

Perceptions, knowledge, and attitudes about COVID-19 vaccine hesitancy in older Portuguese adults.

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Abstract

Background: Coronavirus 2019 (COVID-19) has become a public-health emergency of international concern. Most efforts to contain the spread and transmission of the virus rely on campaigns and interventions targeted to reduce Vaccine Hesitancy and Refusal (VHR).

Objective: This study aims to assess the major factors associated with VHR in the older population in Portugal.

Methods: A nation-wide cross-sectional study was conducted in the older Portuguese population (≥ 65 years old) through Computer-assisted Telephone Interviewing. Logistic regression was used to determine the adjusted Odds Ratio (OR) of the independent variables (perceptions, knowledge, and attitudes) and the outcome (VHR).

Results: The response rate was 60.1% (602/1001). Perceptions, knowledge, and attitudes were strongly associated with VHR probability. A 1-point Likert scale increase in concerns about the vaccines' efficacy and safety increased the risk of VHR by 1.96 (95%CI:1.40-6.28) and 3.13 (95%CI:2.08-8.22), respectively. A reduction of VHR probability for "reliability of the information released by social media" (OR=0.34, 95%CI:0.16-0.70) and for "trust in national and international competent authorities" (OR=0.34, 95%CI:0.17-0.69) is also observed per 1-point increase.

Conclusions: As VHR seems to be strongly associated with perceptions, knowledge, and attitudes, the design and promotion of vaccination campaigns/educational interventions specifically targeted at changing these potentially modifiable determinants may help to tackle COVID-19 vaccine hesitancy and refusal and achieve a wider vaccine coverage.

Keywords: COVID-19; PORTUGAL; OLDER ADULTS; VACCINATION; HESITANCY

1. Introduction

To control and prevent the spread of the COVID-19 pandemic, mass vaccination campaigns are a key element. However, the success of these campaigns will largely depend on the vaccination coverage achieved within the population [1,2]. It has been shown that vaccination coverage rates are frequently under the recommended levels to limit the spread and reduce the burden of vaccine-preventable diseases on healthcare systems.

Vaccine Hesitancy and Refusal (VHR) [3] is described as the reluctance or refusal to vaccinate despite the availability of vaccines, and it was identified as one of the ten threats to global health in 2019 [4]. VHR is usually caused by doubts, distrust and worries/fears concerning vaccine efficacy, protection, and safety [5–8], and is greatly influenced by the media [8,9], particularly among older people. The speed of development and approval of the several COVID-19 vaccines, the lack of a long-term safety and efficacy records and the way misinformation was initially spread may have led to a rise in VHR [10]. However, to combat this pandemic, population vaccination against SARS-CoV-2 is imperative, aiming to immunise the population as quickly as possible [11–13].

One of the major risk factors for severe COVID-19 disease is age [14–19]. Therefore, older people, together with those with underlying chronic health conditions, are prioritised to receive the COVID-19 vaccine, as they are more likely to develop a serious form of the illness, if infected. Moreover, adverse health outcomes triggered by COVID-19 infection also increase among older adults, such as hospitalisation, intensive care unit admissions and mortality [16–18].

Therefore, the decision to get vaccinated is especially critical among these older adults. Our study aims to assess the main determinants (perceptions, knowledge, and attitudes, as well as sociodemographic factors) that influence the Portuguese older population on COVID-19 vaccination hesitancy and refusal.

2. Methods

2.1 Setting

This study was carried out in mainland Portugal with a population of around 10.3 million inhabitants [20]. This study, involving older adults (≥ 65 years old) from the general population, was conducted between April and May 2021, a period in which the first COVID-19 vaccines had already been recommended for authorisation in Europe by European Medicines Agency

(EMA) [21] and the vaccination of the Portuguese older population had already been initiated. The reason for choosing this at-risk population was related to their priority in receiving the COVID-19 vaccine [22].

In Portugal, COVID-19 vaccination has started in December, 2020 and, until now, only four vaccines were approved for emergency use: **i)** Pfizer/BioNTech: BNT162b2, **ii)** Moderna: mRNA-1273, **iii)** Oxford/AstraZeneca: AZD1222 – now being the recommended vaccine for adults over 60 years old [23], and **iv)** Janssen (Johnson & Johnson): Ad26.COV2.S [24]. Since the beginning of the vaccination process, the non-institutionalised older adults were contacted by the health services to schedule their vaccination.

2.2 Study Design

A cross-sectional study was carried out in a Portuguese population sample of older adults (≥ 65 years old) from mainland Portugal, through Computer-Assisted Telephone Interviewing (CATI) by the company GAPS Politics and Society SL. The database was supplied by an international company using a random and automatic dial process based on the country's numbering plan, distributed by regions in proportion to the population. This database does not include any personal information, respecting the General Data Protection Regulations (GDPR). The distribution of the resident population in 2019, including by age range, was obtained from the Statistics Portugal web portal on April 7th, 2021 [25]. For this study, as the surveys were applied according to the population living in mainland Portugal with ≥ 65 years old, the calculation of the population's distribution was performed accordingly.

The sample size calculation assumed an expected proportion of intention to be vaccinated of 66% (based on the flu vaccination coverage for groups at-risk, [26]), and a precision of 4% in either direction.

2.3 Data Collection

A questionnaire was designed based on an extensive bibliographic review [27,28] and focus groups, conducted with teachers and health professionals. Afterwards, considering the information obtained from the literature, the questionnaire was developed, and its face and content validity was assessed by a multidisciplinary panel, composed by epidemiologists, pharmacologists, and public health experts.

The questionnaire was divided into three sections and its completion took no longer than ten to fifteen minutes. The sections included:

- a) Questions about the sociodemographic characteristics of the participants (sex, age group, education level, household composition, geographical region);
- b) Six questions concerning the evaluation of the overall health condition of the respondents, their vaccination status, and if they belong to a risk group;
- c) Some questions to assess participants' perceptions, knowledge, and attitudes regarding the vaccines against SARS-CoV-2, namely the existing barriers to vaccination, the efficacy of the vaccine and the vulnerabilities and worries related to vaccination. These variables were measured using a 4-point Likert scale (from strongly disagree to strongly agree).

The telephone interviews were conducted between April 21st and May 10th, 2021.

2.4 Variables Definition

A new composite dependent variable (VHR) was created through the evaluation of the three following questionnaire items:

- "Have you already been vaccinated against COVID-19?";
- "In case you haven't, why not?";
- "Once the COVID-19 vaccine is available for you, will you get it?"

VHR was considered to take the value 1 when the older adult was not vaccinated and had with no intention to get the vaccine; taking the value 0 in the remaining cases (has already been vaccinated, has not been vaccinated but the vaccine is scheduled, or has the intention to get the vaccine) (*see fig. 2*).

2.5 Statistical Analysis

A binary logistic regression analysis was computed to model the associations between independent variables and COVID-19 VHR. The model assessed the crude risk of VHR taking account of perceptions, knowledge, and attitudes, adjusted for statistically significant ($p < 0.1$) personal sociodemographic and health condition variable. Results were expressed as odds ratios (ORs) with their 95% confidence intervals (CIs) and correlated p-value (for which the level of statistical significance was set to $p < 0.05$).

2.6 Ethics

This study was conducted by GAPS Politics and Society SL, having as basis the contract established with "la Caixa" Foundation, which is following the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data and the free movement of such data, and which repeals Directive 95/46/EC (GDPR). In addition, GAPS is a member of the European Society for Opinion and Marketing Research (ESOMAR). Participation on the study was volunteer and participants gave their informed consent before participation. The responses given were completely anonymous and confidential and were exclusively used for this study.

3. Results

Of the total of 8103 telephone calls made, 4989 were not answered, 1064 were incorrect phone numbers, 1049 corresponded to people with less than 65 years old (not part of our target population) and the remaining refused to participate. In the end, a total of 602 valid surveys were completed, as shown in Figure 1.

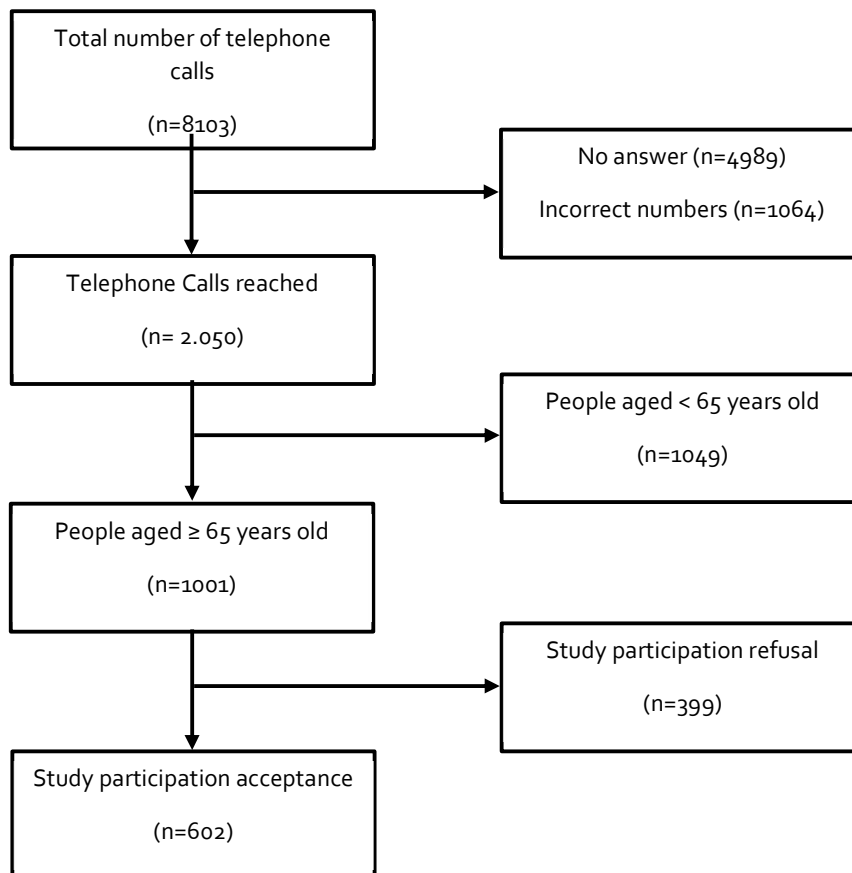


Figure 1: Flow diagram of the cross-sectional study.

Figure 2 illustrates the construction of the dependent variable:

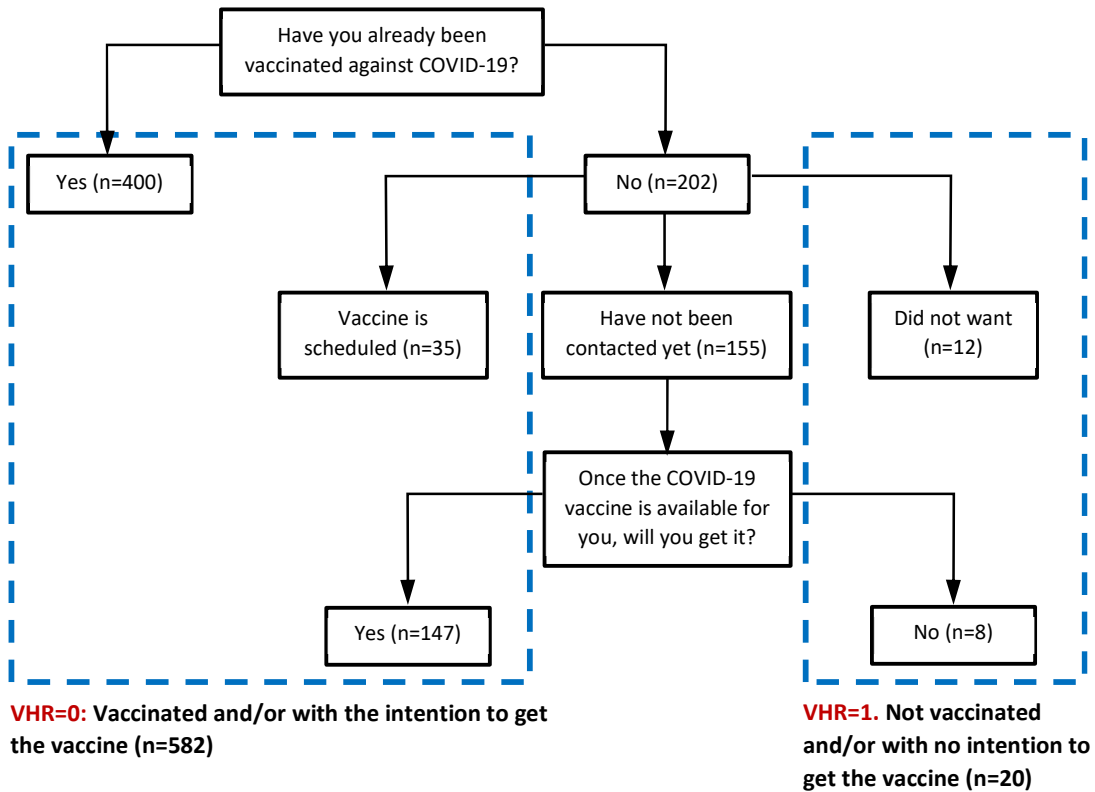


Figure 2: Definition of the composed variable (VHR) by taking into consideration three different questionnaire items related to the vaccination refusal/acceptance and/or no intention/intention to get the COVID-19 vaccine.

The response rate was over 60% (Fig.1). More than 65% of the older adults were already vaccinated against COVID-19, and around 3.3% did not want or had no intention to get the vaccine (Fig. 2).

Table 1 displays the sociodemographic characteristics and health condition status of the population sample under study and their influence on VHR. In the fully adjusted analysis, only households with one family member aged less than 18 years old appear to be more susceptible to VHR ($p < 0.05$).

Table 1. Influence of the study population sociodemographic characteristics and health condition on COVID-19 VHR (adjusted Odds Ratio).

		COVID-19 vaccination intention		Crude analysis		Adjusted analysis ^a	
		N (%)		OR	95% CI	OR	95% CI
		Yes	No				
<i>Sociodemographic characteristics/information</i>							
Sex	Male	242 (97.6)	6 (2.4)	1.00		1.00	
	Female	340 (96.0)	14 (4.0)	1.66	0.63, 4.38	1.20	0.41, 3.46
Age Group (years)	65 - 79	412 (96.5)	15 (3.5)	1.00		1.00	
	≥ 80	170 (97.1)	5 (2.9)	0.81	0.29, 2.26	0.75	0.25, 2.25
Education Level	None	47 (95.9)	2 (4.1)	1.00		1.00	
	Lower secondary education	426 (97.3)	12 (2.7)	0.73	0.16, 3.37	0.56	0.11, 2.91
	Upper secondary education	37 (92.5)	3 (7.5)	0.90	0.15, 5.61	0.60	0.08, 4.77
	University	72 (96.0)	3 (4.0)	0.98	0.16, 6.08	0.77	0.11, 5.59
Household Family Members	1	133 (95.7)	6 (4.3)	1.00		1.00	
	2 to 3	392 (97.3)	11 (2.7)	0.62	0.23, 1.72	0.61	0.20, 1.82
	4 to 5	45 (95.7)	2 (4.3)	0.99	0.19, 5.06	0.26	0.03, 2.53
	> 5	12 (92.3)	1 (7.7)	1.85	0.21, 16.64	1.04	0.02, 46.37
Family Members < 18 years old	0	550 (97.2)	16 (2.8)	1.00		1.00	
	1	15 (83.3)	3 (16.7)	6.88	1.81, 26.14	14.52	2.25, 94.02
	≥ 2	17 (94.4)	1 (5.6)	2.02	0.25, 16.14	1.97	0.05, 83.15
Geographical Region	North	197 (96.6)	7 (3.4)	1.00		1.00	
	Center	147 (98.0)	3 (2.0)	0.57	0.15, 2.26	0.56	0.14, 2.31
	Lisbon Metropolitan Area	167 (96.5)	6 (3.5)	1.01	0.33, 3.07	0.92	0.28, 2.99
	Alentejo	48 (98.0)	1 (2.0)	0.59	0.07, 4.88	0.56	0.06, 4.96
	Algarve	23 (88.5)	3 (11.5)	3.67	0.89, 15.18	3.00	0.62, 14.42
<i>Health Condition Auto-evaluation</i>							
Health Condition Classification	Very good	31 (91.2)	3 (8.8)	1.00		1.00	
	Good	200 (97.6)	5 (2.4)	0.26	0.06, 1.14	0.25	0.05, 1.21
	Reasonable	259 (97.4)	7 (2.6)	0.28	0.07, 1.14	0.29	0.06, 1.38
	Weak / Poor	73 (94.8)	4 (5.2)	0.57	0.12, 2.68	0.63	0.11, 3.82
	Very weak / Very poor	19 (95.0)	1 (5.0)	0.54	0.05, 5.61	0.31	0.02, 4.89
Diagnosis of Chronic Disease ^b	No	307 (97.2)	9 (2.8)	1.00		1.00	
	Yes	275 (96.2)	11 (3.8)	1.36	0.56, 3.34	1.32	0.47, 3.69

^aAdjusted for the effects of the other variables included in the table.

^b See supplementary table S1 for the effects of individual chronic diseases on VRH

OR = odds ratio; CI = confidence interval.

Table 2 shows that several perceptions, knowledge, and attitudes are strongly associated to a higher or lower predisposition to be vaccinated. For each point increase on the Likert scale, the probability of VHR increases by about 3-fold (OR=2.96, 95%CI 1.40 - 6.28) for "I am concerned about the vaccine's efficacy" and by more than 4-fold (OR=4.14, 95%CI: 2.08 - 8.22) for "I am concerned about the vaccine's possible side effects".

Table 2 also shows that being aware of the **benefits of receiving** the COVID-19 vaccine (S3–S6: knowledge about the serious complications that may arise from a COVID-19 infection (OR=0.16, 95%CI:0.07-0.38), the importance of vaccination to decrease the probability of being infected and suffering complications (OR=0.21, 95%CI:0.09-0.45 and OR=0.34, 95%CI:0.12-0.96, respectively), and the concerns about getting an infection (OR=0.14, 95%CI:0.06-0.32) has a significant inverse relationship with VHR probability. Hence, a 1-point increase of the Likert-scale reduces the probability of VHR.

Regarding the influence of the perceived quality of the **information disclosed** by participants, Table 2 shows that a 1-point increase in Likert scale in the statements "I believe that the information released on the social media is reliable" and "I believe that the information released by the competent authorities is reliable" decreases the propensity for VHR (OR=0.34, 95%CI:0.16-0.70, and OR= 0.34, 95%CI:0.17-0.69 respectively). Furthermore, a 1-point increase in the Likert scale decreases the probability of VHR by (OR = 0.39, 95%CI:0.20 - 0.75), in the case of being confident that the COVID-19 pandemic ends when most of the population gets vaccinated.

Table 2. Influence of the perceptions, knowledge, and attitudes of older adults (≥ 65 years old) on COVID-19 VHR. Adjusted Odds Ratio per 1-point in Likert scale of each perception, knowledge, and attitudes.

Statement	Valid N	Median	Adjusted analysis ^a	
			OR ^b	95% CI
S1. The probability of getting COVID-19 is high.	590	3	0.54	0.22 - 1.30
S2. I am concerned about the probability of getting COVID-19.	602	3	0.57	0.26 - 1.27
S3. The complications from COVID-19 are serious.	601	3	0.16	0.07 - 0.38
S4. The probability of being infected with COVID-19 decreases with vaccination.	588	3	0.21	0.09 - 0.45
S5. I feel less worried about being infected with COVID-19 if I get vaccinated.	589	3	0.14	0.06 - 0.32
S6. The probability of suffering complications from COVID-19 decreases with vaccination.	597	3	0.34	0.12 - 0.96
S7. I am concerned about the vaccine's efficacy.	600	2	2.96	1.40 - 6.28
S8. I am concerned about the vaccine's possible side effects.	601	2	4.14	2.08 - 8.22
S9. I will only get the vaccine when most of the population has taken it.	601	2	0.88	0.32 - 2.44
S10. I am concerned about the vaccine's manufacturer/country of origin.	600	2	1.19	0.52 - 2.71
S11. I will only get the vaccine if it is required to travel between countries.	602	2	0.73	0.24 - 2.28
S12. I will only get the vaccine if I obtain sufficient information.	602	3	0.61	0.25 - 1.48
S13. COVID-19 vaccination: I believe that the information released on the social media is reliable.	587	3	0.34	0.16 - 0.70
S14. COVID-19 vaccination: I believe that the information released by the competent authorities is reliable.	589	3	0.34	0.17 - 0.69
S15. I am confident that the pandemic will end when most of the population is vaccinated.	586	3	0.39	0.20 - 0.75
S16. Even after being infected with COVID-19, I must get the vaccine.	589	3	0.67	0.33 - 1.39
S17. If infected with COVID-19, I would like to take a test to check my acquired immunity.	590	3	0.77	0.34 - 1.73
S18. After taking the COVID-19 vaccine, I would like to take a test to check my acquired immunity.	588	3	0.46	0.21 - 1.01

^a These data are adjusted for the variables in which the analysis of the sociodemographic variables resulted in $p < 0.1$ (Family members < 18 years old).

^b OR indicates the increase/decrease in VHR (probability of not getting vaccinated or not having the intention to get the vaccine).

4. Discussion

With herd immunity elusive, vaccination constitutes the best defence against COVID-19 [29]. However, refusing vaccination may prevent COVID-19 vaccines from achieving sufficient immunisation coverage to end the global pandemic [30]. To our knowledge, this is the first study assessing the main perceptions, knowledge, and attitudes of the Portuguese older adults towards non-vaccination against COVID-19. As these are potentially modifiable variables, our results may aid in designing and developing educational interventions specifically targeted to reduce VHR among the older population.

The only determinant regarding the participants' sociodemographic characteristics which may likely influence vaccination intention, is having one family member aged less than 18 years old in the household. In these cases, older adults are 14.5 times more prone to refuse vaccination or having no intention to get the vaccine. Possible explanatory reasons may include the influence of the younger family members, as in another study assessing the factors associated with COVID-19 VHR in Portugal, a higher odds of vaccine refusal was also found for persons with school-age children at home [31]. Other reasons may be related to the lack of information on the vaccine benefits or perception of the information provided as inconsistent or contradictory among this group [31,32].

The analysis of the perceptions, knowledge and attitudes of the Portuguese older adults revealed an interesting series of factors that may have a positive effect on COVID-19 vaccination acceptance and intention, such as:

- knowing that the complications arising from a COVID-19 infection are serious (OR=0.16) (S₃)
- perceiving that vaccination decreases both the probability of getting a COVID-19 infection (OR=0.21) (S₄) and suffering from associated complications (OR=0.34) (S₆)
- feeling less worried about getting infected after taking the vaccine (OR=0.14) (S₅)
- and believing that vaccination can put an end to the pandemic (OR=0.39) (S₁₅).

These predictors of vaccination intent have been previously shown [33,34] and have demonstrated that people became more willing to accept the COVID-19 vaccine when the perception of the infection risk and disease severity increases. Another recent study has revealed that the intention to get the vaccine can also be associated to an interest in personal

protection and well-being against COVID-19 infection, particularly in low- to middle-income countries [35].

We found that the older population trusts the information released by the social media (OR=0.34) (S13) and competent national and international authorities (OR=0.34) (S14), leading to a decrease in VHR. In fact, social media has been widely used worldwide as the main source of COVID-19 information [9,36,37], hence being essential that it delivers trustful and evidence-based vaccine information, as extensive anti-vaccine content is frequently shared across social media, thus negatively impacting vaccination intention [9]. These results are in line with findings from similar studies where the competent authorities, such as the Centre for Disease Control and Prevention, WHO [38] and national health authorities [1], have been shown to be key drivers of COVID-19 vaccine acceptance, as the confidence in the endorsements by these organisations make the population more willing to take the vaccine.

A task force for COVID-19 vaccination has been coordinating the vaccination process since its beginning, defining priority groups and vaccines' distribution [39,40], and, by the beginning of October 2021, over 85% of the total Portuguese population was fully vaccinated [41], thus becoming the leading country in the world with the highest vaccination coverage rate [42]. Throughout the vaccination process, the media outlets disseminated the various statements released by the competent authorities daily, helping to disseminate reliable information among the population, namely those from the Directorate-General of Health representatives. However, it is important to emphasise that Portugal was already one of the countries with the highest influenza vaccine coverage in Europe, [43] - which may have had a role in the reduced number of vaccine-hesitant older adults. Thus, previous public health measures to enhance vaccine coverage regarding other infectious diseases, might have influenced the trust in the COVID-19 vaccine, when comparing vaccination coverage rates in other countries.

Our results also indicate that the two most important determinants for refusing or not having the intention to get the vaccine were the worries/concerns about its efficacy (OR=2.96) (S7) and perceived safety (OR=4.14) (S8). These findings are in agreement with previous studies performed in Portugal [31] and in other countries [10,35,36,44-47], where these same two factors were leading causes of VHR. A previous study with Swiss older adults shown that those unsure or against vaccination would rather prefer to maintain the protecting measures (hand hygiene and mask use) than be vaccinated [10]. Moreover, the rare but severe cases of thrombosis and concerns around potential increased risk of blood clots from the AstraZeneca vaccine may have also increased the older adults' VHR levels [35,44].

These results may impact the way we approach the problem of VHR in general, but particularly among older adults. As research on human coronaviruses suggests that lifetime immunity is unlikely [48,49], it becomes extremely important to combat VHR. This can be achieved by identifying the main factors associated to VHR, aiming to design and develop targeted vaccination campaigns or educational interventions, that should highlight the protection effects and other benefits provided by COVID-19 vaccines. The promotion of these interventions would be essential as they could lead to significant improvements in immunisation coverage rates. Strategies to enhance vaccine literacy and acceptance that directly focus on community-specific worries and needs to build confidence in different contexts, and educating the public about the need for universal vaccine coverage, should also take these findings into consideration [47].

The current research presents several strengths and limitations. The contribution of older adults with different health condition statuses provided diverse perceptions, knowledge, and attitudes about COVID-19 vaccination across different settings. Furthermore, perspectives from the study population were obtained from various parts of mainland Portugal, providing input from different geographical locations. CATI does not require literate participants and presents a high accuracy in data collection, at the same time as it makes the interviewing process much quicker [50,51].

Still, the interpretation of the results must be carefully considered since this is a cross-sectional study, where causal inferences cannot be drawn. Moreover, some vulnerable older adults may have been underrepresented, since the use of CATI to reach this target audiences is becoming more difficult, and our study did not include home resident older adults. Nevertheless, a 60% response rate has been achieved, being a very high response rate for this type of data collection [52]. Though we do not know the perceptions of 40% of the sample, which possibly affects the statistical representativeness of the sample, in terms of scientific research, and according to Rothman [53], the generalisation is not dependent on the statistical representativeness of the sample, but on the mechanisms implied in the detected association of the phenomenon under study [53–55]. Another limitation of our study is that, when data were collected – and for confidentiality reasons -, only two groups (65-79 and +80) were considered. One might think that this could be a limitation as we do not have enough data to compare with the Portuguese population over 65 years old. Still, as the main objective of our study is to assess the impact of knowledge, perceptions, and attitudes on VHR, and since the relationship between the exposure and the effects remains unchanged by the representativeness of the sample, we

believe that if there is a lack of representativeness by age, it would not affect the conclusions of this study [56]. In our case, although our sample may not be representative of the Portuguese older population, our main goal was to assess the mechanism underlying the influence of the perceptions, knowledge, and attitudes on COVID-19 VHR, so this should not be seen as an important study limitation [53–55]. Still, we cannot fully exclude the possibility of a response bias, neither assure that every determinant of VHR has been identified, as there were only 20 respondents who were vaccine-hesitant.

However, though the number of people with hesitancy for COVID-19 vaccination is quite small and represents only 3% of the responders, which can be seen as a limitation, we believe that, though 3% of vaccination hesitancy is low in relative terms, it is very high in absolute terms (as there are ~68,000 over 65 years old in Portugal, a country with ~10.3 M inhabitants). This is a very high figure for a group so vulnerable and under extremely high risk, as these older adults are unprotected and depend entirely on the immunity of the rest of the population and on non-pharmacological measures, such as social distancing and masks.

Although the applicability of the results of a knowledge, attitudes, and perceptions study such as ours to different settings can be affected by factors dependent on the environment (such as health system of health authorities and even cultural factors), we have observed a high consistency of the knowledge, attitudes, and perceptions' determinants between settings [57–62].

Although these findings were specific to the population under study, - and therefore may not be reproducible in different settings - we believe that the mechanisms underlying the influence of the perceptions, knowledge, and attitudes on COVID-19 VHR would possibly be very similar in other contexts. Finally, it is important to consider that the COVID-19 pandemic has been highly dynamic, and so has been the vaccination process and the discoveries throughout this period – namely the knowledge regarding side effects and vaccines' effectiveness. Thus, as the telephone interviews conducted only for two months, we cannot assure that vaccination hesitancy rates would be the same as those in past or future moments, nor the perceptions associated.

5. Conclusions

The results of this study suggest that the main predictors of VHR among the Portuguese older adults are modifiable factors, namely misbeliefs about the efficacy and safety of COVID-19 vaccination. Hence, this study provides useful insights on the main determinants influencing

COVID-19 vaccination among older adults, particularly the major perceptions, knowledge, and attitudes associated to non-vaccination, which should be considered in further research and vaccination campaigns to help mitigate VHR.

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