Article

Brazilian Adults' Attitudes and Practices toward the Mandatory Vaccination for COVID-19 and the Hesitancy about Childhood Vaccination

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Abstract: Background: This study describes the attitudes and practices of Brazilian adults regarding the mandatory vaccination for COVID-19 and the hesitancy to children´s vaccination. Methods: The participants answered an online questionnaire disseminated on social networks. An adaptation of the SAGE-WG questionnaire was used to measure the children's vaccination hesitancy. Results: Among 1,007 participants, 677 (67.4%) believed that vaccination for COVID-19 among adults should be mandatory. Just over half of the participants (51.5%) believe that parents and guardians should be free to decide whether their children should be vaccinated against COVID-19, and 9.1% were unsure about this. Younger, non-religious people who have higher self-perceptions of risk for COVID-19, and who evaluate the federal government's performance in combating the disease as bad or very bad, have a higher agreement with mandatory vaccination, a lower agreement that parents and guardians should be free to vaccinate their children, and lower child vaccination hesitancy scores. Conclusion: In Brazil, mandatory COVID-19 vaccination for adults is far from a consensus, and an expressive part of the population believes that parents and guardians should be free to choose whether or not to vaccinate their children. These perceptions and vaccine hesitancy for children are associated with religious and political inclinations.

Keywords: COVID-19; vaccine hesitancy; children; pediatrics; public health

1. Introduction

Vaccination is one of public health's most outstanding achievements, contributing to the decline in mortality and morbidity from various infectious diseases [1]. Vaccines are

responsible for eliminating polio in the Americas and the worldwide eradication of small-pox [1]. However, some outbreaks of vaccine-preventable diseases, including measles, polio, and pertussis, have occurred in several developed countries and are mainly associated with groups of individuals with unsatisfactory vaccination coverage or even those unvaccinated [2-5]. Lack of confidence in vaccines is a threat to the success of vaccination programs [1]. In Brazil, Sato [6] reports that since the 1990s, childhood vaccination coverage has been 95%, indicating good adherence of the population to vaccination. However, since 2016, this coverage has begun to decline by about 10 to 20 percentage points, accompanied by an increase in infant and maternal mortality [6]. In addition, the author mentions the weakening of the Brazilian Unified Health System (SUS) and social and cultural aspects that influence vaccination acceptability as contributing factors to this reduction.

According to the *SAGE Working Group on Vaccine Hesitancy*, vaccine hesitancy refers to the delay in accepting or refusing a vaccine despite its availability [7]. In Dubé et al.'s conceptual model [1], vaccine hesitancy is described as an individual behavior influenced by many factors, such as knowledge or past experiences. Hesitation is also a result of broader influences and should always be analyzed in the historical, political, and sociocultural context in which vaccination occurs. It also includes trust in the system that provides vaccines, in health professionals who recommend and administer vaccines, in policymakers who decide on vaccination programs, and in the different types of information about vaccines conveyed in the media [1]. According to Dubé et al. [8], people who have some vaccine hesitancy make up quite heterogeneous groups, and the individual vaccination attitudes and behaviors are not a simple dichotomy of "acceptance" or "rejection". Therefore, reducing them to "anti-vaccines" is incorrect. Some people may refuse all vaccines, but there are also people who may refuse some but accept to receive others. Some people may accept the recommended vaccines but feel insecure about the decision to vaccinate their children.

The first reported case of the disease caused by the SARS-CoV-2 coronavirus (COVID-19) in Brazil occurred on February 26, 2020, in São Paulo [9]. On January 17, 2021, the National Health Surveillance Agency (ANVISA) authorized the emergency use of two vaccines for the disease in the country, and soon after, a nurse at the Intensive Care Unit (ICU) of the Emílio Ribas Institute (São Paulo) became the first person vaccinated in the national territory [10]. In December 2021, ANVISA released the vaccination of children 5 to 11 years old, and on January 14, 2022, 15 children became the first immunized in an event promoted by the São Paulo state government [11]. At least 15 Brazilian Federative Units began vaccination on January 15, 2022. Although Brazil has recorded a cumulative total of more than 27,000 cases of COVID-19 as of February 2022, and more than 630,000 deaths due to the disease, reports of people refusing to receive the vaccine, or being against vaccinating their children, influenced mainly by fake news disseminated on social media, are common in the media [12,13]. In a national web survey that used data collected between November 2020 and January 2021, 30% of participants showed some type of hesitation about receiving the COVID-19 vaccine [14]. Based on information released by State Health Secretariats, some media reports in the first week of February 2022 reported that only 18.8% of 5- to 11-year-old children in Brazil had received the first dose of the COVID-19 immunizer [15]. Despite a possible delay in completing the data in the National Immunization Program Information System, this number is below expectations, evidencing a slow rhythm of the vaccination of children in Brazil.

The objective of the present study was to evaluate variables associated with mandatory vaccination for COVID-19 in adults and the hesitancy to vaccinate children. For that, Brazilians aged 18 years and older were invited to participate in the study. We consider the hesitancy to be related both to the decision about vaccinating one's own children and to attitudes toward vaccinating children in the community in which the participants live. Therefore, participation in the study was independent of whether or not the person has individuals under 12 years of age under their responsibility.

2. Materials and Methods

2.1. Study design and settings

This is a cross-sectional study with electronic data collection (open web survey). To ensure the quality of data collection and study findings, the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) was considered [16]. Data collection was based on the Research Electronic Data Capture (REDCap) platform, a secure web-based software platform designed to support data capture for research studies [17]. Invitations for participation in the study, along with the link to the questionnaire, were distributed on social networks (Facebook, Twitter, Instagram, WhatsApp, and others). The media also helped to publicize the research, and the researchers were thus interviewed by TV stations and newspapers. To attempt to reach a geographically representative sample of the population of interest, the survey was disseminated in all regions of Brazil (North, Northeast, South, Southeast, and Center-West). Participation in this survey was voluntary, and no compensation was provided.

2.2. Ethical issues

The Research Ethics Committee of the University Hospital of Ribeirão Preto Medical School, University of São Paulo, authorized this study (approval number CAAE:56391422.0.0000.5440). The applied methods followed the guidelines for research procedures with any stage in a virtual environment made available by the Brazilian Research Ethics Commission (Circular Letter 1/2021-CONEP/SECNS/MS). The Informed Consent Form was on the first page of the electronic questionnaire, detailing the purpose, confidentiality, and voluntary nature of the study. Participants could decide whether or not to participate in the study after reading it. They were also informed that they might withdraw from the study at any moment. The first question on the instrument asked whether the volunteer was 18 years old or older. In the case of a negative answer, the survey ended there. Furthermore, all the questions provided the option "I prefer not to answer" between the response categories, implying that participants were not compelled to answer any questions that made them uncomfortable.

2.3. Variables

The online questionnaire was developed by the responsible researchers, including sociodemographic variables such as gender, age, education level, and region of residence in Brazil (i.e., North, Northeast, Center-West, Southeast, or South). Questions on religion included religious affiliation and how the participant perceives their religiosity (with possible responses from very religious to non-religious). Participants were asked if they had ever had COVID-19, if they had received a vaccine, and how they thought they were at risk for the disease [18]. Perceptions of the COVID-19 vaccination were evaluated based on the questions "Should the vaccine for COVID-19 in adults be mandatory?" and "Should parents and guardians be free to decide whether their children will receive vaccinations?" [19].

An adaptation of the SAGE-WG questionnaire [20], originally administered to parents and caregivers, was used as a measure of children's vaccination hesitancy. The SAGE-WG was developed based on previously validated instruments [19,21] and does not refer to the vaccine for COVID-19, but childhood vaccination in general. A Portuguese version of the SAGE-WG was presented by Sato [6]. For the purposes of the present study, we adapted the SAGE-WG for COVID-19 vaccination according to the ten items presented below:

1.   The vaccine for COVID-19 is important for children's health.
2.   The vaccine for COVID-19 can prevent a child from developing the disease.
3.   Getting a child vaccinated for COVID-19 is important for the health of other children in the neighborhood or in the same school.
4.   The COVID-19 vaccine provided by SUS is beneficial for all children, even those without any diseases or health problems.

5.   The vaccine for COVID-19 carries more risks than vaccines that are used for other diseases (such as measles, polio, and others).

6.   The information that SUS providers give about the COVID-19 vaccine for children is reliable.

7.   Getting children vaccinated can prevent adults living with them from getting COVID-19.

8.   It is important to follow the recommendations that SUS providers give about vaccinating children with COVID-19.

9.   I am concerned about serious reactions that the COVID-19 vaccine can cause to children.

10.   Children should get the COVID-19 vaccine, even if the number of cases of the disease is small.

The abbreviation SUS in items 4, 6, and 8 refers to the Brazilian Unified Health System (in Portuguese, *Sistema Único de Saúde*), one of the largest and most complex public health systems in the world. A 5-point response scale was used (strongly disagree = 4; disagree = 3 points; neither agree nor disagree = 2 points; agree = 1 point; strongly agree = 0 points). The total score is given by the sum of points of the items, where the points for items 5, 9 and 10 must be previously reversed. Thus, a score range from 0 to 40 points is obtained, such that the higher the score, the greater the hesitation to vaccinate children.

2.4. Statistical analysis

Qualitative variables were described according to absolute and relative frequencies, and simultaneous 95% confidence intervals (S95%CI) for multinomial proportions were obtained using the method proposed by Sison and Glaz [22], implemented in the R program with the "MultinomialCI" package. Associations between the perception about mandatory vaccination, the perception of whether parents and guardians should be free to decide whether to vaccinate their children against COVID-19 and variables of interest, were analyzed using the Pearson's chi-squared test with p-values calculated by Monte Carlo simulation with B = 5,000 replicates [23]. Cramér's V coefficients were used as effect size measures, where values below 0.10 mean negligible association; between 0.10 and below 0.20 mean weak association; between 0.20 and below 0.40 mean moderate; and between 0.40 and 0.60 mean a relatively strong association [24].

Associations between the scores obtained from the adapted SAGE-WG questionnaire and variables of interest were assessed by linear regression models. The scores were log-transformed to normalize the residuals of the models and to stabilize the within-group variances. In addition, gender and age groups were used as covariates to adjust for their confounding effect. Given the well-known limitations of p-values [25], omega-squared statistics were calculated to indicate the magnitude of these associations [26]. According to Cohen, statistics close to 0.01, 0.06, and 0.14 should be interpreted as small, medium, and large effects, respectively [27]. Omega-squared statistics were obtained using the "effectsize" package or the R language.

3. Results

The completion rate (the ratio of the number of people who finished the survey divided by those who agreed to participate) was 1,011/1,072 = 94.3%. Four people were excluded for not living in Brazil. Thus, 1,007 participants were included in the study. Table 1 compares the distribution of the participants by gender, age group, education level, and Brazilian regions with the profile of the Brazilian population according to IBGE. Women, people living in the South Region, and those with a complete higher education are overrepresented in our sample, while people aged 61 and up are underrepresented.

Table 1. Characteristics of the study participants, and comparisons with the profile of the Brazilian population.

Variable	Participants	Brazilian

	n (%) [1]	S95%CI for proportions	Population (%) [2]
Gender			
Female	725 (72.4)	(69.6, 75.2)	51.8
Male	276 (27.6)	(24.8, 30.4)	48.2
Age group (years)			
18 – 24	177 (17.6)	(14.7, 20.7)	14.9
25 – 30	136 (13.5)	(10.7, 16.6)	12.7
31 – 35	138 (13.7)	(10.9, 16.8)	10.6
36 – 40	145 (14.4)	(11.6, 17.5)	10.9
41 – 50	207 (20.6)	(17.7, 23.7)	18.3
51 – 60	132 (13.1)	(10.3, 16.2)	14.8
61 or older	69 (6.9)	(4.0, 9.9)	17.8
Education level			
No schooling or incomplete elementary school	2 (0.2)	(0, 3.1)	38.7
Complete elementary school or incomplete high school	9 (0.9)	(0, 3.8)	12.5
Complete high school or incomplete higher education	293 (29.1)	(26.2, 32.0)	31.4
Complete higher education	702 (69.8)	(66.9, 72.7)	17.5
Brazilian Region			
Southeast	335 (33.3)	(30.1, 36.5)	43.3
Northeast	234 (23.2)	(20.1, 26.5)	26.3
South	201 (20.0)	(16.8, 23.2)	14.8
North	128 (12.7)	(9.5, 16.0)	7.8
Central-West	109 (10.8)	(7.6, 14.1)	7.8

S95%CI: simultaneous 95% confidence intervals for proportions (Sison and Glaz method).

1. Numbers may not sum to total due to missing data.

2. According to Brazilian Institute of Geography and Statistics (IBGE).

Table 2. Distribution of participants regarding the perception about mandatory vaccination for COVID-19 in adults.

		Should the vaccine for COVID-19 in adults be mandatory?			
	Total [1]	Yes n (%)	No n (%)	Not sure n (%)	Effect size [2] (p value) [3]
Gender					
Female	723	503 (69.6)	190 (26.3)	30 (4.1)	0.069

Male	276	172 (62.3)	90 (32.6)	14 (5.1)	(0.089)
Age groups (years)					
18 – 24	177	150 (84.7)	22 (12.4)	5 (2.8)	0.125
25 – 30	136	90 (66.2)	41 (30.1)	5 (3.7)	(<0.001)
31 – 40	283	182 (64.3)	88 (31.1)	13 (4.6)	
41 – 60	337	209 (62.0)	110 (32.6)	18 (5.3)	
61 or older	69	44 (63.8)	22 (31.9)	3 (4.3)	
Education level					
No schooling or incomplete elementary school	2	2 (100.0)	0 (0.0)	0 (0.0)	0.057
Complete elementary school or incomplete high school	9	6 (66.7)	3 (33.3)	0 (0.0)	(0.308)
Complete high school or incomplete higher education	292	212 (72.6)	69 (23.6)	11 (3.8)	
Complete higher education	701	457 (65.2)	211 (30.1)	33 (4.7)	
Brazilian Region					
Southeast	335	209 (62.4)	105 (31.3)	21 (6.3)	0.079
Northeast	234	170 (72.6)	58 (24.8)	6 (2.6)	(0.129)
South	201	130 (64.7)	64 (31.8)	7 (3.5)	
North	127	92 (72.4)	29 (22.8)	6 (4.7)	
Central-West	108	76 (70.4)	28 (25.9)	4 (3.7)	
Are you a religious person?					
Very religious	148	87 (58.8)	57 (38.5)	4 (2.7)	0.086
Moderately religious	441	295 (66.9)	126 (28.6)	20 (4.5)	(0.025)
A little religious	250	181 (72.4)	56 (22.4)	13 (5.2)	
Non-religious	130	95 (73.1)	30 (23.1)	5 (3.8)	
Have a religion					
Catholic	385	265 (68.8)	102 (26.5)	18 (4.7)	0.108
No religion, but believe in God	197	140 (71.1)	47 (23.9)	10 (5.1)	(0.198)
Evangelic	114	65 (57.0)	44 (38.6)	5 (4.4)	
Spiritist	97	70 (72.2)	24 (24.7)	3 (3.1)	
Atheist	63	50 (79.4)	12 (19.0)	1 (1.6)	
Protestant	33	17 (51.5)	13 (39.4)	3 (9.1)	
Spiritualist	31	19 (61.3)	11 (35.5)	1 (3.2)	
Umbandist	17	12 (70.6)	5 (29.4)	0 (0.0)	
Buddhist	6	5 (83.3)	1 (16.7)	0 (0.0)	
Other religions	33	22 (66.7)	11 (33.3)	0 (0.0)	
Have you ever had COVID-19?					
No	415	297 (71.6)	95 (22.9)	23 (5.5)	0.094
Yes	519	344 (66.3)	159 (30.6)	16 (3.1)	(0.001)

No sure	70	36 (51.4)	29 (41.4)	5 (7.1)	

Have you received a vaccination for COVID-19?

No	37	0 (0.0)	37 (100.0)	0 (0.0)	0.327
Yes, but only one dose	55	6 (10.9)	48 (87.3)	1 (1.8)	(<0.001)
Yes, all doses available	903	670 (74.2)	191 (21.2)	42 (4.7)	

Self-perception of risk

Very high	75	52 (69.3)	21 (28.0)	2 (2.7)	0.147
High	243	162 (66.7)	68 (28.0)	13 (5.3)	(<0.001)
Low	436	320 (73.4)	103 (23.6)	13 (3.0)	
Very low	161	102 (63.4)	51 (31.7)	8 (5.0)	
No risk at all	19	3 (15.8)	15 (78.9)	1 (5.3)	
No sure	68	37 (54.4)	24 (35.3)	7 (10.3)	

Do you consider your knowledge of COVID-19 satisfactory?

Yes	830	546 (65.8)	250 (30.1)	34 (4.1)	0.090
No	92	62 (67.4)	22 (23.9)	8 (8.7)	(0.005)
No sure	81	68 (84.0)	12 (14.8)	1 (1.2)	

How do you evaluate the federal government's performance in combating COVID-19?

Very good	116	38 (32.8)	75 (64.7)	3 (2.6)	0.301
Good	163	81 (49.7)	71 (43.6)	11 (6.7)	(<0.001)
Average	193	123 (63.7)	64 (33.2)	6 (3.1)	
Bad	155	117 (75.5)	31 (20.0)	7 (4.5)	
Very bad	366	318 (86.9)	32 (8.7)	16 (4.4)	

Do you agree that COVID-19 will finally be successfully controlled?

Yes	514	320 (62.3)	176 (34.2)	18 (3.5)	0.133
No	227	158 (69.6)	63 (27.8)	6 (2.6)	(<0.001)
No sure	260	199 (76.5)	41 (15.8)	20 (7.7)	

Have all your children between 5 and 11 years old received the COVID-19 vaccine? [4]

Yes	168	120 (71.5)	37 (22.0)	11 (6.5)	0.489
No	89	21 (23.6)	64 (71.9)	4 (4.5)	(<0.001)

1. Numbers may not sum to total due to missing data.

2. Cramér's V coefficient.

3. P-values computed for a Monte Carlo test with B = 5,000 replicates.

4.   Considering 257 participants who declared they had children between 5 and 11 years old.

Among the study participants, 677 (67.4%; 95%CI: 64.5% to 70.4%) believed that vaccination for COVID-19 among adults should be mandatory, 284 (28.2%; 95%CI: 25.4% to 31.3%) were opposed to such a policy, and 44 (4.4%; 95%CI: 1.5% to 7.4%) were undecided. Table 2 shows that there was no evidence of an association between the belief that the vaccine should be mandatory and variables such as gender, educational level, and region of residence. There was a higher frequency of respondents who believe that the vaccine should be mandatory for adults among younger people (18-24 years old; 84.7%), and among those who considered themselves not very or not at all religious. Evangelicals and Protestants were those who most disagree with mandatory vaccination (38.6% and 39.4%, respectively). Not surprisingly, among respondents who did not received the vaccine for COVID-19, all of them believed that the vaccine should not be mandatory, while approximately three-quarters (74%) of those who have received all available doses believed in mandatory vaccination. There were higher percentages of people who refused to take the vaccine mandatory among respondents who do not perceive COVID-19 risks and among those who have already had the disease or were unsure about it. Table 2 also shows that the positive perception of the actions of the Brazilian federal government regarding the fight against COVID-19 was associated with disagreement about compulsory vaccination.

Just over half of the participants (51.5%; 95%CI: 48.4% to 54.7%) believed that parents and guardians should be free to decide whether their children should be vaccinated against COVID-19, and 9.1% were unsure about this. The percentage of participants in favor of this freedom of choice was higher among those who have children between the ages of 5 and 11 than among those without children in this age group (62.0% and 47.5%, respectively). The results shown in Table 3 indicate that this perception was not associated with gender, education, and region of residence, but older people tend to be more in favor of freedom of choice in vaccinating children. This defense of freedom of choice was also more frequent among people who perceive themselves as more religious, among those who were vaccinated, those with a lower perceived risk of COVID-19, those who approve of the Brazilian government's actions to combat the disease, and among those who believe that the disease will finally be controlled.

Table 3. Distribution of participants on the perception whether parents and guardians should be free to decide whether to vaccinate their children against COVID-19.

| | | Should parents and guardians be free to decide whether their children will receive vaccinations? | | | |
	Total [1]	Yes n (%)	No n (%)	Not sure n (%)	Effect size [2] (p value) [3]
Gender					
Female	722	366 (50.7)	288 (39.9)	68 (9.4)	0.029
Male	275	148 (53.8)	104 (37.8)	23 (8.4)	(0.662)
Age groups (years)					
18 – 24	176	63 (35.8)	84 (47.7)	29 (16.5)	0.135
25 – 30	136	66 (48.5)	58 (42.6)	12 (8.8)	(<0.001)
31 – 40	281	144 (51.2)	112 (39.9)	25 (8.9)	

41 – 60	339	205 (60.5)	113 (33.3)	21 (6.2)	
61 or older	68	38 (55.9)	27 (39.7)	3 (4.4)	

Education level

No schooling or incomplete elementary school	2	2 (100.0)	0 (0.0)	0 (0.0)	0.055
Complete elementary school or incomplete high school	8	5 (62.5)	3 (37.5)	0 (0.0)	(0.397)
Complete high school or incomplete higher education	292	145 (49.7)	113 (38.7)	34 (11.6)	
Complete higher education	700	365 (52.1)	279 (39.9)	56 (8.0)	

Brazilian Region

Southeast	334	167 (50.0)	139 (41.6)	28 (8.4)	0.078
Northeast	233	105 (45.1)	102 (43.8)	26 (11.2)	(0.146)
South	201	108 (53.7)	77 (38.3)	16 (8.0)	
North	128	79 (61.7)	40 (31.2)	9 (7.0)	
Central-West	107	58 (54.2)	37 (34.6)	12 (11.2)	

Are you a religious person?

Very religious	147	96 (65.3)	40 (27.2)	11 (7.5)	0.183
Moderately religious	440	258 (58.6)	145 (33.0)	37 (8.4)	(<0.001)
A little religious	250	102 (40.8)	117 (46.8)	31 (12.4)	
Non-religious	130	37 (28.5)	82 (63.1)	11 (8.5)	

Have a religion

Catholic	386	212 (54.9)	141 (36.5)	33 (8.5)	0.194
No religion, but believe in God	196	84 (42.9)	88 (44.9)	24 (12.2)	(<0.001)
Evangelic	115	83 (72.2)	24 (20.9)	8 (7.0)	
Spiritist	95	45 (47.4)	42 (44.2)	8 (8.4)	
Atheist	63	10 (15.9)	45 (71.4)	8 (12.7)	
Protestant	32	23 (71.9)	6 (18.8)	3 (9.4)	
Spiritualist	31	16 (51.6)	12 (38.7)	3 (9.7)	
Umbandist	17	7 (41.2)	9 (52.9)	1 (5.9)	
Buddhist	6	4 (66.7)	2 (33.3)	0 (0.0)	
Other religions	33	15 (45.5)	17 (51.5)	1 (3.0)	

Have you ever had COVID-19?

No	413	195 (47.2)	184 (44.6)	34 (8.2)	0.067
Yes	519	282 (54.3)	189 (36.4)	48 (9.2)	(0.064)
No sure	70	39 (55.7)	22 (31.4)	9 (12.9)	

Have you received a vaccination for COVID-19?

No	37	36 (97.3)	1 (2.7)	0 (0.0)	0.197
Yes, but only one dose	55	51 (92.7)	3 (5.5)	1 (1.8)	(<0.001)
Yes, all doses available	901	420 (46.6)	391 (43.4)	90 (10.0)	

Self-perception of risk

Very high	75	36 (48.0)	37 (49.3)	2 (2.7)	0.109
High	243	123 (50.6)	98 (40.3)	22 (9.1)	(0.009)
Low	435	207 (47.6)	182 (41.8)	46 (10.6)	
Very low	161	88 (54.7)	57 (35.4)	16 (9.9)	
No risk at all	19	15 (78.9)	4 (21.1)	0 (0.0)	
No sure	67	46 (68.7)	17 (25.4)	4 (6.0)	

Do you consider your knowledge of COVID-19 satisfactory?

Yes	828	432 (52.2)	327 (39.5)	69 (8.3)	0.066
No	92	51 (55.4)	29 (31.5)	12 (13.0)	(0.066)
No sure	81	32 (39.5)	39 (48.1)	10 (12.3)	

How do you evaluate the federal government's performance in combating COVID-19?

Very good	116	101 (87.1)	8 (6.9)	7 (6.0)	0.366
Good	164	124 (75.6)	27 (16.5)	13 (7.9)	(<0.001)
Average	191	121 (63.4)	53 (27.7)	17 (8.9)	
Bad	155	70 (45.2)	55 (35.5)	30 (19.4)	
Very bad	366	91 (24.9)	252 (68.9)	23 (6.3)	

Do you agree that COVID-19 will finally be successfully controlled?

Yes	513	296 (57.7)	171 (33.3)	46 (9.0)	0.117
No	228	114 (50.0)	101 (44.3)	13 (5.7)	(<0.001)
No sure	258	103 (39.9)	123 (47.7)	32 (12.4)	

Have children between the ages of 5 and 11

Yes	255	158 (62.0)	78 (30.6)	19 (7.5)	0.127
No	735	349 (47.5)	315 (42.9)	71 (9.7)	(<0.001)

Have all your children between 5 and 11 years old received the COVID-19 vaccine? [4]

Yes	167	78 (46.7)	72 (43.1)	17 (10.2)	0.433
No	88	80 (90.9)	6 (6.8)	2 (2.3)	(<0.001)

1. Numbers may not sum to total due to missing data.
2. Cramér's V coefficient.
3. P-values computed for a Monte Carlo test with B = 5,000 replicates.
4. Considering 255 participants who declared they had children between 5 and 11 years old.

Figure 1 shows the frequencies of answers to the adapted SAGE-WG questionnaire. Most respondents agreed or very agreed that the vaccine for COVID-19 is important for children's health (76.7%), the vaccine can prevent a child from developing the disease (66.2%), and getting a child vaccinated for COVID-19 is important for the health of other children in the neighborhood or in the same school (76.8%). However, about half of the respondents (51.9%) agreed or strongly agreed that they are concerned about serious reactions that the COVID-19 vaccine can cause to children.
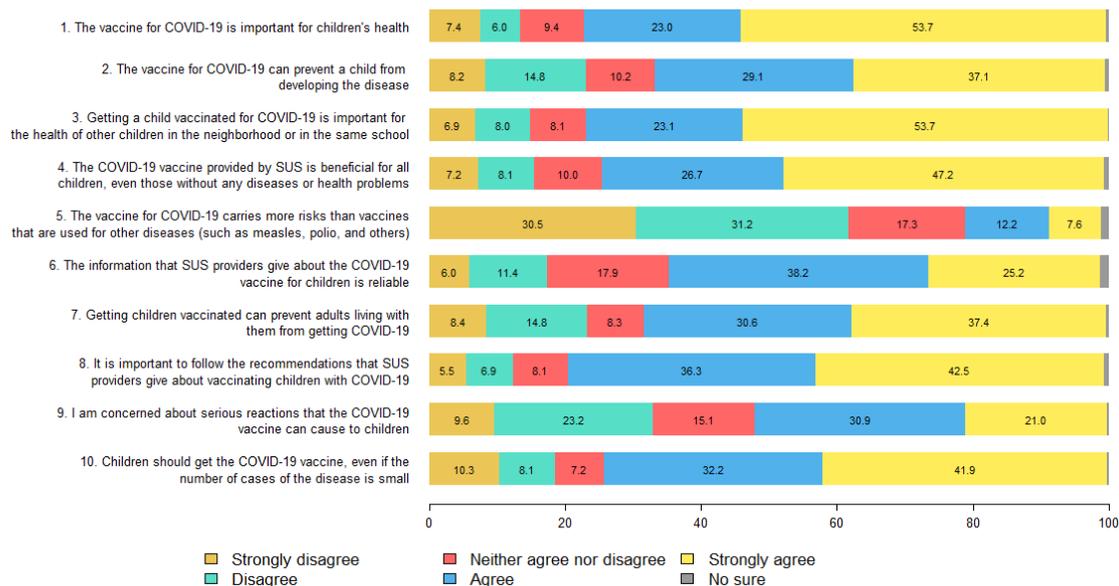
Figure 1. Frequencies of answers to the adapted SAGE-WG questionnaire. The abbreviation SUS in the questions 4, 6, and 8 refers to the Brazilian Unified Health System (in Portuguese, Sistema Único de Saúde).

Table 4 shows the means and standard deviations for the scores obtained from the adapted SAGE-WG questionnaire, according to the variables of interest. ANOVA and omega-squared effect sizes suggest that parental vaccination hesitancy is not associated with gender and region of residence, but it tends to increase with age. Participants who considered themselves to be very religious tend to have a higher intensity of vaccine hesitancy, with the averages being higher for evangelicals and Protestants and lower for atheists and people with no religion. As expected, people who have not received the vaccine for COVID-19 tend to have a high intensity of parental vaccine hesitancy. Considering only those with children between the ages of 5 and 11, vaccine hesitancy is considerably higher among those who have not vaccinated their children than among those who have vaccinated them. High mean scores on the adapted SAGE-WG were also associated with low perceived risk for the disease, good ratings of the federal government's performance in combating COVID-19, and the belief that the disease will finally be controlled.

Table 4. Descriptive statistics for the scores obtained from the adapted SAGE-WG questionnaire, and comparisons between groups. Larger scores suggest higher vaccination hesitance intensity.

	Total [1]	Mean (SD)	*p* value [2]	ω^2 statistics [3]
Gender				
Female	698	13.70 (7.88)	0.202	<0.01

Male	264	14.83	(8.84)		

Age groups (years)

18 – 24	168	11.31	(5.90)	<0.001	0.02
25 – 30	131	13.85	(7.81)		
31 – 40	273	13.88	(8.17)		
41 – 60	326	15.31	(8.74)		
61 or older	66	15.36	(9.33)		

Education level

No schooling or incomplete elementary school	2	14.50	(7.78)	0.010	<0.01
Complete elementary school or incomplete high school	8	12.12	(10.08)		
Complete high school or incomplete higher education	276	13.53	(7.01)		
Complete higher education	680	14.22	(8.58)		

Brazilian Region

Southeast	328	14.63	(8.67)	0.112	<0.01
South	191	14.95	(8.93)		
Northeast	222	12.72	(7.35)		
North	121	13.84	(7.64)		
Central-West	105	13.45	(7.18)		

Are you a religious person?

Very religious	143	16.71	(10.04)	<0.001	0.03
Moderately religious	423	14.65	(7.69)		
A little religious	242	12.19	(6.97)		
Non-religious	125	11.58	(7.81)		

Have a religion

Catholic	374	13.68	(7.79)	<0.001	0.05
No religion, but believe in God	187	12.91	(8.11)		
Evangelic	110	17.58	(8.05)		
Spiritist	92	12.95	(7.50)		
Atheist	61	10.23	(5.82)		
Protestant	30	18.67	(8.40)		
Spiritualist	29	14.62	(9.47)		
Umbandist	17	15.41	(10.15)		
Buddhist	6	13.50	(11.33)		
Other religions	33	14.24	(7.86)		

Have you ever had COVID-19?

No	402	12.79	(7.48)	<0.01	0.02
Yes	497	14.86	(8.46)		

No sure	67	14.96	(8.96)		
Have you received a vaccination for COVID-19?					
No	34	32.79	(4.07)	<0.01	0.21
Yes, but only one dose	51	26.63	(7.85)		
Yes, all doses available	873	12.38	(6.42)		
Self-perception of risk					
Very high	72	11.90	(6.25)	<0.01	0.05
High	232	14.12	(7.68)		
Low	427	13.09	(7.51)		
Very low	157	14.37	(9.27)		
No risk at all	16	27.81	(9.94)		
No sure	61	18.07	(8.54)		
Do you consider your knowledge of COVID-19 satisfactory?					
Yes	805	13.98	(8.43)	0.14	<0.01
No	84	15.07	(6.92)		
No sure	76	13.07	(6.34)		
How do you evaluate the federal government's performance in combating COVID-19?					
Very good	113	23.81	(8.87)	<0.01	0.04
Good	158	18.12	(7.38)		
Average	185	15.29	(7.39)		
Bad	147	12.12	(6.08)		
Very bad	356	8.99	(4.37)		
Do you agree that COVID-19 will finally be successfully controlled?					
Yes	493	14.86	(8.64)	0.01	<0.01
No	224	13.69	(8.20)		
No sure	246	12.40	(6.59)		
Have children between the ages of 5 and 11					
Yes	249	16.42	(9.30)	<0.01	0.02
No	708	13.05	(7.48)		
Have all your children between 5 and 11 years old received the COVID-19 vaccine? [4]					
Yes	167	11.75	(5.92)	<0.01	0.44
No	82	25.93	(7.51)		

SD: Standard deviation.

1. Numbers may not sum to total due to missing data.

2. P-values from linear regression models with sex and age as covariates, testing the null hypothesis of non-association between each variable and the scores obtained from the adapted SAGE-WG questionnaire.

3. Omega-squared statistics, where values close to 0.01, 0.06, and 0.14 should be interpreted as small, medium, and large effects, respectively.

4. Considering 257 participants who declared they had children between 5 and 11 years old.

4. Discussion

Brazilian adults regarding the mandatory vaccination for COVID-19 and the hesitancy to childhood vaccination. Our results indicated that among the participants, 67.4% (95%CI: 64.3% to 70.3%) believed that vaccination for COVID-19 among adults should be mandatory and 51.5% (95%CI: 48.4% to 54.7%) believed that parents and guardians should be free to decide whether their children should be vaccinated against COVID-19. Studies in different parts of the world have investigated people's perception of vaccination against COVID-19. A study carried out in June and July 2020 in Germany showed that about half of residents were in favor, and half were against, a policy of mandatory vaccination [28]. This policy was rejected with a higher probability by women and favored by older people. There was no evidence of an association between the perception of this policy and the political orientation of the respondents. In a cross-sectional online survey among a representative sample of the French population conducted in May 2021, 43% of the respondents were in favor of mandatory COVID-19 vaccination, 41.9% were opposed to such a policy, and 15.1% were undecided [29]. The age groups of 18–24 and 25–34 years were significantly more opposed than the group of 75 years or older. In addition, partisans of the far left and green parties were more likely to be opposed to the mandatory COVID-19 vaccine. A community-based survey carried out in Portugal from September 2020 to January 2021 showed that the refusal to take COVID-19 vaccines was associated with a worse perception of government measures to respond to the pandemic [30]. A web survey including 2697 respondents from the US, Canada, and Italy showed that individuals who did not believe their government had responded appropriately to the pandemic had higher odds of being vaccine-hesitant [31].

Other researchers have found a link between COVID-19 vaccine hesitancy and a negative perception of government measures [32,33]. However, in contrast to these findings, our study shows that people who have a positive perception of the federal government's performance in fighting COVID-19 tend to disagree with mandatory vaccination, believe that parents should be free to vaccinate or not vaccinate their children, and have greater hesitation in vaccinating children. This can be easily explained, considering that during the COVID-19 pandemic, the Brazilian government adopted a radical stance of right-wing populism and minimized the severity of the disease and discredited the vaccines [34,35]. The Brazilian president insisted on promoting hydroxychloroquine and ivermectin for the prevention and treatment of COVID-19 instead of encouraging vaccination of the population, even though these drugs have been shown to be ineffective in treating the disease [36-38]. Out of party loyalty or populism, many other politicians have also advocated the use of dubious pharmacological interventions for COVID-19. In fact, a German study that explored what drives citizens' attitudes toward mandatory vaccination during the COVID-19 pandemic showed that respondents tend to adjust their position on this issue in the direction of their most preferred political party [39]. This partly explains our results.

Aside from political beliefs, our results also show a relation between religiosity and vaccination reluctance. We observed that non-religious people, atheists, and people who have no religion, but believe in God tend to be in favor of mandatory adult vaccination, do not think parents should be free to vaccinate or not vaccinate their children, and have

lower vaccine hesitancy scores according to the adapted SAGE-WG questionnaire. Some authors have showing that religious considerations play an important role in vaccine attitudes, beliefs, and decisions [40-41]. However, the way in which religious affiliation and beliefs shape vaccine attitudes and behavior can vary greatly from one country to another, according to social and cultural characteristics. During the COVID-19 pandemic, it was noted a close connection between conservative religious leaders and the Brazilian president, and they also contribute to discredit the vaccine and promote ineffective treatments [42-43]. From the beginning of the period of social isolation, famous Brazilian pastors of Neo-Pentecostal churches refused to suspend public worship services and circulated messages in their blogs and social networks calling for their followers not to fear the virus, as God would protect those who have faith [44]. Influent personalities in the Spiritism, a religion that represents the third largest religious segment in Brazil, have also declared their support for the federal government and contributed to the dissemination of fake news, scientific denialism, and misinformation about COVID-19 [45]. However, while our findings show that Evangelicals and Protestants have higher mean vaccine hesitancy scores according to the adapted SAGE-WG questionnaire (17.58 and 18.67, respectively), Spiritists have a mean score of 12.95, similar to that of people who have no religion, but believe in God (12.91). This highlights that the mechanisms in the relation between religiosity and vaccination reluctance are complex and can be moderated by many factors including religious involvement, sectarianism, adherence to social norms of the religious group, and political interests of religious leaders and influencers. Further studies are needed to assess the structures of these relationships in the Brazilian population.

This study has some limitations that need to be considered. First, this is a cross-sectional study, and cause-effect relationships are not allowed. Second, the method of data collection prevented us from obtaining a representative sample. Table 1 shows that our sample is mostly composed of women with high education levels, which is also the case in other Brazilian web surveys based on convenience samples targeting a broad population [46-48]. Most vulnerable individuals, with low schooling levels and high poverty levels, may express least willingness to be vaccinated [14]. Although our results are valid only for particular groups, they suggest that, in Brazil, understanding parental vaccine hesitancy needs the assessment of political-religious characteristics of the population, in addition to variables such as risk perception, gender, age, and age groups. More complex sampling schemes, such as those based on chain referral sampling techniques [49], may be used in future studies.

5. Conclusions

Our findings show that among the population represented by the study participants, the mandatory COVID-19 vaccination in adults is far from a consensus, and nearly half believing that parents and guardians should be free to decide whether to vaccinate their children, while another half believe otherwise. Brazil's current period of political turbulence, combined with religious leaders' influence on COVID-19 control issues, has a major impact on people's decisions to receive the vaccine and vaccinate their children. Vaccine acceptance among the general public has an essential role in the successful control of the pandemic, and studies on population characteristics associated with vaccine hesitancy are important for planning strategies that can avoid the perpetuation of the COVID-19 pandemic in Brazil.

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