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Investigation and Modeling of the Variables of the Decision to Vaccinate as the Foundation of an Algorithm for Reducing Vaccination Reluctance

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Abstract: The purpose of this study is to examine the factors that influence vaccination options, including vaccination against COVID-19, in order to develop a management algorithm for decision-makers to reduce vaccination reluctance. This paper's primary objective is to empirically determine the relationships between different variables that correlate to non-vaccination behavior of the target population, as well as the implications for public health and situational management strategies for future vaccination intentions. We created a questionnaire to investigate the personal approach to disease prevention measures in general and vaccination in particular. Using SmartPLS, load factors for developing an algorithm to manage vaccination reluctance were calculated. The results shows that the vaccination status of an individual is determined by their vaccine knowledge. The evaluation of the vaccine itself influences the choice not to vaccinate. There is a connection between external factors influencing the decision not to vaccinate and the clients' motives. This plays a substantial part in the decision of individuals not to protect themselves by vaccination. External variables on the decision not to vaccinate correlate with agreement/disagreement on COVID-19 immunization, but there is no correlation between online activity and outside influences on vaccination refusal or on vaccine opinion in general.

Keywords: COVID-19 vaccine; vaccine hesitancy; model reducing vaccine reluctance; public health

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1. Introduction

In the absence of a specific treatment for SARS-CoV-2 infections, preventing COVID-19 infection has become a top priority. Initially, prevention consisted of non-pharmacological measures [1] suggested by the World Health Organization and adopted by each state through normative acts. In Europe, the European Medicines Agency authorized the use of a vaccine only 10months after the announcement of the pandemic, followed shortly after by three other vaccines. One year after the start of the vaccination campaign, the full-scheme vaccination coverage in many European countries did not meet the targets set by the authorities. This finding coincides with low population confidence in the quality of

medical services and a general unwillingness to vaccinate. Vaccination reluctance is not a new phenomenon [2,3], but it has recently been identified as one of the greatest threats to public health [4]. In the context of a pandemic, hesitancy regarding COVID-19 vaccination has been observed globally, and there are numerous studies [5,6] investigating factors that influence vaccination options [7], but they do not address the general population, but rather specific populations [8,9] or professional categories. Moreover, our study supplements the information on the option to vaccinate [10] and confidence in the measures ordered by the authorities, and deployed through the health system, during the pandemic [11–17].

This study aims to examine the factors that influence, in Romania, the options available for the COVID-19 vaccine, as well as the prophylactic measures chosen by the general population and by average healthcare professionals. In designing this research, we assumed that reluctance to vaccination is caused by factors related to the vaccine (doubt about its safety, quality, or efficacy) on the one hand, and that reluctance is influenced and fed by media information, opinion leaders, and acquaintances on the other hand. To investigate these factors, a questionnaire was administered online, as well as via letter support, to adults from all over the nation, both rural and urban.

Beginning with the premise that well-informed people have a modern lifestyle that emphasizes health, the positive role of physical activity, and sustainability, we devised a 27-item questionnaire consisting of multiple-choice questions to investigate personal attitudes towards disease prevention measures in general and vaccination in particular.

2. Materials and Methods

The purpose of this study was to analyze the reasons for rejecting or accepting vaccination in order to develop tools to encourage unvaccinated individuals to make a vaccination decision, as well as to empirically determine the relationships between various factorial variables and the non-vaccinating behavior of the target population to receive the COVID-19 vaccine.

We developed a 27-item questionnaire (Appendix A), which includes demographic data (age, gender), socio-professional data, and movement-related information, based on the premise that people are informed by scientifically validated sources and live a modern lifestyle that emphasizes health, the positive role of physical activity, and sustainability (occupation, environment). Multiple-choice questions probed respondents' attitudes toward disease prevention measures in general, and vaccination against COVID-19, influenza, and other diseases for which there are vaccines in particular. The formulation of questions addressing vaccine aversion was based on the findings of previous studies [11–17]. The questionnaire items addressed the level of satisfaction with the pandemic activities of local authorities, county public health authorities, the emergency medical care system, primary care, specialized medical care, and emergency medical care. For a preliminary study on the decision of citizens to receive the SARS-CoV-2 vaccine, the following hypotheses were considered:

H1: *A person's vaccination status is determined by the knowledge he or she has regarding the vaccine.*

H2: *External influences on the decision not to vaccinate are related to the evaluation of the vaccine itself.*

H3: *There is a connection between external influences on the decision not to vaccinate and the customers' reasons, which play a crucial role in the person's decision not to protect themselves through vaccination.*

H4: *An association exists between external influences on the decision not to vaccinate and agreement/disagreement on COVID-19 vaccination.*

H5: *There is a correlation between online activity and external influences on the decision not to vaccinate.*

H6: *There is a link between online activity and opinion about vaccines in general (not just for COVID-19).*

H7: *There is a connection between the reasons of the customers, who play a crucial role in the decision not to protect themselves by vaccination, and the agreement/disagreement regarding vaccination against COVID-19.*

H8: *There is a connection between the fundamental reasons for refusing COVID-19 vaccination and the choice to vaccinate.*

H9: *There is a connection between the essential grounds for refusing COVID-19 vaccination and vaccination status.*

H10: *There is a correlation between a positive view of vaccines in general (not just for COVID-19) and the decision to vaccinate against COVID-19.*

H11: *There is a connection between the decision to vaccinate against COVID-19 and the vaccination status.*

H12: *There is a correlation between the decision to vaccinate against COVID-19 and the vaccination status of individuals who place a high value on their own health.*

The questionnaires were administered online as well as on paper between October and December 2021, and results were then entered into the database. Using the SmartPLS3.3 program [18], the reliability and validity of the data were examined.

A total of 1673 respondents with an average age of 36.50 years and a gender distribution of 78.56 percent females chose to complete the survey. The respondents completed 94.5% of the questionnaires autonomously, while the interviewer helped respondents to complete 5.5% of the questionnaires.

3. Results and Discussion

Although 63.4% of respondents from our study agreed that vaccination is an extremely effective method for boosting immunity, vaccination is not a widely accepted practice. The vaccination acceptance rate is consistent with the statistics revealed in previous studies, which indicate a global percentage of 71.5%, ranging from 90% in China to 55% in Russia [19]. Within this broader context, 65.2% of Romanian respondents reported being immunized against COVID-19. The percentage is higher than that found in other European countries such as Poland (56.31%) [19] and France (58.89%) [19], but it should be noted that 89.9% of respondents in our study declared a medium or high level of medical knowledge. This high level of knowledge could explain why the vaccination acceptance rate is higher in our study group than in other European countries. The percentage of respondents who approve of immunization against COVID-19 varies not only from country to country or across occupational groups [20], but also with the length of time since the vaccine's introduction into medical practice. The reasons for refusing vaccination against COVID-19 also change over time [21]. It is worth noting that at the time of survey completion (October–December 2021), 10.2% of respondents were also vaccinated with the influenza vaccine for the 2021–2022 season, even though no negative influence was detected and there were no safety concerns regarding co-administration [22]. The results of an investigation into the explanations for COVID-19 vaccination refusal for our subjects is reported in Figure 1.

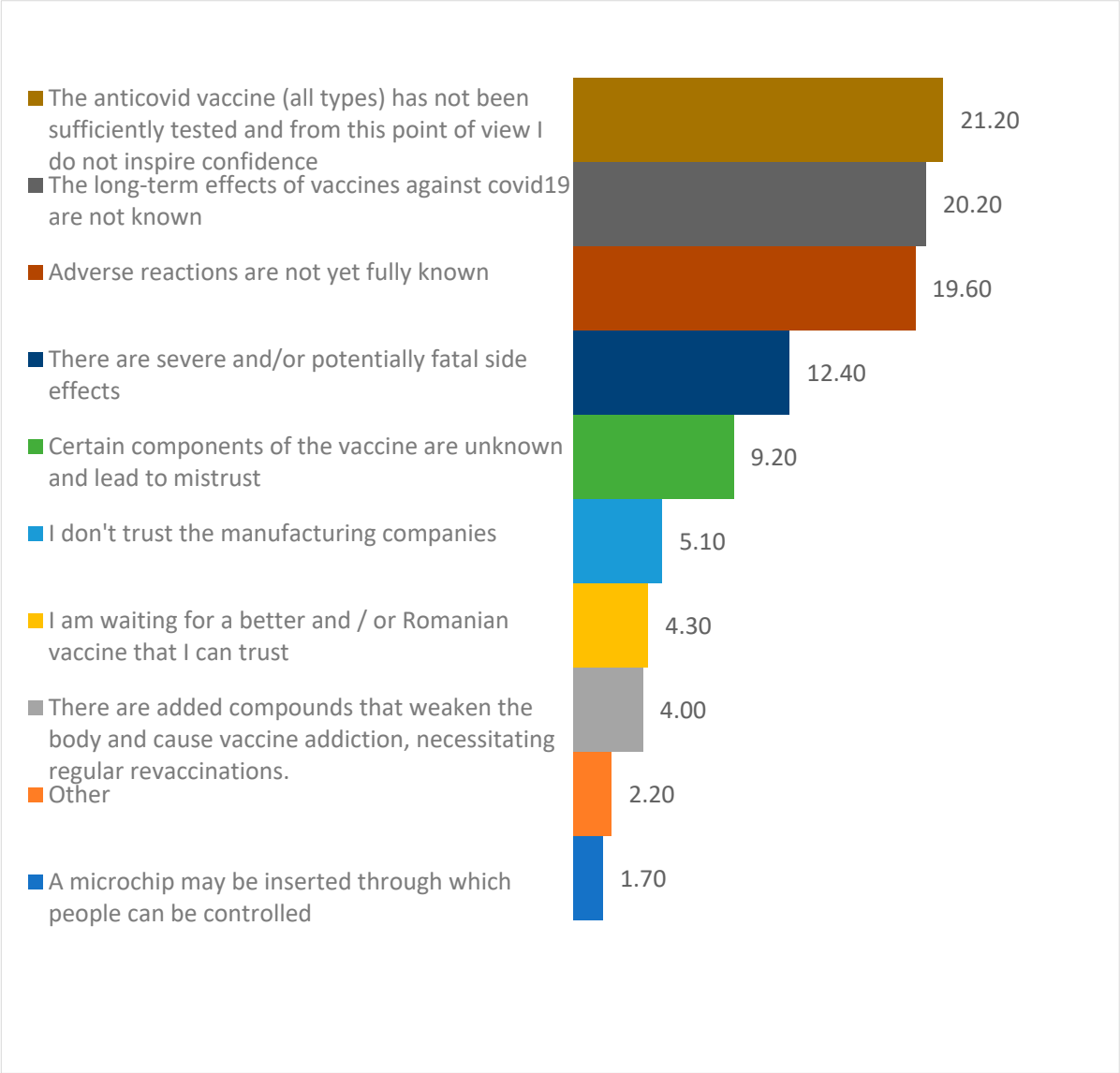

Figure 1. Reasons for COVID-19 vaccine reluctance.

Regarding reasons for vaccine reluctance (Table 1), our findings concur with those of other meta-analyses [23,24], in which side effects, lack of trust, or concern about potential side effects were the most prevalent. A total of 24.8% from the unvaccinated respondents believed in the possibility of conspiracy theories, supporting the conclusion of a previous study that "conspiracy beliefs pose a significant threat to public health" [25]. For this reason, it is essential to find the most effective communication strategy, such as conveying the weight of evidence and scientific consensus surrounding vaccines and related myths, or incorporating humor and warnings about encountering misinformation [26].

It is also worth mentioning that from the unvaccinated respondents, 52.0% indicated they would be vaccinated, whereas 21.2% rejected the idea and 11.0% did not trust the result. Reluctance to vaccinate is not a generally applicable principle, as 56% of respondents believe vaccines are beneficial, 24.9% agree with some of them, and 19% agree with those that prevent childhood diseases but not the COVID-19 vaccine. However, 61.2% of respondents agree that vaccination has contributed to a decline in the number of hospitalized cases in countries with vaccination rates exceeding 80%. According to other studies, the vaccine was found to be 68.8% effective in preventing SARS-CoV-2 infection and hospitalization [27].

This may explain why a high proportion (56%) of respondents in our study believe the COVID-19 vaccine to be beneficial.

Table 1. Aspects playing an essential role in the decision to not vaccinate.

	Total Agreement	Agreement	So-So	Less	Not at All
The anti-COVID-19 vaccine (all types) has not been sufficiently tested, and from this point of view it does not inspire confidence.	50.80%	21.50%	14.30%	5.90%	7.60%
Adverse reactions are not yet fully known.	52%	27%	11.70%	4%	5.30%
The long-term effects of anti-COVID-19vaccines are not known.	56.10%	24.60%	10.30%	3.40%	5.50%
There are severe and/or potentially fatal side effects.	36.70%	28.10%	19.40%	11.40%	4.50%
There are introduced substances that weaken the body and generate addiction to the vaccine, a fact that requires frequent revaccinations.	19.30%	12.70%	23.20%	23.90%	20.80%
Certain components of the vaccine are unknown and lead to mistrust.	29.40%	25.80%	21.30%	12.90%	10.50%
A microchip may be inserted through which people can be controlled.	10.70%	6%	11.90%	16.20%	55.20%
I am waiting for a better and/or Romanian vaccine that I can trust.	20.30%	15.70%	19.40%	16.40%	28.20%
I don't trust the manufacturing companies.	22%	13.40%	24.40%	16%	24.10%

In order to gain a better understanding of the factors that lead to vaccination acceptance, non-vaccinated respondents were asked to answer additional questions. Results are presented in Table 2.

Table 2. Information regarding self-reported knowledge of the COVID-19 vaccine.

	I Do Not Know	I Do Not Know Well	So-So	I Know	I Know Very Well
The benefits regarding your own health	11.70%	13.90%	20.40%	34%	19.90%
Prevention of serious and severe forms of the disease	12.90%	12%	18.40%	38.70%	18%
Reducing disease transmission	13.20%	12.70%	17.50%	36.10%	20.40%
How the vaccine works	19.20%	11.90%	23%	32.30%	13.60%
Adverse effects	20.60%	20.60%	19.60%	29%	18.60%

These data are consistent with global predictors of vaccine reluctance [28].Using additional questions, we studied the determinants of vaccine refusal among the unvaccinated. The results are presented in Table 3.

As can be seen, the role of social media in vaccine reluctance is relatively minor. Another previous study suggests that social media vaccination campaigns are ineffective [29]. The high proportion of unvaccinated respondents who cited doctors as an important factor in their decision not to be vaccinated was also observed at the international level, where the overall acceptance of vaccination was 51% [28] among healthcare workers, with statistically significant heterogeneity by gender, age, or medical specialty. In our study, females between the ages of 41 and 50 had the highest acceptance rate (77.1%) for the COVID-19 vaccine, while males between the ages of 31 and 40 had the lowest rate (34.6%). It is important to note that in our study, the majority of respondents were female (78.57%), but there is no correlation between the number of males surveyed and vaccine acceptance [26].

Table 3. Opinion on the role in the decision to not vaccinate.

	Not at All	Less Important	So-So	Important	Very Important
The negative campaign sometimes carried out by the mass media	30.40%	16.70%	25.90%	16.20%	10.80%
Opinion leaders who are against vaccination	35.10%	18.40%	25.30%	13.60%	7.70%
Information from Facebook	47.60%	21.80%	18.40%	7.60%	4.60%
Messages and information from friends/relatives	33.50%	18%	24.90%	17%	6.50%
Specialized pages (sites)	27.70%	13.60%	26.10%	21.10%	11.50%
Sites on the internet	35.20%	35.20%	25.30%	11.20%	6.40%
Scientific articles	21%	13.20%	22.30%	23.90%	19.60%
Physician	14.80%	7.20%	24.90%	29.70%	23.40%
Employee	38.50%	18.60%	29.90%	8.20%	4.80%
Other sources	38.30%	18.90%	28.40%	8.20%	6.20%

Non-vaccinated respondents were solicited for more information in this regard in order to find factors that could increase vaccination acceptance. Results are presented in Figure 2.

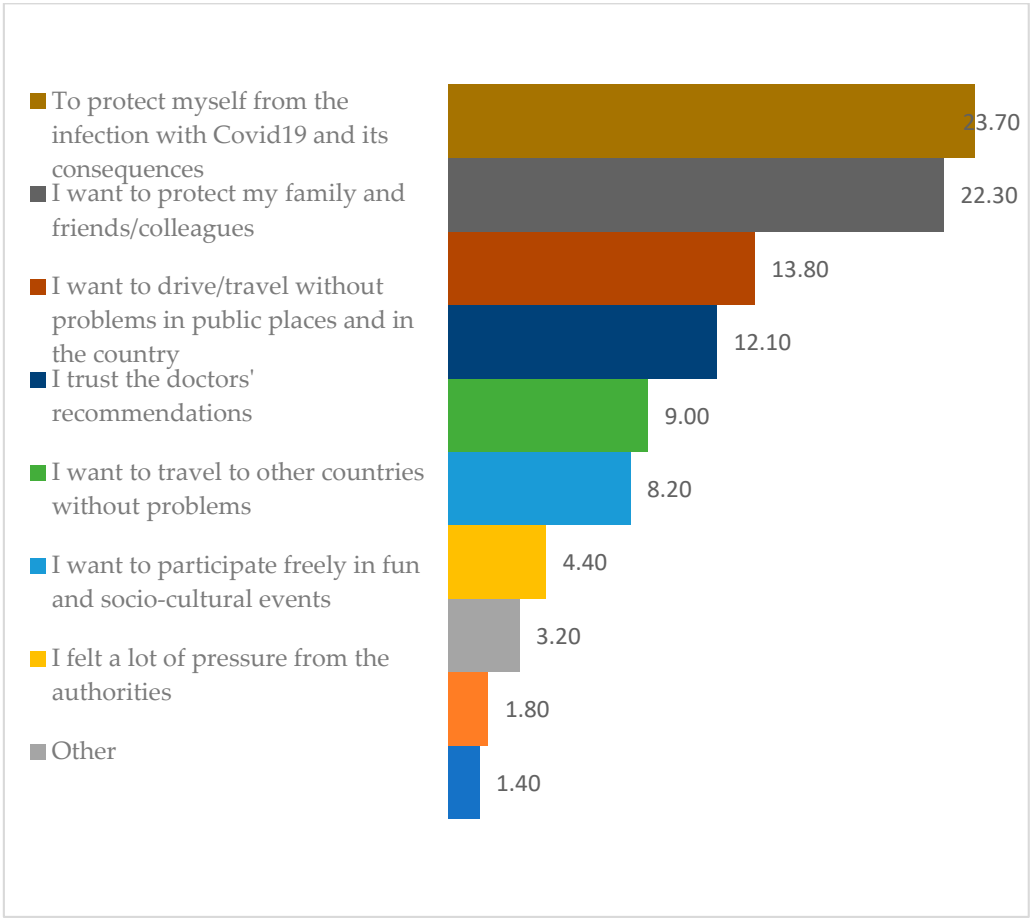

Figure 2. Reasons for vaccination cited by unvaccinated subjects.

This paper's primary objective is to empirically determine the relationships between various factorial variables and the non-vaccinating behavior of the target population, as well as the implications of managing their current situation on their future vaccination intention. In designing this research, we assumed that vaccine reluctance is caused by factors related to the vaccine (not believing in its safety, quality, or efficacy) on the one hand, and by media information, opinion leaders, and known individuals on the other.

In order to test hypotheses and develop a model, we first assessed the trustworthiness (reliability) and validity of the collected data. The concepts of reliability and validity are used to evaluate the quality of research. They indicate the effectiveness of a method, technique, or test. Validity refers to the precision of a measure, whereas reliability refers to the consistency of a measure. When designing research, it is essential to consider reliability and validity, particularly in quantitative research.

The variables' dependability is evaluated utilizing the Cronbach's alpha method and composite reliability (CR). The results regarding reliability and validity, as well as the factor loads for the remaining elements, are presented in Table 1 for the overall sample and each specific sample. It has been determined that the alpha values and CRs in the calculation performed exceed the minimum recommended value of 0.700. The Average Variation Extracted (AVE) and correlation coefficients (CRs) were all greater than or close to 0.500 and 0.700, supporting convergent validity. Due to the large sample size and its representativeness, the results reflect those of the broader population, are based on a clear, easily repeatable methodology, and show that the nine constructs in the proposed model are robust from a scientific perspective (statistically): information about vaccine; non-vaccination reasons; online activity; reasons evaluation for non-vaccination; reasons for vaccination; and reasons for vaccination evaluation.

Cross-loading was used to evaluate the discrimination's efficacy. All factor loads are greater than their respective cross-loads, indicating discriminatory validity. The discrimination's validity was also evaluated using the criteria proposed by Fornelland Larcker and the heterotrait–monotrait method (HTMT). The outcomes of both tests are displayed in Table A1 from Appendix A.

We utilized SmartPLS 3.3 to assess the confidence in the collected data (reliability) and the validity of the data. As shown in Table A1 from Appendix A, for all the indicators used in the assessment of validity and reliability, Cronbach's alpha, rhoA, composite reliability, and Average Variation Extracted (AVE), the result is positive, and the collected data are accurate and reflective of reality.

We have also examined significant connections between the questions asked and the formulated constructs. The results are presented in the table (Table A2 from Appendix A), which demonstrates a very strong correlation between the constructs used in the development of the relationship model in the SmartPLS program and the survey questions. Each response was coded in order to be used in SmartPLS program.

We developed an empirical model of the logically possible relationships between these constructs, and after processing in the SmartPLS program, we obtained the model depicted in Figure 3 and loading factors for each construct (outer loadings) according to Table A2 from Appendix A. In Table 4, each item of the questionnaire with associated code is presented.

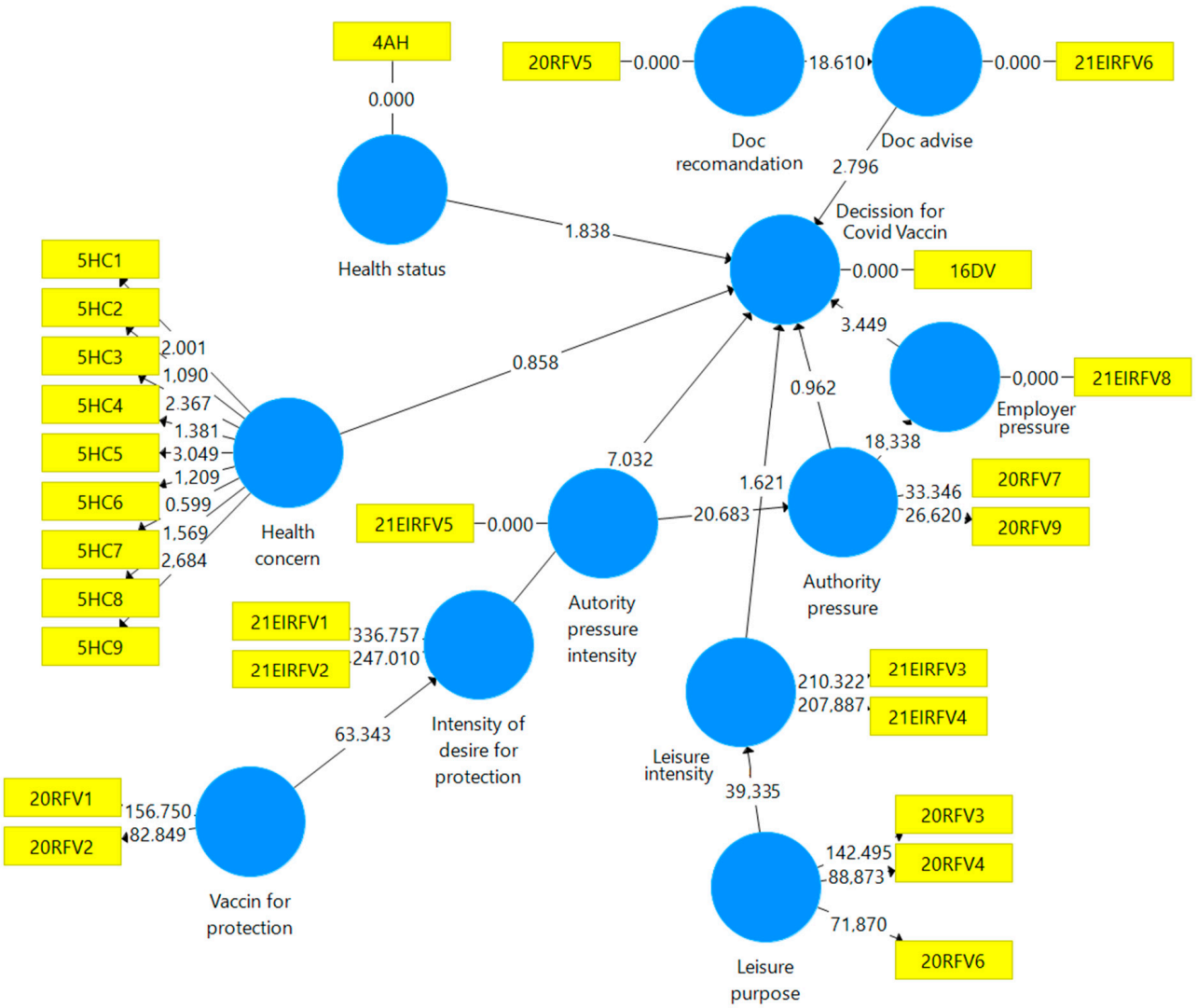

Figure 3. Loadings variables within the model.

Table 4. Item from the questionnaire used in the model and associated code.

Item	Code
Online activity	
Socializing	6OL1
Informed	OL2
Spend money	OL3
I am inactive	OL4
Vaccinated? Vaccine done	13VD
Details about vaccines. Which information about the COVID-19 vaccine do you have:	14 IV
Benefits considering one's health	14IV1
Prevention of serious and severe disease forms	14IV2
Reduction of disease transmission	14IV3
How the vaccine is effective	14IV4

Table 4. *Cont.*

Negative effects	14IV5
Immunization for health. If your health is important, are you willing to undergo COVID-19 vaccination? Yes	15VH1
No	15VH2
Vaccination determination. To what extent are you willing to vaccinate against the COVID-19 virus?	16DV
Not at all	16DV1
So-so	16DV2
Agreement	16DV3
No immunization motives If the answer is no and you decline vaccination, what role does this play in your decision not to develop immunity/protect yourself through vaccination?	17NVR
Persistent negative campaign occasionally through media	17NVR1
Opinion leaders expressing opposition to vaccination	17NVR2
Details from Facebook	17NVR3
Messages and data from friends/relatives	17NVR4
Specialized pages (sites)	17NVR5
Web pages on the internet	17NVR6
Scientifically aware	17NVR7
Physician	17NVR8
Employee	17NVR9
Other origin	17NVR10
Justifications for not vaccinating If the answer is no and you decline vaccination, the decision not to build immunity/protect yourself through vaccination is due to the following:	18RNVD
All types of the COVID-19 vaccine were not adequately tested, and this does not inspire confidence in my opinion.	18RNVD1
I am not yet aware of all adverse reactions.	18RNVD2
Long-term effects of vaccines against COVID-19 are unknown.	18RNVD3
There are life-threatening adverse reactions which can occur.	18 RNVD4
There is an introduced substance that weakens the body and causes vaccine addiction, a fact that the requires frequent revaccinations.	18 RNVD5
Unknown components of the vaccine contribute to mistrust.	18 RNVD6
It is possible to implant a microchip that can be used to control individuals.	18 RNVD7
I am awaiting a superior vaccine and/or Romanian one in which I have confidence.	18 RNVD8
I lack confidence in the manufacturers of the vaccine.	18 RNVD9
Other.	18 RNVD10
Evaluation of non-vaccination reasons	19ERNV
All COVID-19 vaccines were not adequately tested, and as a result, I cannot recommend them.	19ERNV1
I am currently unaware of all adverse reactions.	19ERNV2
I am unaware of the long-term effects of anti-COVID-19 vaccines	19ERNV3
There are life-threatening adverse reactions.	19ERNV4
There is an introduced substance that weakens the body and causes vaccine addiction, a fact that requires frequent revaccinations.	19ERNV5
Unknown components of the vaccine contribute to mistrust.	19ERNV6
It is possible to implant a microchip that can be used to control individuals.	19ERNV7

Table 4. *Cont.*

I am waiting for a better and/or Romanian vaccine on which I can rely.	19ERNV8
I lack confidence in the manufacturers of vaccines.	19ERNV9
Regarding vaccines	24 RV
I consider them beneficial.	24RV1
I agree with some of them.	24RV2
I agree with those who work to prevent childhood diseases, but I disagree with the COVID-19 vaccine.	24 RV3

The loading factors for each construct that are found to have a high value, as those factors observed in the research to have a significant impact within each construct, were selected through multiple interactions. This method aids in gaining a comprehensive understanding of a concept's underlying elements.

Using the SmartPLS program, we have calculated the correlation between the latent variables based on the data presented in Table A3 from Appendix A. In some cases, based on the correlation coefficient, there are fairly robust correlations between the proposed constructions. Correlation analysis between latent variables reveals relationships that cannot be directly observed or measured. If we correlate these latent variables with other observable variables, we can infer the values of the latent variables from the observations of the observable variables. The analysis of the correlation between the latent variables reveals that there is a strong latent link between the criteria underlying the evaluation of non-vaccination or vaccination and variables such as information about vaccine (0.886), non-vaccination reasons (0.810), and vaccination for health (0.833), whereas there is a weaker latent link between the expectations related to the vaccine as a product and the criteria underlying the evaluation of non-vaccination (0.494) or the denial (Table A3 in Appendix A).

In addition, a descriptive statistic has been developed, which can assist us in better comprehending the distribution of statistical values and expanding the descriptive analysis (Tables 5 and 6).

Table 5. Indicative statistics trailing coefficients.

	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis	Skewness	Number of Observations Used
Information about vaccine	0.000	−0.672	−0.672	2.286	1.000	−0.581	1.037	1673
Non-vaccination reasons	0.000	−0.666	−0.666	3.142	1.000	−0.109	1.141	1673
Online activity	0.000	−0.119	−1.202	2.048	1.000	−0.530	0.526	1673
Reasons evaluation for non-vaccination	0.000	−0.670	−0.670	3.123	1.000	−0.113	1.122	1673
Reasons for non-vaccination decision	0.000	−0.594	−0.594	2.308	1.000	0.405	1.412	1673
Regarding vaccine	0.000	−0.804	−0.804	1.750	1.000	−0.970	0.754	1673
Vaccination decision	0.000	−0.639	−0.639	2.733	1.000	0.832	1.406	1673
Vaccination for health	0.000	−0.694	−0.694	1.636	1.000	−1068	0.878	1673
Vaccination status	0.000	−0.731	−0.731	1.371	1.000	−1590	0.641	1673

Table 6. Hypothesis mean, STDEV, T-values, *p*-values.

0	Original Sample (O)	Sample Mean	Standard Deviation	T Values	*p*-Values
H_1	0.117	0.117	0.014	8.667	0.000
H_2	0.810	0.811	0.010	77.718	0.000
H_3	0.696	0.696	0.039	17.977	0.000
H_4	0.848	0.848	0.028	29.814	0.000
H_5	−0.013	−0.013	0.025	0.504	0.615
H_6	0.001	0.000	0.025	0.023	0.982
H_7	0.107	0.108	0.040	2.657	0.008
H_8	0.043	0.044	0.036	1.218	0.224
H_9	0.041	0.040	0.011	3.721	0.000
H_{10}	−0.128	−0.129	0.020	6.494	0.000
H_{11}	0.328	0.328	0.011	29.167	0.000
H_{12}	0.583	0.583	0.015	39.572	0.000

The acceptance of this study's hypotheses by means of statistical tests is displayed in the Table 7.

Table 7. Result of tested hypotheses.

H1	A person's vaccination status is determined by the knowledge he or she has about the vaccine.	Accepted hypothesis.
H2	External influences on the decision not to vaccinate are related to the evaluation of the vaccine itself.	Accepted hypothesis.
H3	There is a relationship between external influences on the decision not to vaccinate and the clients' reasons, which plays a significant role in the decision not to protect themselves by vaccination.	Accepted hypothesis.
H4	There is a relationship between external influences on the decision not to vaccinate and agreement/disagreement on COVID-19 vaccination.	Accepted hypothesis.
H5	There is a connection between online activity and external influences on the decision not to vaccinate.	Hypothesis is not supported.
H6	There is a link between online activity and opinion about vaccines in general (not just for COVID-19).	Hypothesis is not supported.
H7	There is a relationship between the clients' reasons, which play a significant role in their decision not to protect themselves by vaccination, and their agreement/disagreement on COVID-19 vaccination.	Accepted hypothesis.
H8	There is a relationship between the essential reasons for refusing COVID-19 vaccination and the decision to vaccinate.	Hypothesis is not supported.
H9	There is a relationship between the essential reasons for refusing COVID-19 vaccination and vaccination status.	Accepted hypothesis.
H10	There is a connection between the positive opinion/opinion about vaccines in general (not just for COVID-19) and the decision to vaccinate against COVID-19.	Accepted hypothesis.
H11	There is a correlation between the decision to vaccinate against COVID-19 and the vaccination status.	Accepted hypothesis.
H12	There is a correlation between the decision to vaccinate against COVID-19 for those who place value on individual health and the vaccination status.	Accepted hypothesis.

In a large number of previous meta-analyses [30,31] it was found that social factors were associated with vaccine acceptance. Even though efforts to control the spread of SARS-CoV-2 may increase the use of social media as individuals try to remain connected while physically apart [32], our findings do not support the role of social media in vaccine hesi-

tancy due to the high level of medical knowledge reported by respondents, which has also been reported by other studies [25].In a separate study, a strong correlation between attitude and vaccination intent was also discovered [33].Three parameters are known to influence a person's willingness to accept a vaccine: complacency, confidence, and convenience [34]. Our research indicates that a well-designed and targeted informational campaign could increase vaccine acceptance. General vaccine information is recognized as a predictor factor for COVID-19 vaccine acceptance [35].The available COVID-19 vaccines are the most effective means of containing the pandemic [36]. Our study found a vaccine acceptance rate of up to 56%, which is significantly lower than the globally averaged acceptance rate of the COVID-19 vaccine, which was 64.9% [95% CI: 60.5% to 69.0%] [37]. The correlation between vaccine acceptance in general and COVID-19 vaccine acceptance in particular was found in our study as well as in previous studies that investigated the confidence of healthcare professionals in theCOVID-19 vaccine [38]. The role played by socioeconomic status [39] or by a modern lifestyle that emphasizes health was shown to be a factor by our study as well as by previous findings [40]. The health systems are organized differently, but the medical approach to pandemic preparedness was guided by WHO recommendations, ensuring a global response to a global threat [41]. Administrative measures that aided the implementation of public health interventions had varying effects. [42] While in Poland, public health was legally prioritized over individual liberties [43], punitive administrative measures taken against those who violated the regulations were cancelled in Romania due to some legal inconsistencies. In this context, 1.4% of respondents chose to vaccinate because they were afraid of the authorities. The hesitancy for COVID-19 vaccination was found to be a significant problem in older people, particularly those with low incomes and low levels of education, according to a previous study [9]. Individuals who are altruists, care for others, follow government recommendations, and support collective responsibility are more likely to receive COVID-19 vaccination, according to an explanatory factor analysis, findings that are supported by previous research [43].Other studies have found that social media or online activity has a relatively low influence on the decision not to vaccinate, but these channels could be used in order to understand vaccination perceptions [44]. The emotional approach to subjects of public interest could lead to an increase in the vaccination acceptance rate [45]. Employer pressure or workplace constraints do not increase the intention to vaccinate, according to the current study and another conducted in Poland [46]. The measures taken by the employer during the pandemic to protect the staff can contribute to the state of safety at the workplace [47].

4. Conclusions

The vaccination status of a person depends on the knowledge they have about the vaccine. From this perspective, it would be advantageous for health authorities to communicate more openly on potential adverse reactions. Within this context, the companies whose COVID-19 vaccines have been approved for human use are required to present their own results (studies on the beneficial effects of the vaccine concurrently with the possible adverse reactions). Additionally, the approval authorities are required to submit the conclusions of their own studies or validated studies conducted by other research entities with the utmost confidence. This research has shown that there is a connection between the decision not to vaccinate and the evaluation of the vaccine itself, and that citizens are practically influenced by external factors when deciding not to vaccinate. There is no clear connection between online activity and outside influences on the decision not to vaccinate. The decision not to vaccinate is unique to online-active individuals. In the model utilized here, there is a correlation between the decision to vaccinate against COVID-19 for those who place a high value on individual health and the vaccination status. Our approach can be used to determine the causes of vaccination refusal in a community, whether for a newly released vaccine or immunization in general. Our model focuses on COVID-19 vaccination, however a similar pattern applies to all vaccines. In a community with low vaccination rates, it is possible to identify the perception-related factors that cause parents (in the

case of being responsible for children) or adults to be reluctant to vaccinate. Information campaigns might concentrate on factors unique to each community.

4.1. Study Limitation

Despite the fact that this study is based on a large and representative sample of Romanians, the percentage of vaccinated people in the sample is higher than the percentage of vaccinated people in the nation. The primary objective of this first paper was to empirically determine the relationships between various factorial variables and the non-vaccination behavior of the population, i.e., the entire population of Romania. No research was conducted to determine the factors that encourage vaccination, despite the fact that these data are available as a result of our study. This diverse and intricate information will be utilized in an upcoming article.

4.2. Futher Directions

A future research direction will be to deepen this study in order to empirically determine the relationships between various factor variables and the behavior of vaccine beneficiaries. The aim will be to better understand the factors, the interdependence of relationships, and the mechanisms that determine vaccination. The implications for process management and the management of the vaccination situation including vaccination intention, mode, techniques, and channels of communication with the vaccine recipients represent an additional future research direction using modern tools such as the internet of things [48].

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Appendix A

The Perception of Vaccination against COVID-19

This survey aims to analyze the perception of the general population regarding vaccination against COVID-19.

Enter your data:

Sex

Age

Location

Occupation

Education level

1. The questionnaire is completed

- personal
- by interviewer

2. The level of medical knowledge

- reduced
- medium
- high

3. Regarding lifestyle: (multiple possible answers)

- I am a smoker
- I occasionally consume alcohol (less than once a week)
- I consume alcohol weekly
- I practice physical activities regularly
- I am all for light exercise carried out regularly
- I do intense physical/sports activities
- I have 3 meals a day
- I often have breakfast
- I have a balanced work schedule
- I go on trips at least once every 6 months
- Other

4. Regarding the current state of health

- I am diagnosed with one or more chronic diseases
- I am not diagnosed with any diseases
- I am not diagnosed with any diseases, but I am worried about my health

5. To take care of my health (multiple possible answers)

- ☐ I am permanently in contact with the family doctor/general practitioner
- ☐ I do annual medical tests
- ☐ I participate in cancer screening programs
- ☐ I maintain a healthy lifestyle
- ☐ I get information from specialized websites
- ☐ I get information from specialized TV shows
- ☐ I turn to allopathic medicine (homeopathy, apiphytotherapy specialists, etc.)
- ☐ I think the tips from social networks are very useful
- ☐ I think the tips from the lifestyle shows are very useful
- ☐ Other

6. In the online environment

- ☐ I socialize
- ☐ I inform myself
- ☐ I do shopping
- ☐ I am not active online

7. The medical/pharmaceutical service providers I turned to during the pandemic to take care of my health are (multiple possible answers)

- ☐ The family doctor
- ☐ The specialist doctor
- ☐ Hospital
- ☐ Pharmacy
- ☐ Ambulance
- ☐ Other

8. Please rank the trust in medical service providers (the most trustworthy - 5, the least trustworthy 1)

- The family doctor
- Hospital outpatient - specialist doctor
- The private office of the specialist doctor
- Pharmacy
- Ambulance

9. Regarding the management of the pandemic

	total agreement	so and so	disagreement
The local authorities did their duty	☐	☐	☐
The Department of Public Health provided the necessary public health services	☐	☐	☐
The local police effectively monitored the isolated people	☐	☐	☐
The county ambulance service efficiently covered the test requests	☐	☐	☐
The county ambulance service provided the consultation at home in real time	☐	☐	☐
The hospitals provided the necessary medical care for health care and for other diseases, apart from SARS Cov-2	☐	☐	☐
Hospitals provided medical care only for patients with SARS Cov-2	☐	☐	☐

10. I believe that our immunity is important in order to be protected from diseases and to cope with different epidemics and diseases.

- ☐ Not at all
- ☐ Little
- ☐ So and so
- ☐ Important
- ☐ Very important

11. What are the methods by which you increase your immunity/maintain your health (multiple possible answers)

- ☐ Vaccination
- ☐ Juices (ex.: aloe)
- ☐ Special food supplements
- ☐ Common food supplements
- ☐ Sport and exercise
- ☐ Other

12. I think vaccination in general is a very good way to boost your immunity.

- ☐ Total agreement
- ☐ Agreement
- ☐ So and so
- ☐ Little

☐ Not at all

13. I am vaccinated against Covid19

☐ Yes

☐ Not

14. What is your information about the Covid vaccine regarding

	do not know	very little	so and so	know enough	I know very well
The benefits regarding your own health	☐	☐	☐	☐	☐
Prevention of serious and severe forms of the disease	☐	☐	☐	☐	☐
Reducing disease transmission	☐	☐	☐	☐	☐
How the vaccine works	☐	☐	☐	☐	☐
Adverse effects	☐	☐	☐	☐	☐

15. If your health is important, you are willing to get vaccinated against Covid19

☐ Yes

☐ No

16. To what extent are you willing to get vaccinated against Covid19

☐ Not at all

☐ So and so

☐ Agree

17. If the answer is no and you refuse vaccination, the important role in the decision not to increase your immunity/protection by vaccination is also due to

	not at all	little	so and so	important role	very important
The negative campaign sometimes carried out by the mass media	☐	☐	☐	☐	☐
Opinion leaders who are against vaccination	☐	☐	☐	☐	☐
Information from Facebook	☐	☐	☐	☐	☐
Messages and information from friends/relatives	☐	☐	☐	☐	☐
Specialized pages (sites)	☐	☐	☐	☐	☐
Sites on the Internet	☐	☐	☐	☐	☐
Scientific articles	☐	☐	☐	☐	☐
Physician	☐	☐	☐	☐	☐
Employee	☐	☐	☐	☐	☐

Other sources	☐	☐	☐	☐	☐

18. If the answer is no and you refuse vaccination, the essential role in the decision not to increase your immunity/protection by vaccination is due to the following aspects (multiple possible answers)

☐ The anticovid vaccine (all types) has not been sufficiently tested and therefore I do not trust it enough

☐ Adverse reactions are not yet fully known

☐ The long-term effects of vaccines against covid19 are not known

☐ There are severe and/or potentially fatal side effects

☐ Substances have been introduced that weaken the body and create dependence on the vaccine, requiring frequent revaccinations

☐ Certain components of the vaccine are unknown and lead to mistrust

☐ A microchip may be inserted, through which people can be controlled

☐ I am waiting for a better and /or Romanian vaccine that I can trust

☐ I do not trust the manufacturing companies

☐ Other ☐

19. To what extent do the following aspects play an essential role in the decision not to increase your immunity/protection by vaccination

	total agreement	agreement	so and so	little	not at all
The anticovid vaccine (all types) has not been sufficiently tested and therefore I do not trust it enough	☐	☐	☐	☐	☐
Adverse reactions are not yet fully known	☐	☐	☐	☐	☐
The long-term effects of anticovid19 vaccines are not known	☐	☐	☐	☐	☐
There are severe and/or potentially fatal side effects	☐	☐	☐	☐	☐
Substances have been introduced that weaken the body and create dependence on the vaccine, requiring frequent revaccinations	☐	☐	☐	☐	☐
Certain components of the vaccine are unknown and lead to mistrust	☐	☐	☐	☐	☐
A microchip may be inserted, through which people can be controlled	☐	☐	☐	☐	☐
I am waiting for a better and /or Romanian vaccine that I can trust	☐	☐	☐	☐	☐
I don't trust the manufacturing companies	☐	☐	☐	☐	☐

20. If the answer is yes, a key role in the decision to increase your immunity/protection by vaccination is due to the following aspects (multiple answers possible)

☐ To protect myself from the infection with Covid19 and its consequences

- ☐ I want to protect my family and friends/colleagues
- ☐ I want to drive/travel without problems in public places and around the country
- ☐ I want to travel to other countries without any problems
- ☐ I trust the doctors' recommendations
- ☐ I want to participate freely in entertaining and socio-cultural events
- ☐ I felt a lot of pressure from the authorities
- ☐ I was obliged by my employer
- ☐ Fear/respect/obedience to authorities
- ☐ Other

21. An essential role in the decision to increase your immunity/protection by vaccination is due to the following aspects

	total agreement	agreement	so and so	little	not at all
To protect myself from the infection with Covid19 and its consequences	☐	☐	☐	☐	☐
I want to protect my family and friends/colleagues	☐	☐	☐	☐	☐
I want to travel to other countries without problems	☐	☐	☐	☐	☐
I want to drive/travel without problems in public places and around the country	☐	☐	☐	☐	☐
I felt a lot of pressure from the authorities.	☐	☐	☐	☐	☐
Fear/respect/obedience to authorities					
I followed the doctor's recommendation	☐	☐	☐	☐	☐
I want to participate freely in entertaining and socio-cultural events	☐	☐	☐	☐	☐
I was obliged by my employer	☐	☐	☐	☐	☐

22. You got a flu shot this season

- ☐ YES
- ☐ NOT

23. If you have not had a flu shot this season, what are the reasons?

- ☐ I have no resources
- ☐ I can't find the vaccines
- ☐ I do not cooperate with the doctor
- ☐ I reject the idea
- ☐ I don't trust the result

- ☐ I am not informed
- ☐ I haven't succeeded yet, but I want to

24. Regarding vaccines

- ☐ I consider them beneficial
- ☐ I agree with some of them
- ☐ I agree with those that prevent childhood diseases, but I do not agree with the vaccine against Covid

25. At the national level, what are the measures you consider necessary to reduce the number of cases (multiple possible answers)

- ☐ Testing all symptomatic people (vaccinated or unvaccinated)
- ☐ Testing all direct contacts of symptomatic persons (vaccinated or unvaccinated)
- ☐ Isolation of persons tested positive for Covid-19
- ☐ Testing only unvaccinated people
- ☐ No special measures are needed, the pandemic will stop naturally

26. At the European level, it can be seen that there are countries with a vaccination rate over 80%, such as Italy or Portugal, and therefore restrictive measures have been lifted. Do you consider that vaccination contributed to the decrease in the number of hospitalized cases in these countries? (multiple answers possible)

- ☐ Agreement
- ☐ So and so
- ☐ Disagreement

27. Do you believe in the idea of a conspiracy (medical or otherwise) regarding vaccination and its effects of creating addictions and vulnerabilities?

- ☐ Yes
- ☐ Maybe
- ☐ Little
- ☐ They are are complete and utter nonsense
- ☐ I do not know
- ☐ I do not want to answer

Table A1. Cronbach values and composite reliability. Indicators of reliability and validity.

	Cronbachs Alpha	rhoA	Composite Reliability	Average Variance Extracted (AVE)
Information about vaccine	0.986	0.986	0.989	0.946
Non-vaccination reasons	0.982	0.982	0.984	0.859
Online activity	1.000	1.000	1.000	1.000
Reasons evaluation for non-vaccination	0.977	0.981	0.980	0.844
Reasons for non-vaccination decision	0.879	0.893	0.916	0.733
Regarding vaccine	1.000	1.000	1.000	1.000
Vaccination decision	1.000	1.000	1.000	1.000
Vaccination for health	1.000	1.000	1.000	1.000
Vaccination status	1.000	1.000	1.000	1.000

Table A2. Outer loadings.

Question	Informations about Vaccine	Non-VaccinationReasons	Online Activity	Reasons forEvaluation for Non-Vaccination	Reasons for Non-Vaccination Decision	Regarding Vaccines	Vaccination Decision	Vaccination for Health	Vaccination Status
Are you vaccinated against COVID-19?									1.000
What is your information on the COVID-19vaccine:	0.976								
– Benefits pertaining to your health	0.984								
– Prevention of serious and severe disease forms	0.976								
– Reducing the spread of disease	0.974								
– How the vaccine functions	0.953								
– Side effects								1.000	
If your health is important, are you willing to receive the COVID-19 vaccine?							1.00		
To what extent are you willing to receive a COVID-19 vaccination?		0.886							
– Yes		0.936							

Table A2. *Cont.*

Question	Informations about Vaccine	Non-VaccinationReasons	Online Activity	Reasons forEvaluation for Non-Vaccination	Reasons for Non-Vaccination Decision	Regarding Vaccines	Vaccination Decision	Vaccination for Health	Vaccination Status
– Not at all		0.922							
– So-so		0.933							
If the answer is no and you refuse vaccination, does your refusal play a significant role in your decision not to increase your immunity/protection through vaccination?		0.947							
– The negative campaign occasionally conducted by mass media		0.949							
– Opinion leaders who oppose vaccination		0.928							
– Information from Facebook		0.923							
– Messages and information from friends		0.915							
– Specialized pages (sites)					0.867				
– Internet sites					0.885				
– Scientific articles					0.883				
– Physician					0.786				
– Employee				0.905					
– Other sources				0.906					
– If the answer is no and you refuse vaccination, the following factors played a crucial role in your decision not to increase your immunity/protection through vaccination:				0.892					
– The anti-COVID-19vaccine (of all types) has not been adequately evaluated, so I lack confidence in its efficacy.				0.923					

Table A2. *Cont.*

Question	Informations about Vaccine	Non-VaccinationReasons	Online Activity	Reasons forEvaluation for Non-Vaccination	Reasons for Non-Vaccination Decision	Regarding Vaccines	Vaccination Decision	Vaccination for Health	Vaccination Status
– Uncertainty surrounds adverse reactions.				0.940					
– The long-term effects of COVID-19vaccines are unknown.				0.931					
– There are severe and/or fatal adverse effects.				0.936					
– There are introduced substances that weaken the body and cause vaccine addiction, necessitating frequent revaccinations.				0.905					
– Unknown components of the vaccine contribute to mistrust.				0.929					

Table A3. Latent Variable Correlations.

Variable	Information about Vaccine	Non-Vaccination Reasons	Online Activity	Reasons forEvaluation for Non-Vaccination	Reasons for Non-vaccination Decision	Regarding Vaccine	Vaccination Decision	Vaccination for Health	Vaccination Status
Information about vaccine	1.000	0.848	0.011	0.886	0.735	0.523	0.856	0.840	0.917
Non-vaccination reasons	0.848	1.000	−0.013	0.810	0.783	0.587	0.807	0.864	0.912
Online activity	0.011	−0.013	1.000	−0.014	0.022	0.001	0.009	−0.014	−0.012

Table A3. *Cont.*

Variable	Information about Vaccine	Non-Vaccination Reasons	Online Activity	Reasons forEvaluation for Non-Vaccination	Reasons for Non-vaccination Decision	Regarding Vaccine	Vaccination Decision	Vaccination for Health	Vaccination Status
Reasons for evaluation for non-vaccination	0.886	0.810	−0.014	1.000	0.671	0.494	0.874	0.833	0.919
Reasons for non-vaccination decision	0.735	0.783	0.022	0.671	1.000	0.623	0.628	0.825	0.814
Regarding vaccine	0.523	0.587	0.001	0.494	0.623	1.000	0.396	0.688	0.625
Vaccination decision	0.856	0.807	0.009	0.874	0.628	0.396	1.000	0.716	0.871
Vaccination for health	0.840	0.864	−0.014	0.833	0.825	0.688	0.716	1.000	0.950
Vaccination status	0.917	0.912	−0.012	0.919	0.814	0.625	0.871	0.950	1.000

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