of the analysis are presented in Table 1. Concerning the demographic variables, being vaccinated was predicted by higher education, higher age, and higher social status, but not by gender. Concerning personality traits, the trait with the most predictive power in terms of vaccination status was agreeableness, with the odds ratio value of 1.32. Negative emotionality was another trait predictor with the odds ratio value of 1.275. In both cases, a higher level of traits predicted being vaccinated.

In the next step, the analysis focused on the possible role of COVID-19 conspiracies, pseudoscience, and trust in medical institutions as mediators of the relationship between personality traits and vaccination status. The model was built as a parallel mediation with person-

ality trait as the predictor, vaccination status as the binary outcome variable and COVID-19 conspiracies, pseudoscience, and trust in medical institutions as parallel mediators (see Figure 1). As only agreeableness and negative emotionality were shown to be significant predictors of vaccination status, two mediation models – one for each of the two traits – were built.

The results for agreeableness as a mediator are presented in Figure 2 and Table 2. The table contains regression coefficients. Coefficients on vaccination status, which is a dichotomous variable, are expressed in a log-odds metric (logarithms of odds-ratio coefficients) in order to align them with the other regression coefficients (i.e., independent variable effects on

Table 1 *The results of binary logistic regression analysis of demographic variables and personality traits on vaccination status (0 – not vaccinated, 1 - vaccinated)*

	B	S.E.	Odds Ratio	95%CI
Gender	-0.173	0.104	0.841	[0.686, 1.031]
Age	0.016**	0.003	1.017	[1.010, 1.023]
Education	0.204**	0.036	1.227	[1.142, 1.317]
Social status	0.136**	0.033	1.146	[1.073, 1.223]
Extraversion	-0.098	0.090	0.907	[0.761, 1.081]
Agreeableness	0.278**	0.095	1.320	[1.096, 1.589]
Conscientiousness	-0.082	0.097	0.921	[0.762, 1.114]
Negative emotionality	0.243**	0.084	1.275	[1.081, 1.505]
Openness	0.043	0.091	1.044	[0.874, 1.248]

Note. Gender: 0 – men, 1 – women, Nagelkerke pseudo R^2 = 0.078.
** $p \leq .01$

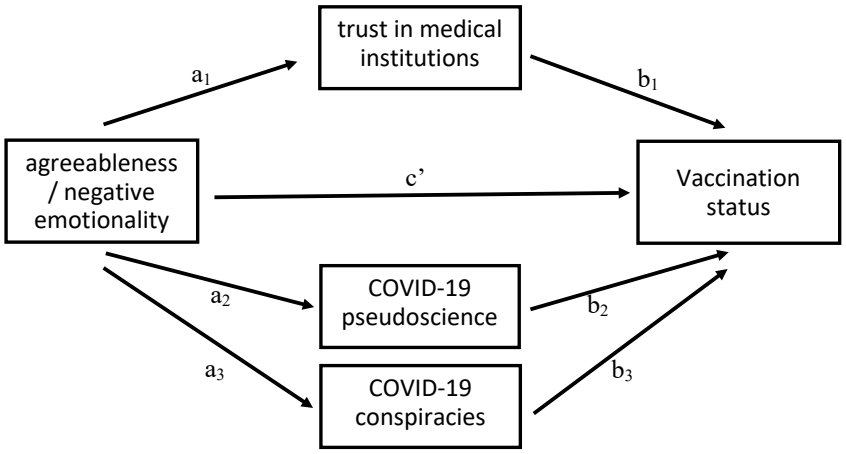

Figure 1 The conceptual parallel mediation model of agreeableness/negative emotionality on vaccination status through trust in medical institutions, COVID-19 pseudoscience, and conspiracy.

mediators). As seen from the Figure 2 and Table 2, agreeableness had a positive effect on trust in medical institutions and a negative effect on COVID-19 pseudoscience and conspiracies. All mediator effects predicting outcome together with agreeableness were significant, with trust in medical institutions increasing the probability of being vaccinated and COVID-19 pseudoscience and conspiracies decreasing the probability of being vaccinated. The last column of the table shows that all parallel indirect effects were significant with a significant total mediation effect of 0.350 with 95% CI [0.205, 0.498]. The direct effect of agreeableness on vaccination status was low and non-significant (-0.100, 95% CI [-0.295, 0.095]).

Concerning negative emotionality, the results of the mediation analysis are presented

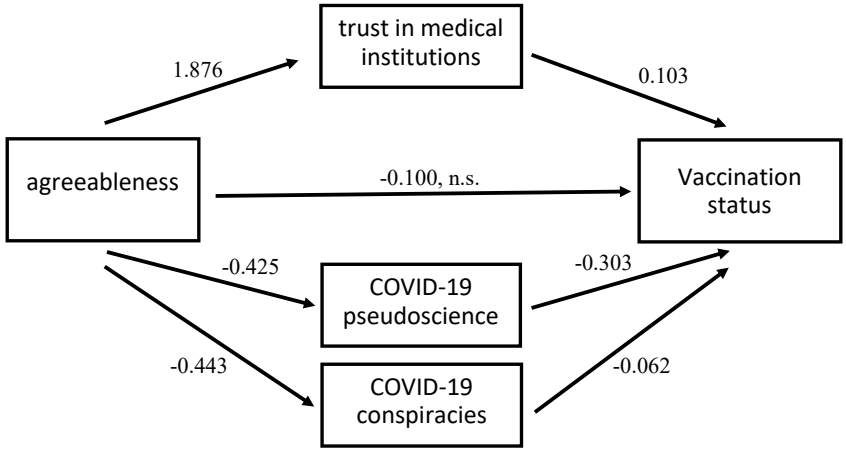

Figure 2 The results of mediation analysis of trust in medical institutions, COVID-19 pseudoscience, and conspiracies, in the relationship between agreeableness and vaccination status (all coefficients are significant unless marked by n.s.).

Table 2 *The regression coefficients (B) of parallel mediation analysis with agreeableness as the predictor, vaccination status as the binary dependent variable and COVID-19 conspiracies, pseudoscience, and trust in medical institutions as mediators*

Mediators	Effect of agreeableness on mediators with 95% CI	Effect of mediator on outcome with 95% CI	Indirect effect with 95% CI
Trust in medical institutions	**1.876 [1.354, 2.399]**	**0.103 [0.081, 0.126]**	**0.194 [0.129, 0.268]**
COVID-19 pseudoscience	**-0.425 [-0.657, -0.193]**	**-0.303 [-0.364, -0.242]**	**0.129 [0.053, 0.218]**
COVID-19 conspiracies	**-0.443 [-0.724, -0.163]**	**-0.062 [-0.110, -0.014]**	**0.028 [0.004, 0.059]**
Total mediation effect			**0.350 [0.205, 0.498]**
Direct effect		-0.100 [-0.295, 0.095]	

Note. The significant effects are bolded. The regression coefficients of mediators on the outcome and the direct effect are expressed in a log-odds metric.

in Figure 3 and Table 3. Likewise, in Table 2 regression coefficients on vaccination status are expressed in a log-odds metric. As seen from the table, negative emotionality predicted only trust in medical institutions (negatively), and the effects on COVID-19 pseudoscience and conspiracies were not significant. All mediators had a predictive effect on vaccination status, however, the indirect effect was significant only for trust in medical institutions. The total indirect effect was low and non-significant (-0.066, 95% CI [-0.189, 0.042]). The lack of a mediation effect is seen also in the direct effect of negative emotionality on vaccination status, which remained significant with a value of 0.201 with 95% CI [0.041, 0.362].

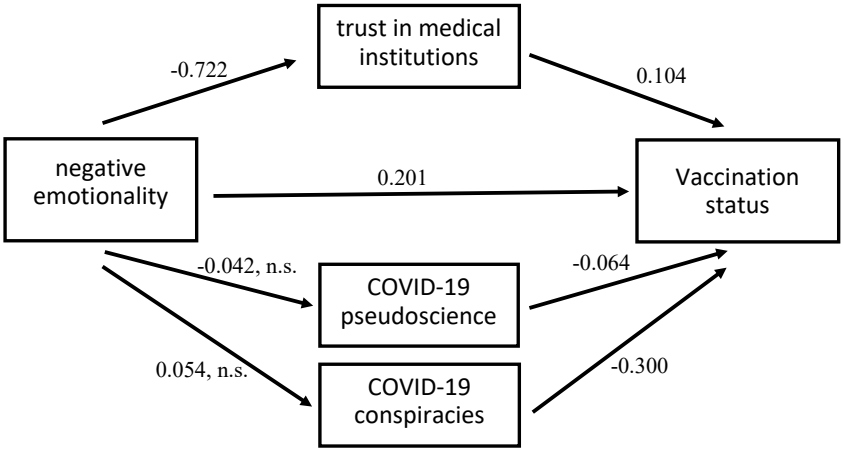

Figure 3 The results of mediation analysis of trust in medical institutions, COVID-19 pseudoscience, and conspiracies, in the relationship between negative emotionality and vaccination status (all coefficients are significant unless marked by n.s.).

Table 3 *The regression coefficients(B) of parallel mediation analysis with negative emotionality as the predictor, vaccination status as the binary dependent variable and COVID-19 conspiracies, pseudoscience, and trust in medical institutions as mediators*

Mediators	Effect of neg. emotionality on mediators with 95% CI	Effect of mediators on the outcome with 95% CI	Indirect effect with 95% CI
Trust in medical institutions	**-0.722 [-1.154, -0.289]**	**0.104 [0.082, 0.127]**	**-0.075 [-0.133, -0.030]**
COVID-19 pseudoscience	-0.042 [-0.233, 0.148]	**-0.064 [-0.112, -0.016]**	0.013 [-0.047, 0.074]
COVID-19 conspiracies	0.054 [-0.176, 0.284]	**-0.300 [-0.361, -0.238]**	-0.003 [-0.022, 0.012]
Total mediation effect			-0.066 [-0.189, 0.042]
Direct effect		**0.201 [0.041, 0.362]**	

Note. The significant effects are bolded. The regression coefficients of mediators on the outcome and the direct effect are expressed in a log-odds metric.

Discussion

The results of regression analysis showed that three demographic variables predicted vaccination status. Being vaccinated was related to being older, more educated, and having higher social status. Concerning age, the results are in line with the previous studies, which confirmed that older people show a higher preference for vaccination against COVID-19 (Shih et al., 2021). Truong et al. (2022) emphasize that older individuals are often more concerned about their health because of their higher susceptibility to disease, which makes these individuals more inclined to vaccinate. Similar results were found for higher social position (education, social status). Those with higher position have lower vaccination hesitancy (e.g., Freeman et al., 2022), which is usually explained by the fact that people with lower social status and education have lower health literacy and therefore, they are less willing to receive vaccines (Kricorian et al., 2022).

The analysis of the personality effect on the vaccination status showed that only two Big Five personality traits were significant predictors of the vaccination status. The highest odds ratio was for agreeableness (OR=1.320), which makes it even more predictive of vaccination status than demographic variables. This finding confirmed the results of several previous studies, which also found that agreeableness is related to higher willingness to be vaccinated (e.g., Lin & Wang, 2020). A possible mechanism which could directly explain this effect deals with the proneness of agreeable people related to social norms and prosociality (Weikl et al., 2022). Since agreeable people manifest higher levels of prosocial behavior (Stavrova & Kokkoris, 2019), vaccination can be means to follow societal requirements and contribute to the common good. In truth, vaccination is frequently framed as not only having an individual benefit but also as a contribution to collective immunity and even moral responsibility (e.g., Giubilini, 2021). For the agreeable person, the meaning of getting vaccinated could be not only to protect oneself against the disease but to protect other people and one's community as well.

Another personality trait which positively predicted vaccination status was negative emotionality. Again, this was in line with previous studies showing a positive relationship between neuroticism/negative emotionality and vaccination willingness (e.g., Halstead, McKay, & Lewis, 2022; Roshchina, Roshchin, & Rozhkova, 2022). The main explanatory mechanism for the direct effect of negative emotionality on vaccination seems to be anxiety. Anxiety is a key component of the neuroticism/negative emotionality trait and it is one of the primary emotions experienced by persons with a higher level of this trait (Barlow et al., 2014). Neuroticism is positively related to fear and the tendency to avoid disease (Oosterhoff et al., 2018), which results in the effort to protect against the disease. This suggests that for persons with higher negative emotionality, vaccination may be the way to eliminate fear of the disease and protect against it. This interpretation is also supported by Adamus, Čavojová, and Ballová Mikušková (2022), who found that the threat of COVID was a significant predictor of pro-vaccination behavior.

On the other hand, the results did not confirm the hypothesized positive effect of conscientiousness and a negative effect of extraversion on vaccination status. This result is surprising, especially for conscientiousness, which has been frequently connected with vaccination willingness and behavior in past research (e.g., Li, 2022). Conscientiousness is even considered a trait which has a strong and stable relationship with general health-related behavior (Gartland et al., 2021), howev-

er, this study did not confirm it for COVID-19 vaccination. One of the possible reasons for that may be related to public discourse on COVID-19 vaccination in Slovakia, where concerns about the safety and side effects of vaccines against COVID-19 were being discussed not only in the general population but by health professionals as well (Tatarkova et al., 2022). The effect of conscientiousness can be two-fold. On one hand, it can increase willingness to be vaccinated as a form of protection; on the other, it can increase the avoidance of vaccination due to safety reasons, especially in societies where discussion about the negative consequences of vaccination is intense.

Similarly, no effect of extraversion was found in this study, despite previous research suggesting the presence of a negative relationship between these two variables (e.g., Adamus, Čavojová, & Ballová Mikušková, 2022; Halstead, McKay, & Lewis, 2022). The main reason extraversion was supposed to predict vaccination hesitancy was that more extraverted people have different information search patterns and, thus, they may encounter more disinformation about vaccination (e.g., Adamus, Čavojová, & Ballová Mikušková, 2022). However, this was not confirmed in this study, and I speculate that some other specific cultural variables (such us between-national personality differences, overall level of trust in the society, etc.) may be playing a role here. However, the effect of personality traits on vaccination status found in previous studies is rather small, and in such cases, the sampling error variance can be higher (Vacha-Haase & Thompson, 2004). This means that the differences in studies could be caused by sample variation. Further cumulative research should be done in this area to provide a more thorough answer to this question.

Finally, open-mindedness did not show a predictive value for vaccination status. This is consistent with some previous results (e.g., Adamus, Čavojová, & Ballová Mikušková, 2022), in which no relationship between openness and vaccination attitudes and behavior was found. Some earlier studies suggested that openness can be positively related to schizotypy (Kemp et al., 2022) or psychotic-like experiences (Knežević, Lazarević, & Zorić, 2022), which are traits encompassing such dimensions as bizarre experiences, persecutory and paranoid ideas, and perceptual abnormalities, thus increasing fear and insecurity towards vaccination. However, a recent study by Knežević et al. (2023) found that contrary to that, neither openness measured by the HEXACO measure nor disintegration (stable dispositional tendency towards psychotic-like phenomena) predicted vaccination status. Moreover, these two traits predicted COVID-19 conspiracy in the opposite direction: openness negatively and disintegration positively. The idea, that openness is inversely related to conspiracy comes from its relation to right-wing authoritarianism (Hotchin & West, 2018), and people with right-wing ideologies are higher in conspiracy theories and vaccine hesitancy (Wollebæk et al., 2022). However, in this study, no such effect was identified in either direction. I speculate that the effect of openness on vaccination hesitancy either does not exist or consists of several mechanisms of different directions and levels with the total effect close to zero.

The mediation analysis tested whether the effect of personality traits can be mediated by selected variables, which were connected to vaccination status as trust in medical institutions and pseudoscience and conspiracy beliefs. Only those personality traits were analyzed which showed a significant effect on vaccination status. The mediation effect was revealed for agreeableness but not for negative emotionality. It seems that the dominant effect by which negative emotionality affects vaccination is direct and it is related to anxiety

(Barlow et al., 2014) and disease avoidance (Oosterhoff et al., 2018), as discussed earlier. On the other hand, the effect of agreeableness on vaccination status was found to be mediated by all variables: trust in medical institutions, pseudoscientific, and conspiracy beliefs. I suppose that the main psychological process behind these mediation effects is related to trust. Being agreeable involves being trusting and confiding (Freitag & Bauer, 2016; Soto & John, 2017). Agreeable persons have higher trustfulness, which can protect them against distrust toward the medical system. As conspiracy beliefs also involve distrust toward the environment, people with low agreeableness can have higher scores in conspiracy (Galliford & Furnham, 2017; Ozimek et al., 2022). This assumption is also supported by the fact that the highest partial mediation effect was found for trust in medical institutions, which is the most explicit trust variable. This result not only confirms the mediation effect of trust-related variables in the personality-vaccination relationship but also confirms that trust issues are relevant and important topics in the study of health and health-related behavior (Birkhäuer et al., 2017).

Limitations

There are several limitations of the study. The first is related to the sample. Although the sample in this study was large and representative of different regions of Slovakia, it was recruited through an online panel of a research agency. The online recruitment has some disadvantages, especially regarding equal approach opportunities to be included in the sample. The persons with the lowest education and without proper access to the internet are underrepresented in online samples, as they usually do not have equal access to the internet and online panels. This can bias the results in some way. The second limitation is the cross-sectional methodological design, which is limited in causal conclusions. Assumptions about both personality effects on vaccination and the mediation model are based on causal assumptions and using only cross-sectional data could lead to bias (e.g., Maxwell & Cole, 2007). In the future, longitudinal data with more advanced statistics procedures should be used for confirmation of these results. Finally, I used a re-categorized version of the variable vaccination status, which was dichotomized into two values. Although this approach brings some advantages, especially robustness in statistical analysis, it can also eliminate some variation and produce potential bias.

Conclusion

The results of this study confirmed some of the assumptions from previous research about the role of personality traits in the decision of whether a specific person is being vaccinated or not. This study replicated the result that positive agreeableness and negative emotionality are the traits which increase the probability of being vaccinated against COVID-19. Proneness of agreeable people to social norms and prosociality and higher fear of disease in persons with negative emotionality are the possible direct mechanisms behind these results. Especially for agreeableness, there seems to be an indirect effect on vaccination status through trust and COVID-19 pseudo-science and conspiracy. On the other hand, this study did not replicate the positive effect of conscientiousness and the negative effect of extraversion on being vaccinated, which may be caused by some specific cultural factors. However, the overall results suggest that when considering individual sources of being vaccinated or not, individual traits should be taken into account and, moreover, they should not be studied isolated

from socially relevant variables such as trust and socially based beliefs.

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