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Unravelling the drivers behind COVID-19 vaccination hesitancy and refusal among teachers: A nationwide study

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ABSTRACT

This study aims to assess the determinants of the coronavirus disease 2019 (COVID-19) vaccination hesitancy and refusal (VHR) among teachers, from pre-school to higher education, through an online survey. A logistic regression analysis was used to determine the adjusted odds ratio (OR) of the independent variables (perceptions, knowledge, and attitudes) per 1-point increase in the Likert scale, and VHR.

Concerns about the vaccines' efficacy and safety increase the risk of VHR (OR = 6.97, 95 %CI: 4.82–10.09 and OR = 8.71, 95 %CI: 5.52–13.73, respectively). Higher risk perceptions of getting infected (1/OR = 3.94, 95 %CI: 2.93–5.29), trust in the effectiveness of vaccines in reducing this risk or protecting against suffering complications (OR = 3.52, 95 %CI: 2.72–4.55 and OR = 10.94, 95 %CI: 7.16–16.68, respectively), and higher trust levels on the information transmitted regarding COVID-19 vaccination, are associated to lower VHR.

As VHR appears to be highly influenced by perceptions, knowledge, and attitudes, it is crucial to promote and design interventions targeted to transforming these determinants.

1. Introduction

Educational systems were among those who suffered the most with the coronavirus disease 2019 (COVID-19) pandemic, with closing schools and university campuses and, after deconfinement, with the implementation of strict measures to contain the spread of the pandemic [1]. To minimize the impact of the COVID-19 pandemic on the education of children, adolescents, and younger adults, high levels of vaccination coverage are highly required [2,3].

However, vaccination hesitancy and refusal (VHR) [4] against COVID-19 remains a problematic barrier to contain the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). VHR was identified as one of the top 10 global threats by the World Health Organization in 2019 [5], and is defined as the unwillingness to be vaccinated, regardless the availability of vaccines [5,6]. With classrooms being a particularly susceptible environment for airborne transmission [7], improving vaccination rates among both students and teachers constitutes an important public health measure, which will ultimately reduce the impact on learning processes.

Teachers can be particularly important public health actors, exerting a strong influence over both students and their parents [8–10]. Thus, while vaccine-acceptant teachers may influence reluctant parents or students to accept vaccination [8–14], it is also possible that vaccine reluctant teachers could undermine vaccine uptake among students and their parents [13].

Therefore, it becomes important to assess what motivates teachers - from kindergarten to higher education levels - to be COVID-19 vaccine-hesitant. Hence, this study, based on the Health Belief Model, which explores the perceived severity, susceptibility, beliefs, and barriers towards COVID-19 vaccination [15–17], has the main objective of assessing what drives teachers' VHR, namely by identifying perceptions, beliefs, and attitudes towards COVID-19 vaccination.

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Recognizing their perceptions, beliefs, and attitudes towards COVID-19 vaccination will not only aid to understand how to reduce and/or remove barriers for vaccination of these education professionals, but may also have a positive impact on the educational community, namely by helping these teachers to influence others to take the vaccine too. Moreover, identifying the main drivers for VHR may also aid in the management of similar situations that may occur in the future, by enhancing the effectiveness and efficiency of vaccination plans.

2. Methods

2.1. Setting and study design

Portugal has a population of around 10.3 million inhabitants [18], with 16.611 pre-school teachers, 30.043 basic education teachers, 100.387 secondary school teachers, and 35.549 higher education teachers [19,20]. This manuscript, involving teachers from different education levels, was conducted between December 2020 and May 2021, and describes a cross-sectional study, that was informed by results from a previous qualitative study, entailing the distribution of an online questionnaire between April 14th and May 16th, 2021.

2.2. Vaccination plan and vaccination status

The vaccination plan, designed by a task force especially dedicated to planning vaccination phases and defining priority groups [21], started in Portugal on December 27th, 2020. Throughout the pandemic, lethality rates in Portugal after vaccination has started did not exceed 2 %, reaching 4.3 % prior to vaccination [22]. Four vaccines were approved for emergency use by the European Medicines Agency [23]: (i) Cominarty® (Pfizer/BioNTech), (ii) Spikevax® (Moderna), (iii) Vaxzevria® (Oxford/AstraZeneca), and (iv) Janssen (Johnson & Johnson). Up until the end of the distribution of this questionnaire, 32 % of the Portuguese population had received at least the first dose of the vaccine, while 14 % had completed their COVID-19 vaccination plan.

2.3. Questionnaire design and distribution

2.3.1. Questionnaire design

A bibliographic review [24,25] and a qualitative study were conducted to help designing the questionnaire. The qualitative study consisted of a focus group session, carried out via videoconference, with eight teachers from different education levels, in which the main objective was to explore the main perceptions, beliefs, and attitudes regarding vaccination against SARS-CoV-2. With the information obtained from both the bibliographic review and the focus group session, a three-section questionnaire was designed:

(a) Sociodemographic characteristics (gender, age, geographical region, among others);
(b) Evaluation of the overall perceived health status, vaccination status, and whether they suffer from chronic conditions;
(c) Assessment of participants' perceptions, beliefs, and attitudes regarding the vaccination against SARS-CoV-2, measured by using a 4-point Likert scale (1-strongly disagree to 4-strongly agree).

This questionnaire was content- and face-validated by a multidisciplinary panel (composed by epidemiologists, pharmacologists, and public health experts). Then, the questionnaire was distributed online through a paid campaign on social networks (Facebook; Instagram; LinkedIn), by GAPS Politica I Societat Sl (https://www.gaps.cat/). Teachers were invited to participate in the study using a non-probabilistic snowball strategy.

2.3.2. Statistical analysis

The sample size was calculated under the assumption that the expected proportion of vaccination intention corresponded to 66 % [26], with a precision of 2%.

Based on three questionnaire items: 1) "Have you already been vaccinated against COVID-19?"; 2) "In case you haven't, why not?"; 3) "Once the COVID-19 vaccine is available for you, will you take it?", a binary dependent variable was defined to assess VHR, which took the value "0" for teachers who took the COVID-19 vaccine or were expecting to take it, and "1" for those who were vaccination hesitant (Fig. 1).

A binary logistic regression analysis was calculated to model the associations between VHR and the independent variables. As a result, three sets of statistical models were developed: (i) the evaluation of both sociodemographic and health condition variables, resorting to crude and adjusted analyses; (ii) the assessment of the influence of the perceptions, beliefs, and attitudes quantified in the survey, on VHR, while adjusting for sociodemographic and health condition variables in the first model presenting a p-value < 0.1. The items that evaluate perceptions, beliefs, and attitudes were included in the model individually, due to the high collinearity between many of them, which can generate bias in parameter estimates and standard errors, and consequently biased inference statistics [27]. Therefore, (iii) a third model was built using several scales as independent variables, composed of items that measure the same construct. To construct these scales, we rely on the results of a factorial analysis with varimax rotation. All the constructed scales were simultaneously included as independent variables in the regression models, adjusting for the sociodemographic characteristics and health condition variables that presented a p-value < 0.1.

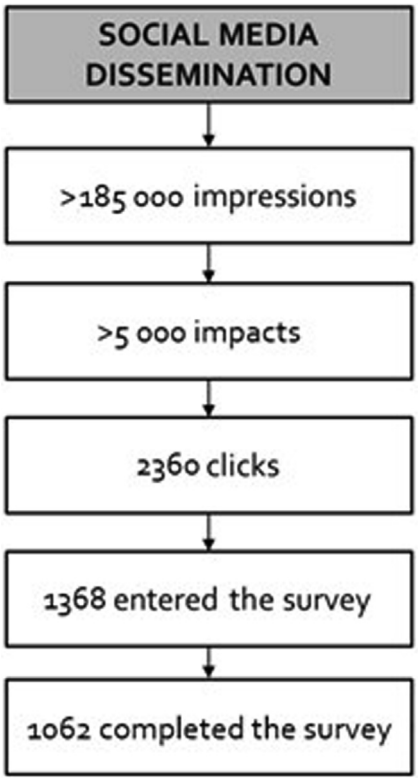

Fig. 1. Teachers' recruitment and survey completion.

The odds ratios (ORs) and interquartile odds ratios (IqOR) and their 95 % confidence intervals (CIs) were used to represent the findings.

2.3.3. Ethics and data protection

Compliance with General Data Protection Regulation - Directive 95/46/EC (GDPR) regulations was ensured, guaranteeing the security, anonymity and confidentiality of any data given by the participants. The study was completely voluntary, and participants gave their informed consent before taking part on it. The Guarda Polytechnic Institute's Ethics Committee granted ethical permission to conduct the focus group study (registry no. 01/2021). GAPS Politics and Society SL collected the data on the basis of the contract celebrated with "la Caixa" Foundation, in accordance with the Regulation (EU) 2016/679 of the European Parliament and of the Council of April 27th, 2016, on the protection of individuals regarding the processing of personal data and the free movement of such data, which repeals Directive 95/46/EC (GDPR). GAPS is also a member of the ESOMAR organization.

3. Results

In total, the campaign made more than 185.000 impressions and 5.000 impacts. From the 2.360 clicks, 1.368 entered the survey and 1.062 have completed it (Fig. 1).

Table 1
Vaccination hesitancy by teacher group.

	Vaccinated or with the intention to get the vaccine - N (%)	Not vaccinated or without the intention to get the vaccine - N (%)
Pre-school	41 (97.6)	1 (2.4)
Basic education	362 (90.5)	38 (9.5)
Secondary education	287 (91.4)	27 (8.6)
Higher education	265 (86.6)	41 (13.4)

The study population was composed of 1062 teachers from pre-school (3.9 %), primary (37.7 %) and secondary (29.5 %) schools and higher education (28.9 %), from which 78.1 % were females and 21.5 % were males, with almost 50 % having between 50 and 64 years old. During the survey period, 45.2 % of the teachers had already received the COVID-19 vaccine and, 88.4 % of the remaining teachers that haven't received the COVID-19 vaccine yet, were willing to take it when available for them.

3.1. Vaccination hesitancy and refusal among teachers

Around 10 % of the teachers (107/1062) expressed VHR. On the Table 1, the results for VHR per teaching group can be observed.

Around 45 % of the inquired population had already been vaccinated, 14 % had their vaccination scheduled and 30 % expressed their will to get vaccinated when available for them. Fig. 2 depicts the overall distribution of the teachers.

3.2. Influence of demographic characteristics on vaccination hesitancy and refusal

The Table 1 below provides the results of the adjusted analysis regarding the sociodemographic characteristics and VHR, with OR values corresponding to a 1-point increase in the Likert scale. No statistical differences were found regarding gender, age, or educational level in terms of VHR. In terms of geographical area, only teachers from Algarve (south of Portugal) were significantly more prone to be vaccination hesitant (OR = 2.86, 95 %CI 1.31–6.24, p = 0.008). When analyzing teachers' health status perception, those who reported a "weak" health status over 4 times more prone to be vaccine-hesitant per 1-point increase in the Likert scale (OR = 4.17, 95 %CI 1.25–13.94, p = 0.021), and those with diagnosis of chronic diseases were 50 % less probable to be vaccination hesitant (OR = 0.53, 95 %CI 0.30–0.93, p = 0.026).

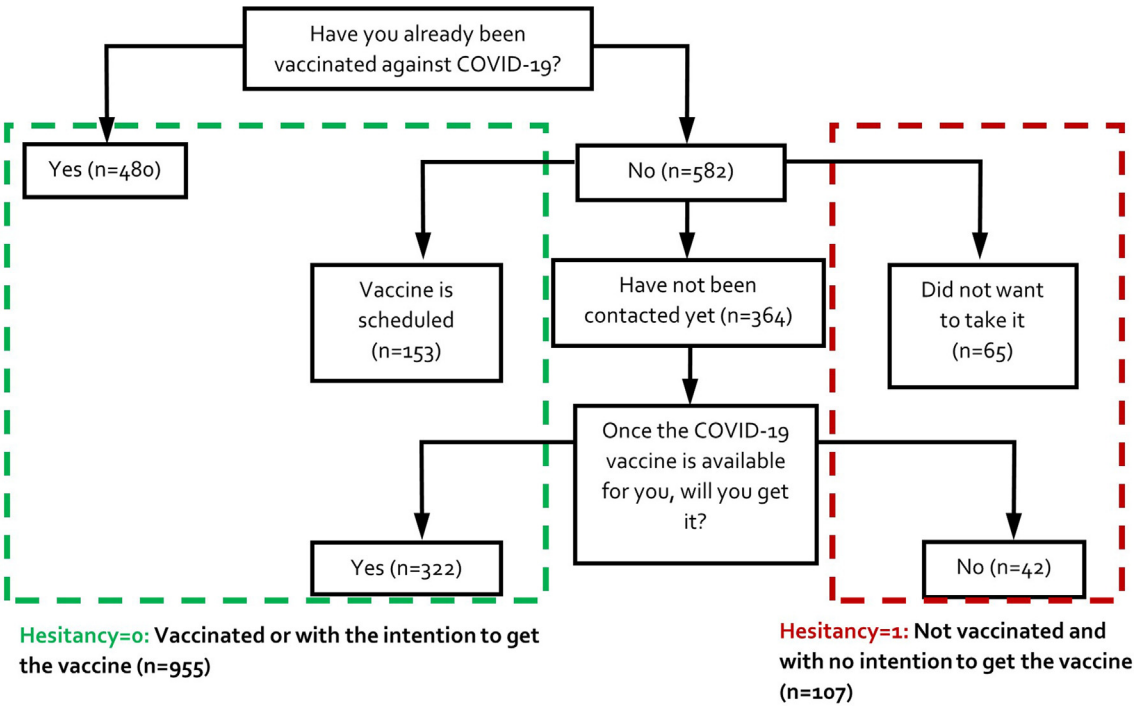

Fig. 2. VHR variable definition and population distribution.

3.3. Influence of perceptions, beliefs, and attitudes on vaccination hesitancy and refusal

Table 2 provides the obtained results regarding the analysis of the perceptions, beliefs, and attitudes on VHR, once again with OR values corresponding to a 1-point increase in the Likert scale. All the obtained p-values were below 0.001. All perceptions associated with lower VHR rates had median values equal or above 3. Those with a median of 4 were associated to immunity testing and the seriousness of COVID-19 complications (see Table 3)

When analysing the statements associated with higher VHR probability, median values ranged from 1 for "I will only get the vaccine if it is required to travel between countries." (S11) to 3 for both vaccine safety and efficacy concerns and getting sufficient information about the vaccines (S7, S8, and S12, respectively).

Table 2
Characterization of the population and influence of their characteristics on the COVID-19 VHR. Adjusted Odds Ratio per 1-point increase in the 4-point Likert scale.

	COVID-19 vaccination intention (%)		Crude analysis			Adjusted analysis[a]		
	Yes	*No*	*OR*	*95 % CI*	*p-value*	*OR*	*95 %CI*	*p-value*
Gender								
Male	196 (86.0)	32 (14.0)	1.00			1.00		
Female	756 (91.2)	73 (8.8)	0.59	0.38–0.92	0.020	0.75	0.46–1.23	0.251
Rather not say	2 (100)	–	–	–	–	–	–	
Age group (years)								
18–34	94 (82.5)	20 (17.5)	1.00			1.00		
35–49	375 (89.5)	44 (10.5)	0.55	0.31–0.98	0.042	0.67	0.36–1.25	0.210
50–64	472 (92.4)	39 (7.6)	0.39	0.22–0.70	0.001	0.56	0.29–1.08	0.085
65–79	12 (85.7)	2 (14.3)	0.78	0.16–3.78	0.761	0.97	0.18–5.35	0.972
>=80	1 (100)	–	–	–	–	–		
Educational level								
Pre-School	41 (97.6)	1 (2.4)	1.00			1.00		
Primary/Middle School	362 (90.5)	38 (9.5)	4.30	0.58–32.18	0.155	3.66	0.48–27.96	0.211
Secondary School	287 (91.4)	27 (8.6)	3.86	0.51–29.15	0.191	3.10	0.40–24.04	0.279
Higher Education	265 (86.8)	41 (13.4)	6.34	0.85–47.38	0.072	5.47	0.71–42.10	0.102
Geographical area								
North	267 (89.9)	30 (10.1)	1.00			1.00		
Center	301 (91.5)	28 (8.5)	0.83	0.48–1.42	0.494	0.81	0.46–1.41	0.463
Lisbon Met. Area	236 (91)	26 (9.0)	0.88	0.51–1.53	0.650	0.87	0.50–1.55	0.644
Alentejo	55 (90.2)	6 (9.8)	0.97	0.39–2.44	0.950	1.11	0.43–2.89	0.820
Algarve	43 (78.2)	12 (21.8)	2.48	1.18–5.22	0.016	2.86	1.31–6.24	0.008
Health status auto-evaluation								
Very good	220 (85.6)	37 (14.4)	1.00			1.00		
Good	529 (92.0)	46 (8.0)	0.52	0.33–0.82	0.005	0.66	0.40–1.08	0.094
Reasonable	188 (91.3)	18 (8.7)	0.57	0.31–1.03	0.064	0.84	0.43–1.64	0.605
Weak/Poor	16 (76.2)	5 (23.8)	1.86	0.64–5.38	0.253	4.17	1.246–13.94	0.021
Very weak/Very poor	2 (66.7)	1 (33.3)	2.97	0.26–33.62	0.379	7.23	0.58–89.72	0.124
Diagnosis of Chronic Disease								
No	644 (88.5)	84 (11.5)	1.00			1.00		
Yes	311 (93.1)	23 (6.9)	0.57	0.35–0.92	0.021	0.53	0.30–0.93	0.026

[a]Adjusted for the effects of the other variables included in the table.
OR = odds ratio, CI = confidence interval.

Table 3
Influence of the perceptions, beliefs, and attitudes of teachers on COVID-19 VHR. Adjusted Odds Ratio per 1-point in the 4-point Likert scale of each perception, belief, and attitude.

	Median	OR	95 % CI	p-value
S1. The probability of getting COVID-19 is high.	3	0.46	0.35–0.61	<0.0001
S2. I am concerned about the probability of getting COVID-19.	3	0.25	0.19–0.34	<0.0001
S3. The complications from COVID-19 are serious.	4	0.14	0.09–0.20	<0.0001
S4. The probability of being infected with COVID-19 decreases with vaccination.	3	0.28	0.22–0.37	<0.0001
S5. I feel less worried about being infected with COVID-19 if I get vaccinated.	3	0.20	0.15–0.28	<0.0001
S6. The probability of suffering complications from COVID-19 decreases with vaccination.	3	0.09	0.06–0.14	<0.0001
S7. I am concerned about the vaccine's efficacy.	3	6.97	4.82–10.09	<0.0001
S8. I am concerned about the vaccine's possible side effects.	3	8.71	5.52–13.73	<0.0001
S9. I will only get the vaccine when the majority of the population has taken it.	1.5	4.77	3.62–6.28	<0.0001
S10. I am concerned about the vaccine's manufacturer/country of origin.	2	2.05	1.63–2.57	<0.0001
S11. I will only get the vaccine if it is required to travel between countries.	1	3.88	3.00–5.02	<0.0001
S12. I will only get the vaccine if I obtain sufficient information.	3	2.91	2.17–3.89	<0.0001
S13. COVID-19 vaccination: I believe that the information released on the social media is reliable.	3	0.17	0.12–0.24	<0.0001
S14. COVID-19 vaccination: I believe that the information released by the competent authorities is reliable.	3	0.11	0.07–0.16	<0.0001
S15. I am confident that the pandemic will end when most of the population is vaccinated.	3	0.18	0.13–0.25	<0.0001
S16. Even after being infected with COVID-19, I must get the vaccine.	3	0.14	0.10–0.19	<0.0001
S17. If infected with COVID-19, I would like to take a test to check my acquired immunity.	4	0.45	0.34–0.61	<0.0001
S18. After taking the COVID-19 vaccine, I would like to take a test to check my acquired immunity.	4	0.39	0.30–0.51	<0.0001

ORs adjusted for sociodemographic characteristics ($p < 0.1$) – Geographical area, Health status auto-evaluation, Diagnosis of chronic disease.
Valid N for all statements = 1062.

All statements regarding the risk perceptions of getting infected with COVID-19 (S1, S2), suffering complications (S3), and the perceptions on the effect of the vaccines on both risks (S4-S6) were associated with lower VHR rates, with 1/OR values ranging from 2.17 (S1) to 10.94 (S6). Statements S13-S16 also revealed high 1/OR values, ranging from 5.56 to 9.19, thus being associated to up to 9 times lower VHR probability per 1-point increase in the Likert scale. Most of these statements are particularly associated to the reliability of information sources, which goes in accordance with the barrier of accepting to take the vaccine only when obtaining enough information on the topic, in which teachers are almost three times more reluctant to get the vaccine per 1-point in the Likert scale (OR = 2.91, 95 %CI: 2-17-3.89).

On the other hand, the statements about concerns regarding vaccine efficacy – S7 - (OR = 6.97, 95 %CI: 4.81–10.09) and safety – S8 - (OR = 8.71, 95 %CI: 5.52–13-73) were the strongest determinants for VHR among teachers, being up to 8 times more probable to be vaccine-hesitant per 1-point increase in the Likert scale. Concerns regarding the vaccines' manufacturer were the least important factor for vaccination hesitancy (OR = 2.05, 95 %CI: 1.63–2.57). When stratifying the results obtained per teaching level (Supplementary material S2), it can be observed that overall, the basic education results tend to be less potent when comparing to secondary and higher education levels. The teachers from secondary education tens to give a higher importance to the severity of COVID-19 – S3 – when compared to other education levels (1/OR = 10.57, 95 %CI: 4.49–24.86). Teachers from higher education tend to be more concerned with the vaccine's effectiveness - S6 and S16 - (1/OR = 20.25, 95 %CI: 9.17–44.71 and 1/OR = 16.51, 95 %CI: 7.78–35.04, respectively) and side effects - S8- (1/OR = 15.38, 95 %CI: 6.76–35.01), as well as the trust in competent authorities – S14 – (1/OR = 19.52, 95 %CI: 8.80–43.33), comparing to teachers from other educational levels.

Due to possible collinearity between the statements, a factorial analysis was conducted to determine the main dimensions for VHR, thus providing a more robust measure of associations within a specific domain. From the factorial analysis, five dimensions were identified: i) perceived susceptibility and severity of the COVID-19; ii) trust in vaccine effectiveness; iii) safety concerns regarding the vaccine; iv) trust in information disseminated regarding the vaccine; iv) perceived testing necessity. On Table 4 we present the results obtained:

When analysing the results on the Table 4, it is observed that the most determinant factor for VHR is the trust in vaccine effectiveness, being over 25-fold lower per a change from the 75th to the 25th percentile in the assessments of the scale (1/IqOR = 25.16). On the other hand, those who are more concerned with the vaccine's safety are over 11-fold more prone to be vaccination-hesitant per from the 75th to the 25th percentile in the assessments of the scale (IqOR = 11.04). Though the other factors are less determinant than the aforementioned, they all present a protective effect for VHR, with a 1/IqOR ranging from 2.76 to 9.12.

4. Discussion

In order to be protected against a severe COVID-19 infection, vaccine-induced immunity seems to be the best defence. Teachers are particularly important public health actors not only among children, adolescents, and younger adults, but also among parents and the community in general [28]. The results of this study indicate for the first time that teachers' perceptions, beliefs, and attitudes towards COVID-19 vaccines, are crucial determinants of VHR, exerting a very strong influence over it. These results are even more relevant when considering that those perceptions, attitudes, and behaviours are modifiable, thus being important factors to consider when designing interventions targeted to combat teachers' vaccination hesitancy, and possibly students' and families' hesitancy too.

To better understand these determinants, and according to the factors identified through the factorial analysis, we considered the model proposed by Razai [29], which presented the Five C's to combat COVID-19 VHR. In terms of sociodemographic factors **(context)** [29], and according to our studies among health professionals, teachers from regions with lower incidence and mortality rates [22] are significantly more likely to refuse vaccination. This may also be reflected in the lower vaccination rates in this region, when compared to others [30], and may be caused by factors such as local differentiation in deconfinement stages [31,32].

Though the published literature has not revealed health status perception to be a determinant for VHR [33], and although those with a "weak" health status auto-perception have higher VHR rates, having associated chronic diseases were shown to lower VHR probability by 50 % per 1-point increase in the Likert scale, which might be associated to a higher sense of needing to protect their health status, when compared to those who perceive their health as "very good" or do not suffer from chronic diseases.

When analyzing perceptions, beliefs, and attitudes towards COVID-19 VHR, it is noted that the statements with higher association strength for a lower VHR among teachers are linked to lower **complacency** (S1 to S3) **and communications** (S13 and S14). In particular, a lower likelihood of VHR was found for perceptions associated to the seriousness of complications caused by COVID-19 infection (S3), and to the trust in the information released by the competent authorities (S14), which is in accordance with the published literature [14,34].

Thus, our results suggest that, to reduce VHR, it is essential to emphasize the effectiveness of COVID-19 vaccines in lowering infection complications aiming to improve vaccination, highlighting that the information released by the authorities is reliable and evidence-based to build the trust on these entities. Our results also reveal that the risk perception of getting infected (S1) and acquired immunity testing (S17 and S18), though significant, are the least important factors for lower VHR among teachers.

On the other hand, the most important factors associated to higher VHR rates are concerns regarding both the vaccines' efficacy and safety, with **confidence and trust** being the most prominent factor for VHR [29,35]. Once again, highlighting the effectiveness of the COVID-19 vaccine is particularly important, namely by informing teachers about the risk–benefit ratio of taking the vaccine. Though **convenience** also appears to be a significant factor, only getting the vaccine if they get sufficient information (S12) or if it is required to travel (S11) are amongst the weakest factors for higher VHR levels among teachers.

Table 4
Influence of the identified factors on COVID-19 VHR. Adjusted Interquartile Odds Ratio per each change from the 75th to the 25th percentile in the assessments of the scale.

	p-value	IqOR	95 %CI	1/IqOR	95 %CI
Perceived susceptibility and severity of COVID-19	<0.001	0.11	(0.07–0.17)	9.12	(5.99–13.90)
Trust in vaccine effectiveness		0.04	(0.02–0.07)	25.16	(14.58–43.41)
Vaccine safety concerns		11.04	(7.29–16.70)		
Trust in information		0.28	(0.23–0.35)	3.55	(2.87–4.39)
Perceived testing necessity		0.36	(0.27–0.49)	2.76	(2.06–3.77)

Teachers, known to be professionals able to adapt their languages and spread age-adapted knowledge among their students and families, may now be seen as very important public health actors: while vaccination hesitant teachers may have a negative influence over parents, children, adolescents and university students, those who are pro-vaccination can help their students and/or families with the adoption of preventative measures against COVID-19 – specially to get vaccinated [8–14,36]. Although teachers may play an important role in reducing VHR among students and their families, for instance by reinforcing concepts, such as herd immunity and its impact, the risk-benefit relationship of getting vaccinated, while also raising awareness regarding misinformation [36], the survey instrument used in this study has not measured the knowledge or self-efficacy of teachers in providing education about COVID-19 infection and COVID-19 vaccines.

However, for those teachers who are reluctant to get vaccinated, and considering that during the pandemic schools were closed and classes were cancelled throughout the entire year, it is imperative to highlight that vaccination acceptance may help reducing these disruptions, thus aiding students to return to their normal learning activities, which has consequently a great impact on the long run. Still, though there was still some hesitancy and refusal among teachers, the vaccination of younger people in Portugal, especially among those between 12 and 17 years of age surpassed the expectations, reaching over 85 % of fully immunized children and adolescents by the second half of October [30].

4.1. Strengths and limitations

To the best of our knowledge, this is the first study to identify the factors associated with COVID-19 VHR among teachers. Causal inferences cannot be formed because this is a cross-sectional study. Thus, generalizing conclusions requires caution, as corroboration from other countries and circumstances is required. Furthermore, studies on perceptions post-vaccines' emergency approval and distribution are still scarce, limiting the comparison with other contexts.

Another potential limitation of this study may come from the fact that the sample may not be representative of all teachers in Portugal, since it is likely that those who participated in the study may be more motivated and have more positive opinions on the subject than the total population of teachers in Portugal. However, we believe that this is not an important limitation, since the main objective of our study is not to determine the prevalence of VHR among teachers in Portugal (which may be overestimated or underestimated due to non-participation), but to determine the influence of perceptions, beliefs, and attitudes on VHR. This relationship is determined by the underlying mechanisms between the associations between perceptions, beliefs, and attitudes and VHR, which, as stated by Rothman [37], do not depend on participation or not in the study. Moreover, the survey instrument used in this study has not measured teacher's knowledge or perspectives regarding their own role in providing education, for instance to students and their parents, on both COVID-19 infection and vaccine.

5. Conclusions

Schools, through their teachers, play a decisive role in promoting the health of the community in which they are located, and this also extends to combating COVID-19 VHR. The results of our study may constitute an important contribution to the advances in COVID-19 research activities, since they indicate that perceptions, beliefs, and attitudes towards vaccination are strongly associated with VHR. Furthermore, considering the different magnitude of effect of each dimension on VHR, this study may serve as a guide to prioritize targeted interventions to reduce VHR among teachers, namely regarding concerns about the vaccines' safety and effectiveness. These results can also indicate that the modification of these perceptions, attitudes, and beliefs among teachers could not only reduce their VHR levels, but also those of their students and respective families. Thus, we believe this study serves as good basis for designing educational interventions to decrease VHR among the educational community, and therefore among the general population.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: All authors report financial support was provided by LaCaixa Foundation..

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2022.07.059.

References

[1] Sabat I, Neumann-Böhme S, Varghese NE, Barros PP, Brouwer W, van Exel J, et al. United but divided: Policy responses and people's perceptions in the EU during the COVID-19 outbreak. Health Policy 2020;124(9):909–18.
[2] Lindholt MF, Jørgensen F, Bor A, Petersen MB. Public acceptance of COVID-19 vaccines: cross-national evidence on levels and individual-level predictors using observational data. BMJ Open 2021;11(6):e048172.
[3] Kerr JR, Schneider CR, Recchia G, Dryhurst S, Sahlin U, Dufouil C, et al. Correlates of intended COVID-19 vaccine acceptance across time and countries: results from a series of cross-sectional surveys. BMJ Open 2021;11(8):e048025.
[4] Adhikari B, Cheah PY. Vaccine hesitancy in the COVID-19 era. Lancet Infect Dis 2021;21:1086. https://doi.org/10.1016/S1473-3099(21)00390-X.
[5] World Health Organization. Ten threats to global health in 2019 2021.
[6] Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrachi M, Zigron A, et al. Vaccine hesitancy: the next challenge in the fight against COVID-19. Eur J Epidemiol 2020;35(8):775–9.
[7] Tupper P, Colijn C, Maini PK. COVID-19 in schools: Mitigating classroom clusters in the context of variable transmission. PLoS Comput Biol 2021;17(7):e1009120.
[8] Underwood NL, Gargano LM, Sales J, Vogt TM, Seib K, Hughes JM. Evaluation of Educational Interventions to Enhance Adolescent Specific Vaccination Coverage. J Sch Health 2019;89:603–11. https://doi.org/10.1111/josh.12786.
[9] Dubé E, Vivion M, Sauvageau C, Gagneur A, Gagnon R, Guay M. Nature Does Things Well, Why Should We Interfere? Qual Health Res 2016;26:411–25. https://doi.org/10.1177/1049732315573207.
[10] Tam CC, Qiao S, Li X. Factors associated with decision making on COVID-19 vaccine acceptance among college students in South Carolina. Psychol, Health Med 2022;27(1):150–61.
[11] Zeyer A, Levin DM, Keselman A. For the mutual benefit. Meeting Health Information Needs Outside Of Healthcare. Elsevier 2015:235–61. https://doi.org/10.1016/B978-0-08-100248-3.00011-1.
[12] Sadaf A, Richards JL, Glanz J, Salmon DA, Omer SB. A systematic review of interventions for reducing parental vaccine refusal and vaccine hesitancy. Vaccine 2013;31:4293–304. https://doi.org/10.1016/j.vaccine.2013.07.013.
[13] Zeyer. Getting Involved with Vaccination. Swiss Student Teachers' Reactions to a Public Vaccination Debate. Sustainability 2019;11:6644. https://doi.org/10.3390/su11236644.
[14] Fukuda Y, Ando S, Fukuda K, Shankar PR. Knowledge and preventive actions toward COVID-19, vaccination intent, and health literacy among educators in Japan: An online survey. PLoS ONE 2021;16(9):e0257552.

[15] Chen H, Li X, Gao J, Liu X, Mao Y, Wang R, et al. Health Belief Model Perspective on the Control of COVID-19 Vaccine Hesitancy and the Promotion of Vaccination in China: Web-Based Cross-sectional Study. J Med Internet Res 2021;23(9):e29329.
[16] Zampetakis LA, Melas C. The health belief model predicts vaccination intentions against COVID-19: A survey experiment approach. Appl Psychol Health Well Being 2021;13(2):469–84.
[17] Wong LP, Alias H, Wong P-F, Lee HY, AbuBakar S. The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay. Hum Vaccin Immunother 2020;16:2204–14. https://doi.org/10.1080/21645515.2020.1790279.
[18] INE. INE - Plataforma de divulgação dos Censos 2021 – Resultados Preliminares 2021. https://ine.pt/scripts/db_censos_2021.html (accessed July 30, 2021).
[19] PORDATA. PORDATA - Docentes em exercício nos ensinos pré-escolar, básico e secundário: total e por nível de ensino 2021. https://www.pordata.pt/Portugal/Docentes+em+exercício+nos+ensinos+pré+escolar++básico+e+secundário+total+e+por+nível+de+ensino-240 (accessed October 13, 2021).
[20] PORDATA. PORDATA - Docentes do ensino superior: total e por sexo 2021. https://www.pordata.pt/Portugal/Docentes+do+ensino+superior+total+e+por+sexo-666 (accessed October 13, 2021).
[21] Direção-Geral da Saúde. Plano de Vacinação contra a COVID-19 . 2020.
[22] Escola Nacional de Saúde Pública. Letalidade e Mortalidade: COVID-19 2021. https://barometro-covid-19.ensp.unl.pt/epidemiologia-da-covid-19/letalidade-e-mortalidade-das-regioes-em-portugal/.
[23] McGill COVID19 Vaccine Tracker Team. COVID-19 Vaccine Tracker: Portugal 2021.
[24] Weinstein ND, Kwitel A, McCaul KD, Magnan RE, Gerrard M, Gibbons FX. Risk perceptions: Assessment and relationship to influenza vaccination. Health Psychol 2007;26:146–51. https://doi.org/10.1037/0278-6133.26.2.146.
[25] Lin Y, Hu Z, Zhao Q, Alias H, Danaee M, Wong LP, et al. Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China. PLoS NeglTrop Dis 2020;14(12):e0008961.
[26] Sanofi Portugal. Gripe e Vacinómetro 2020. https://www.sanofi.pt/pt/atividade-portugal/Sanofi-Pasteur/vacinometro.
[27] Dormann CF, Elith J, Bacher S, Buchmann C, Carl G, Carré G, et al. Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. Ecography 2013;36(1):27–46.
[28] Hall V, Foulkes S, Insalata F, Kirwan P, Saei A, Atti A, et al. Protection against SARS-CoV-2 after Covid-19 Vaccination and Previous Infection. N Engl J Med 2022;386(13):1207–20.
[29] Razai MS, Oakeshott P, Esmail A, Wiysonge CS, Viswanath K, Mills MC. COVID-19 vaccine hesitancy: the five Cs to tackle behavioural and sociodemographic factors. J R Soc Med 2021;114:295–8. https://doi.org/10.1177/01410768211018951.
[30] Direção-Geral da Saúde. Relatório de Vacinação - Semana 35. 2021.
[31] Presidência do Conselho de Ministros. Resolução do Conselho de Ministros 33-A/2020, 2020-04-30 - DRE. Diário da República; 2021.
[32] Escola Nacional de Saúde Pública. Identificação de áreas críticas no espaço e no tempo: comunicação a 28.5.2021. 2021.
[33] Walker AN, Zhang T, Peng X-Q, Ge J-J, Gu H, You H. Vaccine Acceptance and Its Influencing Factors: An Online Cross-Sectional Study among International College Students Studying in China. Vaccines 2021;9:585. https://doi.org/10.3390/vaccines9060585.
[34] Schmitz M, Luminet O, Klein O, Morbée S, Van den Bergh O, Van Oost P, et al. Predicting Vaccine Uptake during COVID-19 Crisis: A Motivational Approach. Vaccine 2022;40(2):288–97.
[35] Cahapay MB. To get or not to get: Examining the intentions of Philippine teachers to vaccinate against COVID-19. J Hum Behav Soc Environ 2022;32(3):325–35.
[36] Arede M, Bravo-Araya M, Bouchard É, Singh Gill G, Plajer V, Shehraj A, et al. Combating Vaccine Hesitancy: Teaching the Next Generation to Navigate Through the Post Truth Era. Front Public Health 2019:381. https://doi.org/10.3389/FPUBH.2018.00381.
[37] Rothman KJ, Gallacher JE, Hatch EE. Why representativeness should be avoided. Int J Epidemiol 2013;42:1012–4. https://doi.org/10.1093/ije/dys223.