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Personality and adherence to the COVID-19 vaccine: the role of agreeableness and openness traits

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Abstract

Aim: This study aimed to verify the relationship between personality traits and commitment to vaccination against COVID-19.

Material and methods: The sample consisted of 595 Brazilian adults aged 18-72 years, who answered the Big Five Inventory 2 Short (BFI-2-S) and a COVID-19 Vaccine Questionnaire.

Results and discussion: Higher scores in agreeableness and openness were associated with a higher probability of adhering to the vaccination program, and higher scores in extroversion and lower scores in agreeableness were associated with poor adherence to the vaccination, anti-vaccine movement, and conspiracy beliefs against the vaccine ($p \leq .01$). These results show the agreeableness and openness traits seem to be crucial for adherence to the vaccination program.

Conclusion: The findings indicate the importance of acknowledging agreeableness and openness traits as relevant in the adherence to the public policies programs against the COVID-19 pandemic.

SARS-COV-2; epidemic; prevention and control; personality assessment

INTRODUCTION

The COVID-19 pandemic began in the Chinese province of Wuhan in December 2019 and spread rapidly to other regions of China and later to other countries in the world. About 109 million people have been diagnosed, and 2.4 million have died of this disease worldwide [1]. United States of America, India, and Brazil are the countries most affected by the COVID-19 pandemic; together, they are responsible for 44.7% of cases and 37% of deaths.

The lack of a vaccine to immunize the population to COVID-19 has led worldwide entities, such as the World Health Organization (WHO), to recommend measures to contain the spread of the virus that causes COVID-19, especially social distance, constant hygiene, and use of facemasks. At specific times of most lavish spread and deaths by COVID-19, extreme measures such as lockdown were indicated and adopted by several countries [2]. The actions contained the transmission speed and flatten the virus

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propagation curve, which relieved the pressure on health systems, preventing them from collapsing, providing a greater possibility of treatment for the population [3-5].

Despite the evident success of the adopted containment measures [6-8] many people declared themselves against isolation, and social agglomeration situations were being reported and becoming routine. News on social aggregations, clandestine parties, and even protests against COVID-19's containment measures was reported in different countries [9-12]. Studies have sought to verify the relationship between the difficulty in following containment measures and personality traits [13-20]. The studies' findings indicate that conscientiousness and agreeableness personality traits are related to greater adherence to the containment measures; in contrast, extroversion was related to lesser commitment to the containment measures.

The record breakthrough in science has enabled several vaccines to be developed, and several countries have started immunizing their population. Currently, about 170 million doses of vaccines have been applied worldwide, and countries like the United States, China, Great Britain, and Israel have stood out as countries with the highest absolute number of doses applied [21]. Although the vaccine represents hope in controlling the COVID-19 pandemic, there is concern about the number of people expressing that they will not be vaccinated, as well as the anti-vaccine movement that has been gaining momentum worldwide. Anti-vaccine is a movement that discourages adherence to vaccines as a form of disease prevention that has a strong presence on social networks currently [22-24]. This movement spreads fake news and beliefs conspiration about vaccines (e.g., vaccines are intended to inject microchips in the people, vaccines change the DNA) [23]. For instance, a survey by the AP-NORC Center for Public Affairs Research [25] indicated that about 20% of the American population has no intention of being vaccinated, and 31% are still unsure whether they will get the vaccine when their turn comes.

A study by Freeman et al. [26] in England indicated that 16.7% of the population were very insecure about being vaccinated, while 11.7% were strongly hesitant. The research concluded that the desire to get a vaccine is closely linked to recognizing collective importance. Besides, hesitation about being vaccinated was associated with less adherence to the guidelines for social distance, age, and educational level. The Datafolha institute published an opinion poll in Brazil in which 22% of respondents indicated that they have no intention of getting the vaccine against COVID-19. Resistance to the vaccine is highest among those aged 25 to 34 (30%), among people who have not adhered to the containment measures (37%), and among supporters of Jair Bolsonaro's government (30%). As we conducted this study in Brazil, it is worth mentioning that Brazilian President Jair M. Bolsonaro has systematically attacked the vaccine for COVID-19 prevention, questioning its effectiveness and influencing the population with conspiratorial beliefs [29, 30] which can implicate specific findings to our research.

There is currently an aggregate of empirical evidence indicating that personality traits are related to adherence to the COVID-19 pandemic containment measures [13-20]. Besides, a previous study found that people who have less commitment to the measures are also those with the most substantial hesitation in vaccination26. It is reasonable to assume that personality traits must also be associated with adherence to vaccination programs against COVID-19, although few studies have directly investigated these associations. Murphy et al. [27] identified psychological characteristics related to the hesitation and resistance to vaccination of COVID-19. They found that people resistant or hesitant to the COVID-19 vaccine tend to have low agreeableness levels and may have low levels of conscientiousness and high neuroticism levels. Hughes and Machan [28] found that higher levels of machiavellianism and primary psychopathy predict a greater tendency to present conspiracy beliefs about COVID-19 and, consequently, less intention to adhere to the vaccine. Considering the low number of studies on the topic and its value for public health, our study aimed to verify the relationship between personality traits and commitment to vaccination against COVID-19.

Our study has three hypotheses based on the previous literature focusing on the containment measures against the pandemic COVID-19. We believe that the associations between FFM's per-

sonality traits and adherence to vaccination will replicate previous findings with the containment measures [13,14,19,20]: h1) conscientiousness will be positively related to adherence to the vaccine and negatively associated with the anti-vaccine movement and conspiratorial beliefs about the vaccine [13]; h2) agreeableness will be positively associated with adherence to the vaccine and negatively associated with the anti-vaccine movement and conspiratorial beliefs about the vaccine [19,20,27]; and h3) extroversion will be negatively related to vaccine adherence and positively to the anti-vaccine movement and conspiratorial beliefs about the vaccine [13].

METHODS

Participants

A community sample composed of 595 Brazilian adults recruited from December 20, 2020, to February 2, 2021. The inclusion criterion was age equal to or greater than 18 years. The participants' age varied between 18 and 72 years (M= 35.86; DP = 11.76), the majority being women (67.7%), from the southeast region (68.7%), and graduated (45.4%). Table 1 presents details on the sample demographics.

Table 1. Details on the sample demographics.

Demographic/Category	n	%
Sex		
Female	403	67.7
Male	192	32.3
Psychiatry Diagnosis (Self-stated)		
No	494	82.9
Yes	102	17.1
Ethnicity		
White	394	66.2
Brown	141	23.7
Black	45	7.6
Asian	6	1.0
Other	9	1.5
Level of education		
Elementary School	1	.2
High School	52	8.7
Undergraduate	92	15.5
University Education	180	30.3
Graduate	270	45.4
Marital Status		
Single	306	51.4
Married	230	38.7
Divorced	37	6.2
Widowed	11	1.8
Other	11	1.8
Brazil's region of residence		
Southwest	409	68.7
Northeast	130	21.8

South	32	5.4
North	13	2.2
Middle-west	11	1.8

Instruments

COVID-19 Vaccine Questionnaire

We developed a questionnaire to verify the intention to adhere to the vaccination program against COVID-19 and conspiracy beliefs against the vaccine. The items focused on three dimensions, adherence to the vaccine (five items; e.g., " I think about getting the vaccine to protect myself from Covid-19"), conspiracy beliefs (seven items; e.g., " The COVID-19 vaccine changes to people's DNA"), and anti-vaccine movement (six items; " I believe that people should not be vaccinated against COVID-19"). We found solutions for up to three factors for the data through parallel analysis, including the 18 items. Using the WLSMV estimator with oblique rotation, the exploratory factor analysis indicated the composition of three factors as the most adjusted model (CFI = .98; TLI = .98; RMSEA = .07) [31] and interpretable. The items of the conspiracy beliefs factor presented loadings that varied between .42 and .96, and the internal consistency was α = .86; ω = .87; the items of the anti-vaccine movement factor presented loadings between .34 and .59, and internal consistency α = .74/ ω = .74; and the items of the vaccine adherence factor presented loadings between .68 and .99, and internal consistency α = .91/.90. Conspiracy beliefs positively correlated with the anti-vaccine movement factor (r = .76), and negatively correlated with vaccine adherence (r = – .76). The anti-vaccine movement factor showed a negative correlation with the vaccine adherence factor (r = – .70). We conducted the analysis using the Mplus version 7.11.

Big Five Inventory-2 Short (Soto & John) [32].

The BFI-2-S is a self-report measure of personality traits based on the Five-Factors Model (FFM), evaluating extroversion, agreeableness, conscientiousness, neuroticism, and openness. This measure is composed of 30 items and must be answered on a 5-points Likert scale. The psychometric investigations with BFI-2-S in Brazil are not yet published, although the Ayrton Senna Institute made public documents regarding BFI-2-S former version33. The internal consistency reliability in our study was extroversion (α = .70; Ω = .71), agreeableness (α= .60; Ω = .60), conscientiousness (α = .75; Ω = .75), neuroticism (α = .77; Ω = .78), and openness (α = .70; Ω = .70).

Procedures

The institution's ethics committee approved this study's procedures and complied with the Declaration of Helsinki provisions regarding human participants' research (WMA)34. All participants signed an informed consent form before participating. Data collection was performed online via Google Forms. We shared the research link on the social media website Facebook and WhatsApp, inviting individuals to participate and relying on the snowball strategy to reach a larger number of participants. We administered the BFI-2-S as well as a questionnaire focusing on COVID-19 Vaccines.

Data Analysis

We conducted the analysis using the Statistical Package for the Social Sciences (SPSS) version 25 and Mplus version 7.11. We performed three linear regressions, wherein each one a factor of the COVID-19 Vaccine Questionnaire was the dependent variable. In the models, the FFM factors were independent variables. Besides, we control age and educational level in the regression models26. We consider a single significant contribution from each independent variable when $p \leq .05$.

We conducted a latent profile analysis (LPA) to empirically discriminate groups according to their scores in the COVID-19 Vaccine Questionnaire factors. We used the following indicators for deciding the best number of profiles to be retained: the average probabilities for the most likely profile membership (entropy) [35] should be higher than 0.80; lower values of Akaike In-

formation Criterion (AIC), Bayesian Information Criterion (BIC), and sample-size adjusted BIC (aBIC) indicate the best model fit; non-significant p values for the Lo–Mendell–Rubin likelihood ratio test (LMR-LRT)36 and Bootstrapped Likelihood Ratio Test (BLRT) indicate that a k-1 profiles model fits the data significantly better than the model with k profiles; models with profiles containing < 5% of the sample should be avoided; theoretical support should exist for the model retained, and profiles should be interpretable37 .

Comparisons between means were conducted via bootstrap ANCOVA with post hoc (Bonferroni) to verify differences in FFM personality traits. We controlled the effect of age, level of education, and sex. We considered the p-value significant when p <.05, and the partial eta squared was used as the effect size indicator. The partial eta squared was interpreted as 0.01 (small), 0.09 (medium) and 0.25 (large)38.

RESULTS

Table 2 presents the results of the linear regression analysis.

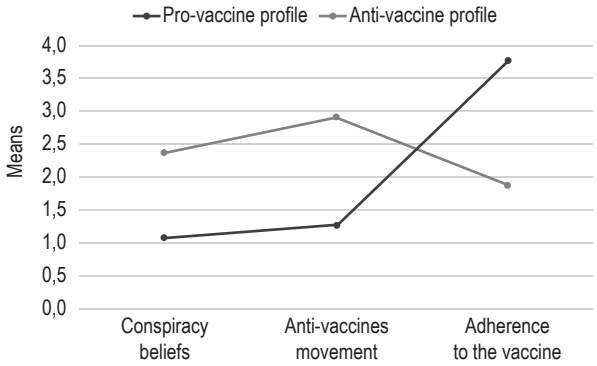
Table 2. Prediction of vaccination factors with personality traits.

	Beta	*t*	p	r^2 adjusted
Adherence to the vaccine				.07
Extroversion	.07	2.41	.16	
Agreeableness	-.13	-3.83	**<.01**	
Neuroticism	-.02	-.99	.31	
Openness	-.09	-2.87	**<.01**	
Conscientiousness	.02	.82	.40	
Age	.01	5.09	**<.01**	
Level of education	-.07	-3.97	**<.05**	
Sex	.01	.139	**.89**	
	Beta	T	p	r^2 adjusted
Anti-vaccine movement				.13
Extroversion	.15	3.94	**<.01**	
Agreeableness	-.13	-2.98	**<.01**	
Neuroticism	-.02	-.62	.53	
Openness	-.26	-5.91	**<.01**	
Conscientiousness	.01	.38	.70	
Age	.01	5.95	**<.01**	
Level of education	-.06	-2.69	**<.01**	
Sex	.09	1.831	**.07**	
	Beta	T	p	r^2 adjusted
Conspiracy Beliefs				.09
Extroversion	-.07	-1.61	**.04**	
Agreeableness	.21	3.72	**<.01**	
Neuroticism	.00	.00	.99	
Openness	.13	2.57	**<.01**	
Conscientiousness	-.01	-.27	.78	
Age	-.01	-4.51	**<.01**	
Level of education	.07	2.57	**<.01**	
Sex	.01	.08	**.93**	

Personality traits presented a predictive contribution to the COVID-19 Vaccine Questionnaire factors. Agreeableness, openness, and educational level showed a single positive and significant contribution to predicting the vaccine adherence factor, while age presented a unique negative contribution. Extroversion and age contributed positively to predicting the anti-vaccine movement factor, while agreeableness, openness, and educational level showed a single negative contribution. Agreeableness, openness, and educational level had a unique negative and significant contribution to predicting the conspiracy beliefs factor, while age contributed positively.

The analysis of latent profiles indicated the possibility of using up to three profiles for our sample, based on the COVID-19 Vaccine Questionnaire factors. However, the solution with three profiles had less than 5% of participants and poor interpretability. The fit for the 3-profiles solution were Loglikelihood = – 791.552 (4); AIC = 1193.005; BIC = 1254.491; aBIC = 1210.045; Vuong-Lo-Mendell-Rubin Likelihood Ratio Test = p <.05; Lo-Mendell-Rubin Likelihood Ratio Test = p <.05; Bootstrapped Likelihood Ratio Test = p <.01; Entropy = .99. The solution with two profiles presented a better interpretive possibility. The fit for the 2-profiles solution were Loglikelihood = – 791.552 (10); AIC = 1603.104; BIC = 1647,023; aBIC = 1615,276; Vuong-Lo-Mendell-Rubin Likelihood Ratio Test = p <.01; Lo-Mendell-Rubin Likelihood Ratio Test = p <.01; Bootstrapped Likelihood Ratio Test = p <.01; Entropy = .99. Also, the Average Latent Class Probabilities for Most Likely Latent Class Membership was greater than .80, and both profiles comprised more than 5% of the sample. Figure 1 shows the scores of the groups in the three factors of the questionnaire.

We named the first profile pro-vaccine (n = 543). This profile is characterized by higher scores in the adherence to the vaccine factor, and lower in the other two factors. We named the second profile anti-vaccine (n = 52), characterized by higher scores on factors conspiracy beliefs and anti-vaccine movement, and lower on the other factor.



Note: Means and standard deviation of the Pro-vaccine profile in Conspiracy beliefs (M= 1.059; SD = .007); Anti-vaccine movement (M= 1.258; SD = .01); Adherence to the vaccine (3.778; SD = .02). Means and standard deviation of the Anti-vaccine profile in Conspiracy beliefs (M= 2.370; SD = .11); Anti-vaccine movement (M= 2.912; SD = .09); Adherence to the vaccine (1.860; SD = .12).

Figure 1. Means of the groups according to Latent Profile Analysis.

We compared the means of the two profiles on personality traits through ANCOVA, controlling age and educational level. The results indicated that there was an effect of the group variable in agreeableness [F (1,595) = 11.68; p <.01] and openness [F (1,595) = 5.98; p <.05], even after controlling for demographic variables. Table 3 presents the adjusted means and the effects of the differences between the profiles.

Table 3. Means comparison of Latent Profiles on personality traits conducted via bootstrap ANCOVA.

Measure	Group	M (SD)	95% Confidence Interval		p	Partial Eta Squared
			Lower Bound	Upper Bound		
Extroversion	Pro-vaccine	3.34 (.03)	3.28	3.40	.35	.001
	Anti-vaccine	3.44(.10)	3.24	3.63		
Agreeableness	Pro-vaccine	3.87 (.02)	3.82	3.92	<.01	.02
	Anti-vaccine	3.58 (.08)	3.43	3.74		
Openness	Pro-vaccine	3.73 (.03)	3.68	3.78	.01	.02
	Anti-vaccine	3.51 (.09)	3.34	3.68		

Neuroticism	Pro-vaccine	2.70 (.03)	2.63	2.76	.75	.00
	Anti-vaccine	2.73 (.11)	2.52	2.95		
Conscientiousness	Pro-vaccine	3.81 (.03)	3.76	3.87	.76	.00
	Anti-vaccine	3.78 (.10)	3.59	3.97		

Note: We controlled for age and educational level; significant differences in bold.

The groups showed a significant difference in agreeableness and openness, where the Pro-vaccine profile presented the higher means. Effects were small for the significant differences.

DISCUSSION

Since the beginning of the COVID-19 pandemic, global actions have been proposed to contain the disease's spread. Currently, the focus is being given to the vaccination campaign implemented worldwide in the hope of ending the ongoing pandemic. Our study aimed to verify the relationship between personality traits and commitment to vaccination against COVID-19. We stress that our data was collected in Brazil, where the President has systematically attacked the vaccine for COVID-19 prevention29,30, which may have impacted our findings.

We found distinct personality patterns predicting adherence to vaccination. Different personality patterns have been observed empirically in previous studies focusing on containment measures [13,14,19,20] and low levels of agreeableness were linked with COVID-19 vaccine hesitancy or resistance27. Our findings only partially confirm our hypotheses. The people who adhere the most are more cooperative and flexible (high agreeableness and openness). These findings confirm our hypothesis 2, showing a substantial role for agreeableness levels to commit to the vaccination program. Indeed, the COVID-19 pandemic has been a unique opportunity to teach us that care for others plays a crucial role in human survival39.

People who follow the anti-vaccine movement and believe in conspiracy theories are the most inflexible (low openness) and with the most substantial interpersonal demand (high extroversion). These findings confirm our hypothesis 3, indicating that interpersonal relationships' continuous need can make it challenging to adhere to the prevention programs to COVID-19, as previously observed [13]. However, we emphasize that the tendency to be indifferent to others (low agreeableness) is more typical of people who follow the anti-vaccine movement, but not necessarily for those who believe in vaccine conspiracy theories. The anti-vaccine movement is characterized by explicit actions against the vaccination program, known for its harmful potential [22,23]. Respect conspiracy theories' beliefs can imply, for those who believe in these beliefs, protecting the people around them. Perhaps these differences explain the role of low agreeableness in the factors.

Our hypothesis 1 was not confirmed since conscientiousness was not significant in any of the analyzes. Although previous studies have found positive associations between conscientiousness and adherence to containment measures13 we did not find significant associations. Perhaps the typical characteristics of this trait, such as organization, commitment, adherence to standards, are more linked to behaviors that need to be repeated in everyday life (e.g., cleaning, wearing masks). Adherence to the COVID-19 vaccine is a behavior that does not imply consistency in the medium or long term, which may explain the non-confirmation of our initial hypothesis. This finding may also indicate that factors with interpersonal weight are those with the greatest impact on adherence to measures that protect the community. Future studies should investigate the stability of this finding. Besides, the openness factor was as essential as the agreeableness factor for adherence to the vaccination program. Although this finding was not expected, based on the previous empirical evidence with the measures to contain COVID-19, it is consistent with the personality trait interpretation. The openness trait is related to flexibility and indicates how much a person is curious and open-minded. Our findings suggest that adherence to the vaccine against COVID-19, a vaccine that had its development and implementation permeated with technological specificities and

news from the world media [40], seems to depend on an amount of the openness trait. We also emphasize that younger and more educated people showed a greater tendency to adhere to the vaccine. Higher educational levels were associated with more adherence to other diseases' vaccination in previous studies [41,42].

This study allows us to conclude that personality traits need to be taken into account by the public policies programs against the COVID-19 pandemic, as observed in previous studies [13,14,19,20]. The agreeableness and openness traits seem to be crucial for adherence to the vaccination program. They should be further investigated in future studies, both in other cultures and concerning these personality traits' specific facets. Besides, studies can be conducted to verify the impact of President Jair Bolsonaro on vaccine adherent.

Our findings should be considered in light of the main methodological limitations of the study. The method used for data collection was carried out for convenience, not randomly, with no specific access to people from groups linked to the anti-vaccine movement. These restrictions on data collection may have reduced the variability of our findings, biasing the impact of participant's demographics in our findings (e.g., outnumbered proportion of women). Besides, we used a personality measure with a limited number of items representing each personality trait, whose nature is self-report, which may imply a bias in accessing information about the personality pattern of the individuals who participated in the research. We need to ponder that the Brazilian version of the BFI-2-S does not have validity studies published with Brazilian adults. Specificities of the Brazilian scale version may explain some of our findings, which future studies may confirm. Regarding the COVID-19 Vaccine Questionnaire, no previous validity studies were conducted.

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