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Vaccine refusal and hesitancy in Spain: an online cross-sectional questionnaire

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Abstract

Background Vaccine refusal and hesitancy represent a crucial challenge to public health, causing delays in vaccination and compromising herd immunity.

Methods To address this issue, we conducted a comprehensive observational study on the adult Spanish population in 2021. Using an online questionnaire, we examined the sociodemographic and sociocultural factors, beliefs, and opinions of those refusing or hesitant about vaccines, as well as their vaccination behaviors by vaccine type and sex.

Results There were 1,312 respondents: 74.5% were female, 73.7% were between 31 and 59 years old, and 71.0% had university studies. Our findings revealed that vaccine refusal rates were relatively low (16.8%), and mainly associated with influenza vaccination (10.3%). Higher refusal rates were observed in those over 60 years old, those expressing hesitancy due to vaccine components, those opposing free and compulsory vaccination, those unaware that vaccination protects the community, and those against consuming cow's milk and using infant formulas for breastfeeding. Vaccine hesitancy was greatest in individuals under 31 years old, women, parents of children under 15 years old, against compulsory vaccination, unaware that vaccination protects the community, with hesitancy due to vaccine costs, and in favour of alternative and complementary treatments.

Conclusions These insights highlight the need for strategies to improve education about vaccination and dispel misconceptions, which are crucial for effectively reducing vaccine refusal and hesitancy across the population.

Keywords Anti-vaccination movement, Anti-vaccine, Vaccination refusal, Vaccine hesitancy

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Background

Vaccination is a cost-effective public health measure that can prevent the spread of diseases and reduce the morbidity burden [1]. High vaccine uptake leads to a decline in the prevalence of vaccine-preventable diseases (VPDs) [2]. Vaccines are safe and effective and, although like medication they can cause adverse effects, these adverse effects are outweighed by individual and collective benefits [1, 3].

The Strategic Advisory Group of Experts (SAGE) Working Group on Vaccine Hesitancy, concluded that vaccination hesitancy refers to delay or refusal of vaccination despite the availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience and confidence [4]. Declines in vaccination present threats to herd immunity [5].

According to the World Health Organization (WHO), 1.5 million child deaths from VPDs occur every year worldwide This is partly due to problems of access to vaccines for socio-economic reasons, and partly to vaccination hesitancy generated by the rise of anti-vaccine movements [6, 7]. Vaccination hesitancy is considered a priority line of action for the WHO and a challenge for those countries working to close the immunisation gap [8, 9].

The SAGE Group noted that the Vaccine Hesitancy Determinants Matrix displays the factors influencing the behavioural decision to accept, delay or reject some or all vaccines under three categories: contextual, individual and group, and vaccine/vaccination-specific influences [4]. A publication analysing the psychological factors that might motivate people in 25 countries to refuse vaccination showed that the best predictors of refusal were the following: high levels of conspiracy beliefs, low tolerance of perceived infringement of personal freedom, aversion to needles or blood, and religious beliefs [10]. Another review highlighted the complexity of factors related to acceptance or refusal of vaccines including demographic factors (ethnicity, age, sex, pregnancy, education, and employment), accessibility and cost of vaccines, personal responsibility and risk perceptions, trust in healthcare authorities and vaccines, safety and efficacy of new vaccines, and lack of information or misinformation [11].

In Spain, vaccination coverage is high but varies depending on the vaccine. Vaccination is offered by the national public health system, and most vaccines are provided free of charge and administered primarily in primary care settings, with minor differences between autonomous communities. Data published by the Spanish Ministry of Health in 2022 showed a slight increase from the previous year in primary vaccination coverage (Polio, DTaP, Hib, Hepatitis B, Meningococcus C, Pneumococcus), as evidenced by the percentage of the population receiving the second dose of the hexavalent vaccine (DTaP, Hib, Hepatitis B) increasing from 96.8% in 2021 to 97.6% in 2022. However, coverage of two doses of the Measles, Mumps, and Rubella (MMR) vaccine in 2022 was 92.6% which did not meet the target coverage of ≥95% needed to keep measles' elimination status, even if coverage was achieved considering only one dose. After the positive effect of the COVID-19 pandemic on influenza vaccine coverage, there was a decreasing trend in influenza vaccine coverage in all population groups, while remaining higher than pre-pandemic levels [12].

Vaccine hesitancy had been previously studied in Spain in specific groups such as healthcare professionals (HCPs) and epidemiologists, so we consider it interesting to study it in the general population [13, 14]. Our study aimed to characterise the profile of the Spanish population with vaccination refusal specifically and hesitancy in general, to inform and support the development of educational and communication strategies aimed at improving vaccination coverage. With this objective, we used an online questionnaire to describe the socio-demographic and sociocultural characteristics, beliefs and opinions of those refusing to have vaccine and those with hesitancy about vaccination, and their vaccination behaviours by vaccine type and sex.

Methods

Study design

We conducted an observational, cross-sectional study on individuals accessing an online survey from March to December 2021. The inclusion criteria required participants to be aged 18 years or older and to have the authority to make vaccination decisions for themselves or others in Spain.

We obtained the information through an online, self-administered questionnaire designed by the project research team. A pilot test was performed before the definitive questionnaire was obtained. To ensure the rigor and validity of the study, an experienced research team with expertise in conducting surveys was involved, thereby guaranteeing the quality and reliability of the instrument. Both were registered on a Research Electronic Data Capture (REDCap) web platform stored on a centralized server where the data remain securely in the custody of the Institut Català de la Salut [Catalan Institute of Health]. Anonymous information was exported to the statistical packages used for later analysis. The REDCap platform generated a link [15] for participation in the survey that was disseminated through scientific societies, social networks, research institutes, paediatricians, and nurses in primary care. (Supplementary Material S1)

Variables

The main variables of the questionnaire were: sociodemographic factors (sex, age, having children under 15 years old, level of education); sociocultural factors (religious beliefs, culture, family); vaccine information variables (whether they have refused any vaccines and, in that case, the type of vaccine refused; who the refused vaccine was for; hesitancy due to vaccine components, associated diseases or to the payment of vaccines; whether they know that personal vaccination protects other people whether they would be in favour of free and compulsory vaccination; opinion about vaccines), variables of trust in the health system (sources of information about vaccines, whether HCPs can understand anti-vaccine arguments, whether HCPs have enough information to satisfy anti-vaccine people, whether when in doubt about vaccines they will consult the HCP); habits (type of diet, consumption of cow's milk, opinion on breastfeeding or artificial breastfeeding, opinion on alternative treatments or complementary treatments).

Statistical analysis

The data were gathered in an anonymized database using the REDCap platform. We conducted a descriptive analysis of the findings, categorizing qualitative or ordinal data using absolute and relative frequencies. In the statistical analysis, only complete cases were considered, and missing values were assumed to be missing at random. We evaluated the relative frequency of the categorical variables using the Chi square test or Fisher's exact test and identified the variables that were both statistically significant and clinically relevant. In selected subgroups of interest, we identified the factors independently associated with these results. The relationship between the variables is quantified using Odds Ratios (ORs), with 95% confidence interval (CI) estimates, as a measure of association for risk. We used logistic regression to identify which factors are independently linked to vaccination refusal or to hesitancy due to vaccine components or diseases that have been associated to being vaccinated. We employed a stepwise conditional variable recall model that retains variables at an adjusted p-value of <0.05 and excludes variables with a value >0.10. This included factors that were statistically significant in our initial comparisons of two variables at a time. We report the likelihood of these factors as ORs and their statistical significance (as adjusted p-values), using a cut-off of $p<0.05$ to define statistical significance. All analysis was conducted using SPSS software version 26.0.

Ethical considerations

This study was approved by the ethics and clinical Research Committee of the Fundació Institut Universitari per a la Recerca a l'Atenció Primària de Salut Jordi Gol i Gurina (IDIAPJGol), with code 20/221-P. The study was conducted following the principles of the Declaration of Helsinki. The variables collected were treated anonymously to guarantee the confidentiality of the data, as established in Regulation (EU) 2016/679 of the European Parliament and the Council of April 27 on Data Protection (RGPD) and the Spanish Organic Law 3/2018, of the 5th December 2018, regarding the protection of personal data and guarantees of digital rights. The database is kept by the principal investigator and the research team in an Excel format, protected by password access. An anonymized database was used for the analysis. Before conducting the survey, online informed consent was completed, accepted, and signed.

Results

Description of the study population and percentages of vaccine refusal and hesitancy (Table 1)

A total of 1,312 individuals participated in the survey, of whom 74.5% were female and 25.5% male. Regarding age distribution, 14.0% were under 31 years old, 73.7% were between 31 and 59, and 12.4% were over 59. University education was reported by 71.0% of respondents.

Among all respondents, 1,294 answered the question on vaccine refusal, with 16.8% (218/1,294) reporting having refused at least one vaccine. The most frequently refused vaccines were influenza (61.9%), followed by tetanus (18.3%) and HPV (16.1%). Additionally, among vaccines not funded by the Spanish Health System in 2019, 11.0% of respondents refused the rotavirus vaccine, 8.3% refused meningococcus B, and 6.9% refused meningococcus ACWY.

Regarding the number of vaccines refused, 66% of respondents who had refused vaccines rejected only one, while 34% refused two or more. In terms of for whom vaccines were refused, the majority (73.4%) had refused vaccines for themselves, while 34.4% refused them for their children and 3.7% for their parents or others.

Vaccine hesitancy was primarily linked to concerns about vaccine components (28.1%), perceived associations with diseases (30.9%), and vaccine costs (29.0%). Overall, 76.1% of respondents expressed strong support for vaccines, while a small proportion were neutral or expressed slight (3.4%) or strong (1.3%) disagreement.

Socio-demographic and Sociocultural characteristics, beliefs, and opinions of the population who refused vaccines

Vaccine refusal was associated with older age (≥ 60 years) (OR = 2.11, 95% CI: 1.22–3.72, $p=0.008$), a cultural and familial background against vaccination (OR = 4.74, 95% CI: 2.26–9.74, $p<0.001$), and hesitancy due to vaccine components (OR = 0.39, 95% CI: 0.29–0.52, $p<0.001$) or vaccine-associated diseases (OR = 0.45, 95% CI:

Table 1 Description of the study population

Sociodemographic data	**Total** ***N*** **= 1312**		***Responders to Q25** ***n*** **= 1294**		**Refusers** ***n*** **= 218**	
Sex:						
Men	326 (25.5%)		325 (25.5%)		53 (24.5%)	
Women	954 (74.5%)		952 (74.5%)		163 (75.5%)	
Age:						
30 years old or less	180 (14.0%)		180 (14.0%)		25 (11.6%)	
31–59 years old	948 (73.7%)		947 (73.8%)		151 (69.9%)	
60 years old or more	159 (12.4%)		157 (12.2%)		40 (18.5%)	
University degree:						
No	374 (29.0%)		372 (28.9%)		58 (26.7%)	
Yes	915 (71.0%)		914 (71.1%)		159 (73.3%)	
Parental Status: Presence of children under 15 years old						
Yes	604 (46.9%)		603 (46.9%)		106 (48.6%)	
No	685 (53.1%)		683 (53.1%)		112 (51.4%)	
Religious beliefs:						
Supportive of vaccination	467 (35.6%)		466 (36.0%)		51 (23.4%)	
Opposed to vaccination	6 (0.5%)		6 (0.5%)		2 (0.9%)	
No opinion	237 (18.1%)		220 (17.0%)		61 (28.0%)	
Non-believer	494 (37.7%)		494 (38.2%)		92 (42.2%)	
Uncertain	108 (8.2%)		108 (8.3%)		12 (5.5%)	
Cultural Stance on Vaccination:						
Supportive of vaccination	1111 (84.7%)		1109 (85.7%)		161 (73.9%)	
Opposed to vaccination	14 (1.07%)		14 (1.08%)		9 (4.13%)	
No opinion	128 (9.76%)		112 (8.66%)		36 (16.5%)	
Uncertain	59 (4.50%)		59 (4.56%)		12 (5.50%)	
Family Stance on Vaccination:						
Supportive of vaccination	1165 (88.8%)		1163 (89.9%)		164 (75.2%)	
Opposed to vaccination	32 (2.44%)		32 (2.47%)		14 (6.42%)	
No opinion	90 (6.86%)		74 (5.72%)		31 (14.2%)	
Uncertain	25 (1.91%)		25 (1.93%)		9 (4.13%)	
Vaccination Attitudes and Behaviors	**Total** *N* = 1312		***Responders to Q25** *n* = 1294		**Refusers** *n* = 218	
Vaccine Refusal History: Has refused at least one vaccine	218 (16.8%)	1294	218 (16.8%)	1294	218 (100%)	218
Type of Vaccine Refused:						
Diptheria	15 (1.14%)	1312	15 (1.16%)	1294	15 (6.88%)	218
Influenza	135 (10.3%)	1312	135 (10.4%)	1294	135 (61.9%)	218
Haemophilus influenzae type B	8 (0.61%)	1312	8 (0.62%)	1294	8 (3.67%)	218
Hepatitis A	18 (1.37%)	1312	18 (1.39%)	1294	18 (8.26%)	218
Hepatitis B	28 (2.13%)	1312	28 (2.16%)	1294	28 (12.8%)	218
Meningococcus ACWY (Nimenrix®, Menveo®)	15 (1.14%)	1312	15 (1.16%)	1294	15 (6.88%)	218
Meningococcus B (Bexero®, Trumemba®)	18 (1.37%)	1312	18 (1.39%)	1294	18 (8.26%)	218
Meningococcus C	12 (0.91%)	1312	12 (0.93%)	1294	12 (5.50%)	218
Pneumococcus	15 (1.14%)	1312	15 (1.16%)	1294	15 (6.88%)	218
Polio	15 (1.14%)	1312	15 (1.16%)	1294	15 (6.88%)	218
Rotavirus (Rotarix ®, Rotateq®)	24 (1.83%)	1312	24 (1.85%)	1294	24 (11.0%)	218
Tetanus	40 (3.05%)	1312	40 (3.09%)	1294	40 (18.3%)	218
Whooping cough	14 (1.07%)	1312	14 (1.08%)	1294	14 (6.42%)	218
Triple vírica (MMR))	22 (1.68%)	1312	22 (1.70%)	1294	22 (10.1%)	218
Papilloma virus HPV	35 (2.67%)	1312	35 (2.70%)	1294	35 (16.1%)	218
Varicella	31 (2.36%)	1312	31 (2.40%)	1294	31 (14.2%)	218

Table 1 (continued)

Sociodemographic data	Total *N* = 1312		*Responders to Q25 *n* = 1294		Refusers *n* = 218	
I do not remember	37 (2.82%)	1312	37 (2.86%)	1294	37 (17.0%)	218
Number of vaccines refused	0.37 (1.54)	1312	0.37 (1.55)	1294	2.21 (3.19)	218
Vaccine Refusal for Specific Individuals						
Son(s) and/or Daughter(s)	75 (5.72%)	1312	75 (5.80%)	1294	75 (34.4%)	218
Parents	8 (0.61%)	1312	8 (0.62%)	1294	8 (3.67%)	218
Self	160 (12.2%)	1312	160 (12.4%)	1294	160 (73.4%)	218
Others	8 (0.61%)	1312	8 (0.62%)	1294	8 (3.67%)	218
Hesitancy Due to Vaccine Components: Presence of doubts due to components such as thiomersal, aluminum, mercury, or formaldehyde	362 (28.1%)	1287	359 (28.0%)	1284	99 (45.4%)	218
Hesitancy Due to Vaccine-Associated Health Risks: Presence of doubts due to associations with diseases such as cancer, allergies, autism, sudden infant death syndrome, multiple sclerosis, asthma, or immune system alterations	399 (30.9%)	1290	398 (30.9%)	1288	101 (46.3%)	218
Hesitancy Due to Vaccine Cost: Presence of doubts due to the necessity of paying for certain vaccines	374 (29.0%)	1288	373 (29.0%)	1286	68 (31.8%)	214
Agreement with Vaccination		1291		1288		214
Totally agree	982 (76.1%)		982 (76.2%)		112 (52.3%)	
Somewhat agree	216 (16.7%)		215 (16.7%)		60 (28.0%)	
Neutral	32 (2.48%)		32 (2.48%)		13 (6.07%)	
Somewhat disagree	44 (3.41%)		43 (3.34%)		18 (8.41%)	
Totally disagree	17 (1.32%)		16 (1.24%)		11 (5.14%)	

[1]Responded to the question of whether they had ever refused a vaccine

Sum of percentages might be slightly different from 100 because of roundings

Table 2 Dependent variable: refusal of vaccination

Significant independent variable	*p*-value	OR	95% CI OR inf	95% CI OR sup
Age group				
30 years old or less	0.004	0.403	0.219	0.742
31–59 years old	0,001	0.491		
60 years old or more	Ref	Ref		
Knowledge of protecting more people	0.005	0.390	0.202	0.754
Desire for free and compulsory vaccination	0.000	0.278	0.200	0.386
Hesitancy due to vaccine components	0.003	1.676	1.195	2.352
Opinion on use of infant formula	0.069	0.684	0.454	1.030
Opinion on consumption of cow's milk	0.021	0.607	0.397	0.929
Constant	0.005	3.521		

0.33–0.60, $p < 0.001$). Vaccine refusers were also less aware of community-wide benefits (OR = 4.52, 95% CI: 2.48–8.16, $p < 0.001$) and more likely to oppose free and compulsory vaccination (OR = 4.60, 95% CI: 3.39–6.26, $p < 0.001$) (Tables A1 and A2).

Additionally, vaccine refusers showed lower trust in HCPs and healthcare websites as sources of vaccine information, relying more on friends. They perceived HCPs as uninformed on vaccine hesitancy (OR = 1.74, 95% CI: 1.29–2.34, $p < 0.001$) and were unlikely to consult them for vaccine-related concerns (OR = 4.46, 95% CI: 2.71–7.29, $p < 0.001$) (Table A2). Lifestyle factors, such as opposition to cow's milk consumption (OR = 3.41, 95% CI: 1.79–6.30, $p < 0.001$), using infant formula instead of breastfeeding (OR = 6.16, 95% CI: 3.02–12.5, $p < 0.001$), and support for alternative medicine, were also linked to increased vaccine refusal (Table A2).

The multivariate logistic regression analysis (Table 2) confirmed that individuals aged 60 years or older, those hesitant due to concerns about vaccine components (OR: 1.676; $p = 0.003$), those opposed to free and compulsory vaccination (OR: 0.278; $p < 0.000$), those unaware that vaccines protect the community, and individuals who opposed consuming cow's milk and the use of infant formulas were independently associated with vaccine refusal (Table 2).

Socio-demographic and sociocultural characteristics, beliefs and opinions of the population with hesitancy due to vaccine components, associated diseases, or payment

Women (OR: 1.55; 95% CI: 1.15–2.10; $p = 0.004$), parents with children under 15 years old (OR: 0.74; 95% CI: 0.58–0.95; $p = 0.018$), and individuals with a cultural background (OR: 7.48; 95% CI: 2.44–28.3; $p < 0.001$) or family opposed to vaccination (OR: 3.83; 95% CI: 1.88–7.98; $p < 0.001$) were more likely to express hesitancy due to concerns about vaccine components. Additionally, hesitancy related to vaccine-associated diseases was more

Table 3 Dependent variable: hesitancy due to vaccine components or associated diseases

Significant independent variables	*p*-value	OR	95%CI OR Inf	95% CI OR Sup
Age group				
30 years old or less	0.190	1,384	0.851	2.253
31–59 years old	0.093	0.695	0.454	1.062
60 years old or more	Ref	Ref		
Gender (binary)	0.009	1.494	1.104	2.023
Children under 15 years old	0.006	0.669	0.502	0.891
Knowledge of protecting more people	0.019	0.418	0.202	0.864
Desire for free and compulsory vaccination	0.000	0.436	0.331	0.573
Hesitancy due to payment for a vaccine	0.000	0.459	0.351	0.600
Opinion on vaccination	0.002	0.307	0.148	0.637
Use of alternative treatments	0.000	0.488	0.350	0.680
Use of complementary treatments	0.001	1.549	1.183	2.029
Constant	0.000	41.261		

frequent in individuals under 30 years old, women, those without a university education (OR: 0.73; 95% CI: 0.57–0.95; $p = 0.018$), parents of children under 15 years old, and those influenced by a cultural background or family opposed to vaccination (Table A1).

Individuals expressing hesitancy due to vaccine components (Table A3) or vaccine-associated diseases (Table A4) were also more likely to be hesitant about vaccine payment (OR for component-related hesitancy: 0.41; 95% CI: 0.32–0.53; $p < 0.001$, and OR for disease-related hesitancy: 0.46; 95% CI: 0.36–0.59; $p < 0.001$). They were less likely to be aware that individual vaccination protects the community (OR for component-related hesitancy: 3.50; 95% CI: 1.95–6.36; $p < 0.001$, and OR for disease-related hesitancy: 5.25; 95% CI: 2.86–10.1; $p < 0.001$) and were less supportive of free and compulsory vaccination (OR for component-related hesitancy: 3.11; 95% CI: 2.41–4.02; $p < 0.001$, and OR for disease-related hesitancy: 2.63; 95% CI: 2.05–3.38; $p < 0.001$). Their preferred sources of information were social networks, family, and friends, and they exhibited a lower level of trust in HCPs. Many of these individuals considered HCPs as uninformed on vaccine hesitancy and were unlikely to consult them for vaccine-related concerns (OR for component-related hesitancy: 4.39; 95% CI: 2.72–7.20; $p < 0.001$, and OR for disease-related hesitancy: 3.69; 95% CI: 2.28–6.05; $p < 0.001$).Hesitancy was also more frequent among respondents who opposed vaccines, the use of infant formula, and the consumption of cow's milk (OR for component-related hesitancy: 4.26; 95% CI: 2.37–7.64; $p < 0.001$, and OR for disease-related hesitancy: 3.72; 95% CI: 2.09–6.65; $p < 0.001$), as well as those who did not follow a Mediterranean diet and favored alternative and complementary treatments (Tables A3 and A4).

Multivariate logistic regression identified significant independent associations between hesitancy due to vaccine components or vaccine-associated diseases and certain demographic and behavioral factors. Specifically, hesitancy was higher among individuals under 30, women (OR: 1.494; $p = 0.009$), parents of children under 15 (OR: 0.669; $p = 0.006$), those unaware that vaccination protects the community (OR: 0.418; $p = 0.019$), those opposed to free and compulsory vaccination (OR: 0.436; $p < 0.001$), and those hesitant about vaccine payment. Support for alternative (OR: 0.488; $p < 0.001$) and complementary treatments (OR: 1.549; $p = 0.001$) was also independently associated with vaccine hesitancy (Table 3).

Hesitancy due to vaccine payment was more prevalent among individuals younger than 30 years old, those without a university degree, and parents with children under 15 years old (Table A1). Those who opposed free and compulsory vaccination (OR: 1.48; 95% CI: 1.15–1.91; $p = 0.003$) and considered friends to be reliable sources of vaccine information (OR: 2.65; 95% CI: 1.45–4.86; $p = 0.002$) were also more likely to exhibit hesitancy related to vaccine cost. Individuals with vaccine payment hesitancy were more likely to report that HCPs were uninformed on vaccine concerns (OR: 1.44; 95% CI: 1.12–1.85; $p = 0.004$) and demonstrated higher levels of vaccine skepticism and were in favour of alternative treatments (Table A5).

Vaccination behaviours by vaccine type and sex

Individuals aged 60 years or older exhibited a higher refusal rate for influenza and tetanus vaccines. Men were more likely to refuse tetanus vaccines (OR: 0.33; 95% CI: 0.17–0.62; $p = 0.001$), whereas university students demonstrated greater refusal of rotavirus vaccines. Parents with children under 15 years of age displayed a higher refusal of Haemophilus influenzae type B, Meningococcal B, and Rotavirus vaccines (Table A6).

Women exhibited greater hesitancy regarding the vaccination of their children (OR: 1.97; 95% CI: 1.06-4.00; $p = 0.030$) and expressed more concerns about vaccine components or related diseases, particularly those without children under 15 years of age. Men were more likely to disagree with vaccines in general and tended to rely more on social networks, television, and radio for vaccine-related information. In contrast, women preferred complementary treatments and considered health websites more reliable sources of vaccine information (Tables A7 and A8).

Discussion

In our study, we found that respondents generally favored vaccination, with a refusal prevalence of 16.8%. This rate aligns with published data on the intention to refuse the COVID-19 vaccine in the Catalan population during the same year as the study. This indicates that the vaccine hesitancy observed in our sample is consistent with broader regional trends. Additionally, within this inquiry, we detected an increase in doubts about vaccines as a result of the pandemic [16], which mirrors global trends of heightened vaccine skepticism fueled by misinformation and rapidly evolving scientific guidelines during the COVID-19 crisis.

Although official data on vaccine rejection are not available to us, we do have official records from the Spanish Ministry of Health outlining vaccine acceptance trends [12]. These records evince that vaccination coverage rates in Spain for the years 2021 and 2023 remained comparably stable. Notably, in 2024, a marginal augmentation in vaccination coverage for MMR and hexavalent vaccines was observed. This suggests a positive trend in the uptake of these essential vaccines, possibly due to public health campaigns and increasing public awareness of the benefits of vaccination. However, this positive trend was contrasted by a diminished coverage for influenza compared to the year 2021 [12]. Therefore, we believe the data on hesitancy and refusal of vaccination could be valuable in the current scenario of vaccination in Spain in 2024, as it highlights areas needing targeted interventions to improve vaccine uptake and address ongoing public concerns about vaccine safety and efficacy.

The SAGE Vaccine Hesitancy Working Group categorize vaccine hesitancy using a matrix of contextual influences, individual/social influences, and vaccine and vaccination specific issues [4, 17].

Our study delved into several contextual influences, particularly focusing on the sociodemographic and sociocultural characteristics of the population. Analysis of respondent age revealed higher rates of vaccine refusal among those over 60 years old. This does not coincide with previous findings from other studies, where a greater likelihood of vaccination was detected in older people because of increased health concerns and susceptibility to illness [11, 18–21]. We believe that the reason for this finding may stem from the significant rejection in our older population of the influenza vaccination, which is primarily targeted at people over 65 years old or with underlying pathologies in Spain, and from the difficulties already described in previous publications to achieve satisfactory vaccination coverage against influenza [21–24]. We also detected greater hesitancy among people under 30 years old, particularly due to concerns about diseases associated with vaccines and the cost of vaccines. This finding is consistent with previously published studies [11, 18–21, 25] and underscores the need for vaccination campaigns tailored to specific age groups, addressing their unique concerns and barriers.

When considering sex, our study revealed that women and parents with children under 15 years old, showed greater hesitancy due to the components of vaccines or diseases that have been associated with vaccines. Greater doubts were detected in women without children under 15 years old than in men. Moreover, women were more likely to refuse vaccines for their children, aligning with previous studies, which show a greater predisposition to vaccination in men than in women, and less acceptance and greater hesitancy in parents [11, 18, 26, 27]. Concretely, women with young children are more concerned about vaccinating their children, necessitating targeted strategies to bolster the trust and confidence, as previously proposed [11, 18, 27, 28].

Regarding education level, individuals without a university education exhibited greater hesitancy due to associated diseases or vaccine payment. This aligns with published studies that show that the higher the level of education, the greater the acceptance of vaccines [11, 18, 20, 23, 29].

Cultural, religious, and family beliefs emerged as influential factors associated with hesitancy and decision about vaccination, with a greater predisposition to get vaccinated if the sociocultural environment is provaccine. These results echo findings from prior studies [3, 10, 18].

It is essential to note that sociodemographic factors, do not act in isolation but interconnect with a range of contextual, individual, and vaccine-specific influences, as highlighted in the WHO 3 C model (confidence, complacency, and convenience) [4, 7, 17].

In terms of political and policy-related contextual influences, most respondents favoured free and compulsory vaccination, except those who refused vaccines or expressed hesitation because of components, associated diseases, or payment for vaccines. Although in recent years there has been growing traction for anti-vaccine movements, most of the population seems to be in favour of compulsory vaccination policies, as evidenced in a 2019 review. Moreover, it seems that support towards mandatory policies increases after their implementation [30]. Nonetheless, efforts to improve vaccine acceptance, such as enhancing education and providing proof of the efficacy, benefits and safety of vaccines, remain crucial [31].

We observed greater vaccine refusal and hesitancy among individuals who deemed health professionals or websites unreliable sources of vaccine information, while considering friends, family, or social networks as reliable sources. These results reinforce previous publications which stated that the crisis in the vaccination system and

the resurgence of anti-vaccine movements are due to the increased accessibility of information and the reduced credibility of HCPs [5, 32]. Exposure to anti-vaccine content on social media was associated with refusal and hesitancy to vaccinate [33–37], highlighting the critical need to combat misinformation to mitigate its effects [35, 36].

Our study also suggests that a lack of trust in HCPs is associated with greater vaccine refusal and hesitancy. This aligns with existing reviews and published studies that conclude that vaccine safety and trust in health authorities are the main factors in promoting vaccine acceptance [11, 38]. According to the WHO's "3Cs" model, confidence in vaccines and in the healthcare system constitute one of the three main determinants of vaccine hesitancy [4, 7, 17].

We detected a greater refusal of the vaccines for influenza, tetanus, papilloma, and varicella (chicken pox). Mostly individuals refused vaccines for themselves and, to a lesser extent, their children. These findings mirror other international studies which highlight the difficulties in achieving satisfactory vaccination coverage for influenza and papillomavirus [31, 36, 39]. Data published by the Spanish Ministry of Health also corroborate these difficulties in vaccination coverage for influenza, papilloma, and varicella in 2021–2022. In Spain, the recommendation to maintain vaccination coverage ≥ 95% for MMR vaccination in 2021–2022 was not achieved [12] and the goal of maintaining measles and rubella elimination status was not met [40]. Again, although there are high coverage rates for tetanus in primary vaccination with the hexavalent vaccine, vaccination coverage with Td decreases in adolescents [12]. In our study, we found a greater refusal of tetanus vaccine than the diphtheria vaccine, although tetanus and diphtheria vaccines are usually administered together. We attribute this difference and other similar ones to a possible lack of knowledge of the vaccination schedule in our reference population or to a greater popular knowledge of tetanus vaccine because of its indication for administration in certain wounds.

Our study revealed a relationship between having hesitancy due to vaccine components and refusing a vaccine. It also showed that having hesitancy due to vaccine components or associated diseases were associated with hesitancy due to vaccine payment. Earlier research has found that accessibility and cost, along with safety and efficacy were reasons for hesitancy [11, 17, 41]. In most Spanish autonomous communities, the Meningococcal ACWY and Meningococcal B vaccines are now part of the public vaccination schedule and thus should no longer be a reason for hesitancy because of costs in these cases [42].

Collective responsibility was assessed and greater refusal and hesitancy was detected in respondents who were unaware that individual vaccination protects the community. The concept of collective responsibility was one of five factors that affect people's perception of vaccines, along with confidence (trust in vaccine efficacy and safety), complacency (perception about the risk of the disease), calculation (weighing the risks and benefits of vaccines) and constraint (accessibility of information about the vaccine). These are part of the 5Cs model [41], which extends from the 3 C model introduced by the WHO SAGE Working group [4].

We intended to study the profile of the local population with vaccine hesitancy and we observed heightened hesitancy among people who disagreed with cow's milk consumption or the use of infant milk formulas, and those who adhered to a non-Mediterranean diet or favoured alternative or complementary treatments for healthcare. This profile of a population with a preference for natural therapies, skepticism towards established scientific positions, and greater reticence towards healthcare systems and HCPs, seems to be the profile of vaccine hesitancy detected in primary care. There is existing literature demonstrating that some individuals tend to reject vaccines due to a philosophy that values what is "natural" and perceives vaccines as toxic. These individuals often prefer alternative treatments, which they consider safer and more natural [43–45]. Additionally, some studies highlight a tendency in certain demographic groups to view cow's milk as less natural, particularly in comparison to plant-based alternatives [46–48]. In another study published in the UK in the same year, rejection and hesitancy towards vaccination were also associated with low confidence in the health service [25]. To address vaccine hesitancy, we urge institutions and governmental bodies to seek strategies to enhance trust in HCPs, public health systems, authorities, and health policies. Encouraging shared participation in the formulation of vaccine recommendations is paramount [38]. Additionally, as previously suggested by some authors, novel approaches such as analysing population opinions on vaccination through social networks using artificial intelligence to complement traditional survey methods, can provide a more comprehensive understanding of vaccine refusal and hesitancy dynamics and allow targeted interventions. Such initiatives can facilitate effective engagement with diverse communities and foster informed decision-making regarding vaccination [34, 49–52].

One of the limitations of this study is the inherent recruitment bias associated with the online survey method, which restricted participation to individuals with internet access. This can produce selection bias problems because there are different probabilities of being involved in the study depending on where people live, their level of education, and their age. Therefore, this may hinder the generalization of the results. However, given that 96.1% of Spanish households have internet access and 85% of Spaniards are users of social

networks [53, 54], the reach of our survey remains substantial. Another possible limitation is potential respondent repetition, although, we anticipate minimal impact on the final results because of expected low rate of repetition. Additionally, our sample skewed towards women and people with a university education, this could limit the interpretation and generalization of our study to the broader population. Additionally, the timing of the survey, conducted during the COVID-19 pandemic, may have influenced participants' attitudes and perceptions due to heightened skepticism and rapidly evolving vaccination policies. However, vaccination coverage rates in Spain for the years 2021 and 2023 remained comparably stable, the insights into hesitancy and refusal may still be valuable for understanding the current vaccination scenario in Spain in 2024. The self-reported nature of the survey introduces the possibility of recall bias, particularly regarding vaccine refusal, as participants may not have accurately recalled all instances of refusal. Finally, reaching the anti-vaccine population posed challenges, as interactions with these groups is difficult. To mitigate eventual bias deriving from this, in our sample size calculation, we considered that the proportion of antivaccine responses would be much lower than the proportion of pro-vaccine responses. Despite these limitations, our study provides valuable insights into vaccine refusal and hesitancy, but caution is warranted in extrapolating findings to the entire population.

Conclusions

Vaccination refusal in our surveyed population was low and mainly related to refusal of influenza vaccination, although hesitancy arguments related to vaccine safety were detected, which could compromise vaccination coverage.

Vaccine refusal was mainly associated with individuals over 60 years old, characterized by hesitancy towards vaccine components, a resistance to compulsory vaccination, and a lack of awareness regarding vaccination's community-wide protection benefits. Furthermore, resistance extended to dietary choices, notably being against cow's milk and the use of infant formulas for breastfeeding.

Vaccine hesitancy, on the other hand, was mainly associated with a younger demographic of people under 30 years old, typically women, parents of young children under 15 years old, and against compulsory vaccination. They were generally also unaware that vaccination protects the community, with hesitancy about vaccine payment or with anti-vaccine attitudes, and in favour of alternative and complementary treatments.

In general, greater hesitancy to vaccination was detected in women and they reported a greater refusal to vaccinate their children than men.

Addressing these complexities requires proactive health policies aimed at strengthening trust in scientific positions and HCPs. Additionally, strategies must be tailored to enhance community engagement and ensure sufficient education regarding vaccination, especially among populations with lingering doubts. Multifaceted approaches are indispensable for navigating the intricacies of vaccine acceptance and safeguarding public health in the face of evolving challenges and threats to established progress made at reducing vaccine refusal and hesitancy.

Abbreviations

VPDs	Vaccine preventable Diseases
SAGE	Strategic Advisory Group of Experts
WHO	World Health Organization
DTaP	Diphtheria, Tetanus, Pertussis
MMR	Measles, Mumps, and Rubella
HCPs	Healthcare professionals
REDCap	Research Electronic Data Capture

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions

AH-F, EA-B, MOB contributed to the study concept and research design, selected, and reviewed the literature on vaccination. JS and XG-A participated in the acquisition, analysis, and interpretation of data. AH-F, EA-B, MOB, JS, XG-A and PG participated in the writing and critical review of the manuscript and approved the final version. AH-F and Group MC-MUVA contributed to the recruitment.

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Data availability
The data are hosted on the research team's internal servers and will be provided under reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics and Clinical Research Committee of the Fundació Institut Universitari per a la recerca a l'Atenció Primària de Salut Jordi Gol i Gurina (IDIAPJGol), with code 20/221-P. The study was conducted following the principles of the Declaration of Helsinki.
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Consent for publication
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Competing interests
The authors declare no competing interests.

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