Vaccine Hesitancy Among Pediatric Nurses: Prevalence and Associated Factors

Usue Elizondo-Alzola  
Agencia de Salut Publica de Barcelona

Mireia G. Carrasco  
Agencia de Salut Publica de Barcelona

Laia Pinós  
Hospital Vall d’Hebron

Camila Andrea Picchio  
Instituto de Salud Global Barcelona

Cristina Rius  
Agencia de Salut Publica de Barcelona

Elia Diez  (ediez@aspb.cat)  
Agencia de Salut Publica de Barcelona  https://orcid.org/0000-0002-0353-3916

Research article

Keywords: Vaccines, vaccine hesitancy, primary healthcare, pediatric nurse, healthcare professionals

DOI: https://doi.org/10.21203/rs.3.rs-28428/v1

License: © ① This work is licensed under a Creative Commons Attribution 4.0 International License.  Read Full License
Abstract

**Background.** Immunization rates of immuno-preventable diseases have declined in recent decades due to vaccine hesitancy. Primary care nurses play an essential role in promoting and maintaining vaccination coverage but may have doubts about or question the need to vaccinate. This study describes the prevalence of vaccine hesitancy and the associated factors among pediatric primary care nurses in Barcelona (Spain).

**Methods.** Cross-sectional descriptive study. We invited the pediatric nurses (N = 165) working at all the Barcelona public primary health services (N = 41) to participate. They answered a questionnaire with sociodemographic and behavioral variables: severity and probability of contracting the diseases in the vaccination schedule; safety and protection of each vaccine; and beliefs, social norms, and knowledge about vaccines. Outcome variable was vaccine hesitancy, dichotomized into no hesitant (nurses who would vaccinate their own offspring), and hesitant (including those who would not vaccinate them, those who had doubts and those who would delay the administration of one or more vaccines). We performed bivariate analysis and adjusted logistic regression models.

**Results.** 83% of pediatric nurses (N = 137) agreed to participate. A 32.1% of them reported vaccine hesitancy, especially about the HPV (21.9%) and varicella (17.5%) vaccines. In the multivariate analysis, hesitancy was associated with low perception of the severity of whooping cough [aOR: 3.88; (95%CI):1.32–11.4], low perception of safety of the HPV vaccine [aOR:8.5;(95%CI):1.24–57.8], the belief that vaccines are administered too early [aOR:6.09;(95%CI):1.98–18.8], and not having children [aOR:4.05;(95%CI):1.22–13.3].

**Conclusions.** Although most pediatric nurses would vaccinate their own children, almost one third display some kind of vaccine hesitancy, mainly related with doubts about HPV and varicella vaccines, as well as some misconceptions. These factors should be addressed to enhance their fundamental role in promoting vaccination among families.

Background

Vaccination is a demonstrably effective, safe, and cost-effective intervention. However, in several high-income European countries, immunization rates of some immuno-preventable diseases such as measles have declined in recent decades, which has contributed to recent outbreaks of this disease. Vaccine Hesitancy (VH) could in part be responsible for this growing global phenomenon. VH defined as the reluctance or refusal to vaccinate despite the availability of vaccines and threatens to reverse progress made in tackling vaccine-preventable diseases. In 2019, the World Health Organization (WHO) placed VH among the top 10 threats to global health.

VH is complex and specific for each context and type of vaccine. In Europe, some common reasons against vaccination include the lack of confidence in vaccines, in their administration, in the public health services, and in the pharmaceutical industry. In the last decade, social networks and some digital media have contributed to expanding these doubts and to eroding families’ trust in health professionals. In the European Union, around 20% of parents report having doubts about vaccinating their children. In France, 36% of parents question the safety of vaccines, and, in Spain, controversies are quite similar to those in other countries: for example, the association between the MMR vaccine and autism is not uncommon, as well as the belief that the pharmaceutical industry influences the public vaccination schedule, or, moreover, 8% of Spanish people think that vaccination carries more risks than benefits.

Healthcare professionals still maintain a positive influence on family’s decisions to vaccinate their children. In Spain, 69% of families reported that pediatricians were their most important source of information. In this country, pediatric primary care teams include medical and nursing healthcare professionals. Primary health nurses can administer vaccines without a medical prescription. All vaccines included in the official schedule are recommended, not required, so communication between families and nurses is crucial to maintain high vaccination coverages. Pediatric nurses use an important part of their consultation time to this task, except in complex non-routine cases, which are attended by pediatricians. These functions, together with their accessibility, make nurses a key actor in vaccination.

A recent study among pediatric primary care teams in Barcelona found that 25% of the healthcare professionals involved in vaccination had doubts about some of the vaccines on the systematic vaccination schedule. The study found differences between pediatricians and pediatric nurses for many variables, nurses being more negatively associated with VH, and recommended exploring this phenomenon in greater detail.
The aim of the current study was to determine the prevalence of VH and to study its associated factors among pediatric primary care nurses in Barcelona (Spain).

**Methods**

**Study design and participants**

We conducted a cross-sectional study. The study population included all the pediatric nurses working at the 41 public primary care centers in Barcelona with pediatric service in 2017. We included nurses who performed care work and excluded students, residents, and temporary nurses. The universe was 165 nurses.

**Data Collection**

We collected the information using a questionnaire based in literature, (15), translated into Catalan and Spanish and culturally adapted using the cognitive debriefing method.(16) Cognitive debriefing is a process where representatives of the target population actively test the translated questionnaires to determine whether respondents would understand the questionnaire as easily as the primary version would be understood. The self-administered questionnaires were made available to nursing staff between March 2016 and February 2017.

The questionnaire gathered sociodemographic information (age, sex years of experience, offspring), and psychosocial determinants based on theoretical models of behaviour: intention to vaccinate their own children, self-efficacy about answering family questions, perception of the severity and probability of contracting the vaccinable diseases, safety and protection conferred by vaccines on the systematic schedule in Catalonia(17), beliefs, social norms, and knowledge about vaccines, as well as myths and doubts posed to nurses by the families. (18)(19)(20)

**Variables**

The outcome variable was VH, a dichotomous variable constructed from the variable on the intention to vaccinate their offspring for each of the 14 antigens (Ag) on the vaccination calendar. We used the intention to vaccinate based on the Theory of Reasoned Action which is a theory of planned behavior, and the integrated behavioral mode. (21) The question was: "If you had a child today, would you agree for them to receive the vaccines on the current systematic schedule?" We coded as "vaccine hesitancy" if the answer was "no", "I have doubts" or "I would do it later" for one or more antigens (Ag), and "non-hesitancy" if they responded otherwise.

In line with the Health Belief Model(22) and based on the results of a systematic review, and its recommendations employing this theory among healthcare professionals (23), we collected data on the participants’ perception of the severity and probability of contracting each immuno-preventable disease, and the safety and protection conferred for each Ag in the schedule. We collected the answers on a 5-point Likert scale plus a don't know response. Then, we created dichotomous variables, excluding non-responses, as follows: probability of contracting the disease, "probable/very probable" vs other responses; severity of the illness, "serious/very serious" vs other responses; safety of the vaccine, "safe/very safe/totally safe" vs other responses; and protection conferred by the vaccine, "protective/totally protective" vs other responses. The perception of the severity of HPV infection was not included in the severity section because the question referred to 8-year-old girls or boys and it is understood that at childhood they can neither become infected by this virus nor suffer from cervical cancer.

Answers regarding beliefs, social norms, and knowledge were collected in five categories and dichotomized into "agreement" or "disagreement" with the most favorable option to vaccination, depending on how the question was stated.

**Analysis of data**

We carried out a descriptive analysis of the data. We studied the relationship between VH and explanatory variables using the chi-square or Fisher's exact tests. After verifying that the data were normally distributed, we analyzed age and years of experience as continuous variables using the T-Student test. We fit logistic regression models using the variables statistically significant in the bivariate analysis and adjusted for sex, years of experience and offspring. We computed the adjusted odds ratios (aOR) and their 95% confidence intervals (CI). We compared the models based on the likelihood ratio test and chose the model providing the most information with the least variables.
We analyzed “do not know/did not answer” (DK/NR) responses and the missing values together. Missing values accounted for less than 5%. When the percentage exceeded 5%, data were analyzed by including and excluding them as a category. We found that missing values did not affect the results, so we decided to exclude missing values of the analysis. Statistical significance was set at $\alpha = 0.05$. The analysis was conducted using Stata software 13.0.

Results

83% of the 165 nurses participated in the study. 96.4% of them were women, with a mean age 47.7 years, 72.3% had children, and had an average of 23.8 years of professional experience was (Table 1).

Table 1: Characteristics of the pediatric nursing population stratified by vaccine hesitancy. Barcelona. 2016-17.

| Vaccine hesitancy | Total (N = 137) | Yes (N = 44) | No (N = 93) | p value |
|-------------------|-----------------|--------------|-------------|---------|
| **Sex**           |                 |              |             |         |
| Male              | 5 (3.6)         | 2 (4.6)      | 3 (3.2)     | 0.701   |
| Female            | 132 (96.4)      | 42 (95.5)    | 90 (96.8)   |         |
| **Age**           |                 |              |             |         |
| Mean, years (SD)  | 47.7 (10.2)     | 46.3 (10.9)  | 48.4 (9.8)  |         |
| ≤42 years         | 49 (36)         | 17 (38.6)    | 32 (34.8)   | 0.892   |
| 43–56 years       | 47 (34.6)       | 15 (34.1)    | 32 (34.8)   |         |
| ≥57 years         | 40 (29.4)       | 12 (27.3)    | 28 (30.4)   |         |
| **Professional experience** |             |              |             |         |
| Mean, years (SD)  | 23.8 (10.5)     | 22.9 (12.0)  | 24.3 (9.9)  |         |
| ≤17 years         | 43 (33.9)       | 15 (37.5)    | 28 (32.2)   | 0.698   |
| 18–30 years       | 48 (37.8)       | 13 (32.5)    | 35 (40.2)   |         |
| ≥31 years         | 36 (28.4)       | 12 (30.0)    | 24 (27.6)   |         |
| **Have children** |                 |              |             |         |
| No                | 38 (27.7)       | 19 (43.2)    | 19 (20.4)   | 0.005   |
| Yes               | 99 (72.3)       | 25 (56.8)    | 74 (79.6)   |         |

Intention to vaccinate

Of the nursing staff interviewed, 32.1% stated that they would have doubts or would delay or avoid vaccinating their children with at least one of the vaccines on the systematic schedule. Excluding varicella and HPV vaccines, the number dropped to 16.8%. HPV (21.9%), varicella (17.5%), hepatitis A (9.4%) and pneumococcal (8.8%) vaccines generated the greatest hesitancy (Fig. 1).

Perception of risk and benefit
Nursing professionals who were hesitant to vaccinate had a low perceived risk of infection for 5 of the 14 diseases in the vaccination schedule (diphtheria, whooping cough, polio, measles and HPV), and a low perception of severity for 7 of them (whooping cough, H. influenzae b, meningococcal disease, hepatitis A, measles, mumps, and varicella) (Table 2).

More than 90% of vaccine-hesitant nurses perceived these vaccines to be very safe, except for the HPV vaccine, which was considered to be very safe by 76.5% of the vaccine-hesitant nurses, and by 97.7% of the non-hesitant nurses \( p < 0.001 \). Hesitant nurses had a lower perception of the protection offered by the HPV vaccine, varicella vaccine, and whooping cough vaccines than those in the non-hesitant group. The perception of protection offered by the other vaccines was greater than 90% in both groups (Table 2).
| Disease or vaccine antigen | High disease susceptibility | High disease severity | High vaccine safety | High vaccine protection |
|----------------------------|-----------------------------|-----------------------|---------------------|------------------------|
|                            | High perception of disease susceptibility: probable and very probable. | High perception of disease severity: severe and very severe. | High perception of the vaccine safety: safe, very safe, totally safe. | High perception of the vaccine protection: protection and significant protection. |
| Diphtheria, %              | Yes (N = 44) | No (N = 93) | Yes (N = 44) | No (N = 93) | Yes (N = 44) | No (N = 93) | Yes (N = 44) | No (N = 93) |
|                            | 34.1 | 55.2 | 0.04 | 0.64 | 100 | 100 | NC | 100 | 89.8 | NC | 1 |
| Tetanus, %                 | 47.6 | 62.5 | 0.163 1 | 0.91 2 | 100 | 100 | NC | 100 | 100 | NC | 1 |
| Whooping cough, %          | 71.4 | 88.8 | 0.013 1 | 0.00 4 | 92.5 | 100 | NC | 68.3 | 77.5 | 0.42 1 |
| Polio, %                   | 14.6 | 33.0 | 0.038 | 0.24 2 | 100 | 100 | NC | 100 | 100 | NC | 1 |
| H. Influenzae b, %         | 47.5 | 67.9 | 0.052 2 | 0.02 3 1 | 100 | 100 | NC | 94.7 | 95.5 | 1 2 |
| Hepatitis B, %             | 43.9 | 60.2 | 0.124 | 0.05 6 | 100 | 100 | NC | 92.1 | 92.1 | 0.736 1 |
| Meningococcal C, %        | 41.5 | 53.9 | 0.277 | 0.01 6 1 | 100 | 98.9 | NC | 92.3 | 98.8 | 0.085 2 |
| Hepatitis A, %            | 46.3 | 57.5 | 0.327 1 | 0.02 4 | 100 | 100 | NC | 95.0 | 95.5 | 1 1 |

NA: Not applicable; NC: Not calculable; HPV: Human papilloma virus

a High perception of disease susceptibility: probable and very probable.
b High perception of disease severity: severe and very severe.
c High perception of the vaccine safety: safe, very safe, totally safe.
d High perception of the vaccine protection: protection and significant protection.
| High disease susceptibility a | High disease severity b | High vaccine safety c | High vaccine protection d |
|------------------------------|-------------------------|-----------------------|--------------------------|
| Measles, %                   | 65.1  80.0  0.048       | 30.2  61.8  0.001     | 100  100 NC 92.7  95.5  0.675 1 |
| Rubella, %                   | 50.0  64.0  0.190       | 27.9  46.6  0.057     | 100  100 NC 92.7  97.8  0.169 1 |
| Mumps, %                     | 64.3  75.0  0.164 1     | 18.6  40.0  0.019     | 97.4  100 0.297  95.5  88.6  0.753 1 |
| HPV e, %                     | 61.5  78.2  0.049 2     | NA NA NA            | 76.5  97.7 < 0.001 1 4 46.9  80.2 < 0.001 5 |
| Varicella, %                 | 97.6  95.6  1           | 4.7  19.1  0.034     | 94.7  97.8 0.579 2 61.5  84.3 0.003 1 |
| Pneumococcal, %             | 61.0  76.7  0.119       | 61.9  66.3  0.527     | 100  100 NC 2  90.0  93.3 0.492 1 |

NA: Not applicable; NC: Not calculable; HPV: Human papilloma virus

a High perception of disease susceptibility: probable and very probable.

b High perception of disease severity: severe and very severe.

c High perception of the vaccine safety: safe, very safe, totally safe.

d High perception of the vaccine protection: protection and significant protection.

e HPV severity was not considered given that the question in this block was addressed to an 8 year old child and it is understood that at this age they do not get the virus.

* Missing values excluded. We detailed the missing values >5%. 1 Missing values between 5–7%; 2 Missing values < 7–9%; 3 Missing value: 9.49%; 4 Missing value: 11.68%; 5 Missing value = 12.4%.

**Beliefs, knowledge and social norms**

Table 3 describes and compares beliefs, social norms and knowledge about vaccination for each group.

Hesitant professionals were more likely than non-hesitant to agree that children should only be vaccinated for serious illnesses (50.0% vs 17.1%, p < 0.001), that they receive more vaccines than necessary (52.3% vs 17.9%, p < 0.001), that it is better for them to develop immunity through disease than through vaccination (39% vs 17.1%, p = 0.007), and that at least one vaccine is administered too early (70.5% vs 57.5%, p = 0.003).
| Beliefs                                                                 | Yes | No  | p value     |
|------------------------------------------------------------------------|-----|-----|-------------|
| Children should only be vaccinated for serious illnesses               | 50.0| 17.1| < 0.001 1   |
| Children receive more vaccines than they need                          | 52.3| 17.9| < 0.001     |
| I am concerned that the immune system of children may be weakened due to receiving an excessive amount of vaccines | 30.9| 14.4| 0.022       |
| I am more likely to trust vaccines that have been around longer than newer ones | 43.2| 31.1| 0.169 1     |
| It is better for children to develop immunity by having the illness than through vaccination | 39.0| 17.1| 0.007 1     |
| At least one of the vaccines in the current vaccination schedule is administered too early | 70.5| 57.5| 0.003       |
| Vaccines in the current vaccination schedule are influenced by illegitimate governmental interests | 54.8| 58.3| 0.703 1     |
| Vaccines in the current vaccination schedule are influenced by illegitimate pharmaceutical interests | 69.1| 61.5| 0.403       |
| Continuing to vaccinate children against Polio in Spain is acceptable even though it has been eliminated from the country a | 97.7| 97.7| 0.992 1     |
| Vaccines are one of the safest sanitary measures a                    | 93.0| 96.7| 0.344       |
| Thanks to scientific research, vaccines are increasingly better and effective a | 100 | 96.7| 0.226       |
| Vaccines strengthen the immune system a                               | 88.1| 92.2| 0.361       |
| Social norms                                                          |     |     |             |
| People in my immediate environment are in favor of vaccination        | 100 | 97.8| NC          |
| Knowledge                                                                 | Agreement | Disagreement | P value |
|---------------------------------------------------------------------------|-----------|--------------|---------|
| MMR vaccine can cause autism                                              | 15.8      | 9.0          | 0.262   |
| At least one vaccine in the vaccination calendar contains thimerosal      | 75.0      | 55.8         | 0.075   |
| The amount of thimerosal in vaccines can cause neurotoxicity             | 51.5      | 53.9         | 0.822   |
| The amount of aluminum in vaccines can cause neurotoxicity               | 45.7      | 19.0         | 0.735   |
| Having an egg allergy is a contraindication for MMR vaccine             | 24.4      | 15.7         | 0.237   |
| The varicella vaccine can cause an attenuated varicella                  | 62.5      | 46.0         | 0.084   |
| At least one vaccine in the vaccination calendar contains aluminum       | 86.7      | 74.3         | 0.171   |

NC: Not calculable. MMR: Measles, Mumps, and Rubella.

a Agreeing express the favorable option to vaccination.

* Missing values excluded. We detailed the missing values >5%. 1 Missing values between 5–7%; 2 23.4, 3 18.9, 4 17.5, 5 16.8.

Both, the hesitant and non-hesitant groups, agreed in similar proportions that the government (54.8% vs 58.3%) and the pharmaceutical industry (69.1% vs 61.5%) have illegitimate interests that influence the vaccination schedule. The 100% of hesitant and 96.7% non-hesitant professionals agreed that, thanks to research, vaccines are getting better and more effective. Also, 93% of hesitant and 96.7% non-hesitant professionals agreed that vaccines are one of the safest health measures available.

We didn't find differences in social norms and knowledge. Notably, more than 5% of values for the knowledge variables were missing, mainly for statements related to the components of the vaccines. For the question, 'At least one vaccine on the calendar contains thiomersal', missing values were 17% in the non-hesitant group and 36% in the hesitant group. Similarly, for the question 'The amount of thiomersal in vaccines causes neurotoxicity', missing values were 11.8% and 7.7% in the hesitant and non-hesitant groups, respectively. Similarly, for the question on whether vaccines contain aluminum, 31.8% of values were missing in the hesitant group and 24.7% in the non-hesitant group.

**Factors associated with VH**

The main factors associated with VH were low perception of the severity of whooping cough (aOR: 3.88; 95% CI: 1.32–11.41), low perception of the safety of the HPV vaccine (aOR: 8.50; 95% CI: 1.24–57.8), and the belief that at least one of the vaccines in the current schedule is administered too early (aOR: 6.09; 95% CI: 1.98–18.8) (Table 4). Another important and, in this case, protecting factor was not having had children (aOR: 4.05; 95% CI: 1.22–13.3).
Table 4
Factors associated to vaccine hesitancy in pediatric nurses. Barcelona. 2016–2017.

| FACTORS                  | OR (95% CI) | aOR (95% CI)* |
|--------------------------|-------------|---------------|
| ILLNESS SUSCEPTIBILITY   |             |               |
| Diphtheria               |             |               |
| High                     | 1           |               |
| Low                      | 2.37 (1.01–5.13) |               |
| Whooping cough           |             |               |
| High                     | 1           |               |
| Low                      | 3.16 (1.24–8.08) | 3.88 (1.32–11.41) |
| Polio                    |             |               |
| High                     | 1           |               |
| Low                      | 2.87 (1.08–7.60) |               |
| Measles                  |             |               |
| High                     | 1           |               |
| Low                      | 2.14 (0.95–4.83) |               |
| HPV                      |             |               |
| High                     | 1           |               |
| Low                      | 2.24 (0.98–5.09) |               |
| ILLNESS SEVERITY         |             |               |
| Whooping cough a          |             |               |
| High                     | 1           | 1             |
| Low                      | 3.23 (1.50–6.89) | 3.88 (1.32–11.41) |
| H. Influenzae B          |             |               |
| High                     | 1           |               |
| Low                      | 2.25 (1.05–4.82) |               |
| Meningococcal disease    |             |               |
| High                     | 1           |               |
| Low                      | 3.35 (1.08–10.41) |               |
| Hepatitis A              |             |               |
| High                     | 1           |               |
| Low                      | 3.01 (1.25–7.25) |               |
| Measles                  |             |               |
| High                     | 1           |               |
| Low                      | 3.73 (1.71–8.13) |               |
| Mumps                    |             |               |
| High                     | 1           |               |
| FACTORS       | OR (95% CI)          | aOR (95%CI)*     |
|--------------|----------------------|------------------|
| Low          | 2.92 (1.21-7.00)     |                  |
| Varicella    |                      |                  |
| High         | 1                    |                  |
| Low          | 4.84 (1.06-22.00)    |                  |
| VACCINE SAFETY |                    |                  |
| HPV b        |                      |                  |
| High         | 1                    | 1                |
| Low          | 13.08 (2.61–65.46)   | 8.50 (1.24–57.80)|
Table 4
Factors associated to vaccine hesitancy in pediatric nurses. Barcelona. 2016–2017 (cont)

| VACCINE EFFECTIVENESS |   |   |
|------------------------|---|---|
| HPV                    |   |   |
| High                   | 1 |   |
| Low                    | 4.60 (1.92–11.02) |
| Varicella              |   |   |
| High                   | 1 |   |
| Low                    | 3.34 (1.41–7.92) |

| VACCINE RELATED BELIEFS |   |   |
|-------------------------|---|---|
| Children should only be vaccinated for serious illnesses |   |   |
| Disagree                | 1 |   |
| Agree                   | 4.30 (1.77–10.45) |
| Children receive more vaccines than they need |   |   |
| Disagree                | 1 |   |
| Agree                   | 2.98 (1.08–8.20) |
| The immune system of children may be weakened due to receiving an excessive amount of vaccines |   |   |
| Disagree                | 1 |   |
| Agree                   | 5.80 (1.42–23.7) |
| It is better for children to develop immunity by having the illness that through vaccination |   |   |
| Disagree                | 1 |   |
| Agree                   | 2.27 (0.54–9.57) |
| At least one of the vaccines in the calendar is administered too early |   |   |
| Disagree                | 1 | 1 |
| Agree                   | 6.00 (2.28–15.80) | 6.09 (1.98–18.77) |

| SOCIODEMOGRAPHIC CHARACTERISTICS |   |   |
| Sex                          |   |   |

OR: odds ratio; CI: confidence interval; HPV: Human papilloma virus.
aOR: adjusted odds ratio; *Odds ratios adjusted for sex, years of experience and offspring

a 6 missing values
b 16 missing values
c 9 missing values
### VACCINE EFFECTIVENESS

|                          |       |
|--------------------------|-------|
| Woman                    | 1     |
| Man                      | 1.42 (0.23–8.90) |

### Professional experience

| Experience   |       |
|--------------|-------|
| <17 years    | 1     |
| 18–30 years  | 0.69 (0.28–1.70) |
| >31 years    | 0.93 (0.36–2.40) |

### Offspring (having one or more children)

| Offspring |       |
|-----------|-------|
| Yes       | 1     |
| No        | 2.96 (1.35–6.47) |
|           | 4.05 (1.22–13.33) |

OR: odds ratio; CI: confidence interval; HPV: Human papilloma virus.

aOR: adjusted odds ratio; *Odds ratios adjusted for sex, years of experience and offspring

| 6 missing values  |
|-------------------|
| 16 missing values  |
| 9 missing values   |

### Discussion

In our study, one in three pediatric nurses questioned the administration of at least one of the routine vaccines in Catalonia. The vaccines that generated most doubts were those against HPV, varicella, pneumococcus and hepatitis A. VH nurses had a lower perception of the risk of vaccines for some diseases, a lower perception of the benefit of the varicella and HPV vaccines, and generally more unfavorable beliefs about vaccination (e.g. the time of administration or the number of vaccines) than non-hesitant nurses.

Compared with other healthcare professionals in European countries, Barcelona pediatric nurses appear to be less likely to have the intention to vaccinate their offspring on the standard vaccination schedule than professionals in countries like Switzerland (24), where 95% of pediatricians would do so. On the other hand, it has been seen that general practitioners in France are less likely to recommend vaccines to their patients than to their offspring (25). If Barcelona’s pediatric nurses would have a similar behaviour, more than 30% of nurses would not recommend vaccines in practice. The vaccines that generate most doubts are those that have been added in the systematic schedule most recently: HPV, introduced in 2008; varicella, in 2016 for infants; and pneumococcus, in 2016. (26) These changes, and the fact that some vaccines are only recommended in Catalonia, such as that against hepatitis A, can generate suspicion if the reasons for these differences are not well communicated. (4)

Despite having been introduced into the calendar in 2008, the vaccine against HPV generates most controversy and misconceptions, as shown by our results on the perception of its protection and safety. Several studies have reported a low perception of the protection offered by the HPV vaccine by parents (20), healthcare professionals (21) and girls (22). This can be related to the perceived scarcity of efficacy studies or a lack of clear information about the infection and the vaccine. (27) The low perception of the safety of HPV vaccine, among vaccine hesitant nurses is consistent with a study that found that primary healthcare professionals had been receiving contradictory information about the effectiveness and efficacy of this vaccine. (28)

Another differential factor between hesitant and non-hesitant was the low perception of the severity of immuno-preventable diseases. This could be related to the fact that primary care nurses do not directly treat these diseases as they are attended by pediatricians and serious cases are referred to the hospital, or, importantly, because these diseases are generally rare. This lack of contact may lead to false beliefs that trivialize vaccination and question the need to vaccinate. Similarly, since 2010, there has been an increase in mild
cases of whooping cough, including among children who had been correctly vaccinated. Thus, this could have eroded the perception of effectiveness in vaccines in some nurses.

Many of the beliefs held by vaccine-hesitant nurses highlight mistrust in the vaccination calendar (too many vaccines and administered too early). This aspect suggests limited knowledge about the reasons and timing of vaccination. Moreover, we have found an association between the distrust in pharmaceutical industry, although not with government health authorities, and the nurses’ perception about vaccine administration timing. Another study observed that the perceived lack of transparency of administrations could lead to mistrust about changes in the vaccination calendar.

Contrary to our assumptions, we observed no differences in knowledge between hesitant and non-hesitant professionals, perhaps because both groups had a high percentage of missing values, especially concerning adjuvants and vaccine preservatives. Some European studies highlight the importance of professionals’ lack of knowledge about the components of vaccines and the possible consequences of this unawareness. The composition of vaccines is one of the questions most frequently raised by families, and it is therefore crucial for pediatric nurses to be familiar with these issues, considering their autonomous role in aspects of vaccination and their close and accessible role for families in primary care pediatrics. Although, in Spain and Catalonia it is compulsory to have a nurse degree to work as a pediatric nurse in primary care, it seems that training in vaccination during the degree is quite basic, as we found that less than a half of nurses reported having enough information about vaccination. Besides, the continuous training of nurses in Spain is optional.

Another factor associated with VH, but in this case as a protective factor, was not having children, which could be because these individuals have not yet had to consider the decision to vaccinate, and may thus assess the risk of these diseases only from a hypothetical standpoint, which is reassessed with better information when having children. It would be interesting to study in more depth the relationship between parenthood and a more favorable attitude to vaccination.

This study has some limitations. Participation was voluntary, which could lead to a selection bias although the percentage of participants was high (> 80%). Individuals who did not participate would likely be even more VH, such that our results could underestimate the magnitude of the problem. The partial face-to-face administration of the questionnaires could introduce a complacency bias in the responses. A further limitation is that data were collected for a specific period, 2016–2017, so our results on VH, which is known to vary according to place, time, and context, may not reflect behaviors before or after that period. Therefore, the results and conclusions of this study may not necessarily apply to other countries or even to other territories in Spain. Even though, some strengths arise, this study accessed to all the pediatric nurses of CAP in Barcelona and allowed to assess the status of a complex multifactorial phenomenon and collected information on the poorly understood issue of VH in pediatric nursing. Our results highlight four factors associated with VH that could be used to compare our context with other populations, and that should be addressed.

**Conclusions**

Although most pediatric nurses would vaccinate their own children, almost one third display some kind of vaccine hesitancy, mainly related with doubts about HPV and varicella vaccines, as well as some misconceptions. These factors should be addressed to enhance their fundamental role in promoting vaccination among families.

**Abbreviations**

VH Vaccine Hesitancy

**Declarations**

**Ethics approval and consent to participate**

The study 2018/7790/I was approved by the ethics committee of the CEIm-Parc de Salut MAR of Barcelona. The study was conducted in accordance with the principles of the Declaration of Helsinki. All participants in the survey provided signed informed consent.
Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

The study was partially funded by the Barcelona Public Health Agency and the Spanish research network CIBERESP.

Authors’ contributions

MGC and CR created the questionnaire administered at the centers. MGC, CR, CAP and LP travelled to centers to administer the questionnaires. UE carried out the statistical analysis. All authors actively participated in discussing the results, contributing ideas, and the writing the paper. All authors have accepted and contributed to the final draft of the text.

Acknowledgements

The authors thank the pediatric teams of the public primary care centers of Barcelona who participated in this survey. We also thank Maria Sagué who started this project and participated in the field work.

References

1. Dean Jamison B, Greenwood, Heng Leng Chee and PW. Science and Technology for Disease Control: Past, Present, and Future. In: Oxford University Press, editor. Disease Control Priorities in Developing Countries. 2nd ed. The International Bank for Reconstruction and Development. The World Bank; 2006.
2. European Center for Diseases Prevention and Control. European Monthly Measles Monitoring. Epidemiological update: Measles monitoring European outbreaks. 2018 Apr 10. Available from: https://ecdc.europa.eu/en/news-events/epidemiological-update-measles-monitoring-european-outbreaks-7-july-2017. Accessed 10 Nov 2019.
3. World Health Organization. Ten Threats to global health in 2019 [Internet]. 2019. [cited 20 December 2019] Available from: https://www.who.int/emergencies/ten-threats-to-global-health-in-2019.
4. Larson HJ, Cooper LZ, Eskola J, Katz SL, Ratzan S. Addressing the vaccine confidence gap. Lancet. 2011 Aug;378(9790):526–35.
5. Salmon DA, Moulton LH, Omer SB, Chace LM, Klassen A, Talebian P, et al. Knowledge, attitudes, and beliefs of school nurses and personnel and associations with nonmedical immunization exemptions. Pediatrics. 2004;113(6):e552–9.
6. Karafillakis E, Dinca I, Apfel F, et al. Vaccine hesitancy among healthcare workers in Europe: A qualitative study. Vaccine. 2016;34(41):5013–20.
7. Stefanoff P, Mamelund S-E, Robinson M, Netterlid E, Tuells J, Bergsaker MAR, et al. Tracking parental attitudes on vaccination across European countries: The Vaccine Safety, Attitudes, Training and Communication Project (VACSATC). Vaccine. 2010 Aug;28(35):5731–7.
8. Larson HJ, de Figueiredo A, Xiaohong Z, Schulz WS, Verger P, Johnston IG, et al. The State of Vaccine Confidence 2016: Global Insights Through a 67-Country Survey. EBioMedicine. 2016;12:295–301.
9. Borràs E, Domínguez À, Fuentes M, Batalla J, Cardeñosa N, Plasencia A. Parental knowledge of paediatric vaccination. BMC Public Health. 2009;9(154):3–9.
10. Centro de Investigaciones Sociológicas. Barómetro Sanitario 2016. Ministerio de Sanidad, Servicios Sociales e Igualdad. 2016. Available from:
11. Ames HMR, Glenton C, Lewin S. Parents’ and informal caregivers’ views and experiences of communication about routine childhood vaccination: A synthesis of qualitative evidence. Cochrane Database of Systematic Reviews. 2017;2(2):CD011787.

12. Navarro Alonso JA, González RJB, Carbonell JCN. Analysis of factors influencing vaccine uptake: perspective from Spain. Vaccine. 2002;20:13–5.

13. Asociación Española de Pediatría de Atención. Programa de Salud Infantil. 2009]. Available from: https://www.aepap.org/biblioteca/programa-de-salud-infantil Accessed 8 Nov 2019.

14. Miller ER, Shimabukuro TT, Hibbs BF, Moro PL, Broder KR, Vellozzi C. Vaccine Safety Resources for Nurses. Am J Nurs. 2015;115(8):55–8.

15. Andrea PC, García CM, Sagué-Vilavilla Maria RC. Knowledge, attitudes and beliefs about vaccination in primary health care workers involved in the administration of systematic childhood vaccines in Barcelona, 2016–2017. Eurosurveillance. 2019;24(6):7–9.

16. Nixon A, Wild DMW. Patient reported outcome recall in light of the final FDA Guidance. Value Heal. 2010;13(3):20–1.

17. Agència de Salut Publica de Catalunya (ASPCAT). Calendari de vacunacions sistemàtiques. 2020. Available from: http://salutpublica.gencat.cat/ca/ambits/promocio_salut/vacunacions/Calendari-de-vacunacions-sistematiques/ Accessed 27 April 2020.

18. Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing Vaccination: Putting Psychological Science Into Action. Psychol Sci Public Interes. 2017;18(3):149–207.

19. Piñeiro Pérez R, Hernández Martín D, Carro Rodríguez M, de la Parte Cancho M, Casado Verrier E, Galán Arévalo S, et al. Vaccination counselling: The meeting point is possible. An Pediatría English Ed. 2017;86(6):314–20.

20. Cruz Piqueras M, Rodríguez García de Cortazar A, Hortal Carmona J, Padilla Bernádez J. Reticencia vacunal: análisis del discurso de madres y padres con rechazo total o parcial a las vacunas. Gac Sanit. 2019;33(1):53–9.

21. Montaño D, Kasprzyk D. Theory of reasoned action, theory of planned behaviour, and the integrated behavioral model. Health Behaviour and Health Education. Theory, Research, and Practice. 2008. p. 67–96.

22. Rimer BK. and KG. Theory at a Glance: A Guide for Health Promotion Practice. 2005.

23. Corace KM, Srigley JA, Hargadon DP, Yu D, MacDonald TK, Fabrigar LR, et al. Using behavior change frameworks to improve healthcare worker influenza vaccination rates: A systematic review. Vaccine [Internet]. 2016;34(28):3235–42.

24. Posfay-Barbe KM. How Do Physicians Immunize Their Own Children? Differences Among Pediatricians and Nonpediatricians. Pediatrics. 2005;116(5):623–33.

25. Agrinier N, Le Maréchal M, Fressard L, Verger P, Pulcini C. Discrepancies between general practitioners’ vaccination recommendations for their patients and practices for their children. Clin Microbiol Infect. 2017;23(5):311–7.

26. AGÈNCIA DE SALUT PÚBLICA DE LA GENERALITAT DE CATALUNYA. Manual de vacunacions de catalunya. 2018. 384 p. Available from: http://salutpublica.gencat.cat/web/.content/minisite/aspcat/promocio_salut/vacunacions/00manual_de_vacunacions/Manual-de-vacunacions.pdf Accessed 19 Dec 2019.

27. Karallakis E. Andrea W}urz b JTID b FA c SC c. The benefit of the doubt or doubts over benefits? A systematic literature review of perceived risks of vaccines in European populations. Vaccine. 2017;35(37).

28. González Cano-Caballero M, Garrido Peña F, Gil García E. MDC-CG. Opinions of Andalusian primary health care professionals about human papillomavirus and its vaccine. An Sist Sanit Navar. 2018;41(1):27–34.

29. Centro Nacional de Epidemiología. CIBERESP. ISCIII. Situación de la tos ferina en España, 2005–2016. Red nacional de Vigilancia Epidemiológica de España. Available from: https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Documents/archivos A-Z/TOSFERINA/Situacion de la Tosferina en España%2C 1998–2016.pdf Accessed 20 Dec 2019.

30. Verger P, Fressard L, Collange F, Gautier A, Jestin C, Launay O, et al. Vaccine Hesitancy Among General Practitioners and Its Determinants During Controversies: A National Cross-sectional Survey in France. EBioMedicine. 2015;2:891–7.

31. European Centre for Disease Prevention and Control. Vaccine hesitancy among healthcare workers and their patients in Europe - A qualitative study. Stockholm: ECDC. 2015. Available from:
32. Ministerio de Sanidad Consumo y Bienestar social. Real Decreto 1302/2018, de 22 de octubre, por el que se regula la indicación, uso y autorización de dispensación de medicamentos y productos sanitarios de uso humano por parte de los enfermeros. 2018. Available from: http://www.boe.es Accessed 23 Dec 2019.

33. Salmon DA, Dudley MZ, Glanz JM, Omer SB. Vaccine Hesitancy: Causes, Consequences, and a Call to Action. Am J Prev Med. 2015;49(6):391–8.

34. Wilson R, Scronias D, Zaytseva A, Ferry MA, Chamboredon P, Dubé E, et al. Seasonal influenza self-vaccination behaviours and attitudes among nurses in Southeastern France. Hum Vaccines Immunother. 2019;15(10):2423–33.

Figures

Figure 1

Pediatric nurses responding "yes, doubts, later, or no" to vaccinating their own children (%). Barcelona. 2016-17 (N=137)