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RESEARCH PAPER



# Investigating Italian parents' vaccine hesitancy: A cross-sectional survey

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**ABSTRACT**

This cross-sectional survey was designed to assess the prevalence of vaccine hesitancy and to identify factors associated among a randomly selected sample of parents. A questionnaire was self-administered from October to December 2017 to a sample of parents of children aged 2 to 6 years attending five randomly selected pre-schools in the geographic area of Naples, Italy. Out of the 727 selected parents, 437 returned the questionnaires for a response rate of 60.1%. The median of Parent Attitudes about Childhood Vaccines Survey (PACV) score among participants was 45.8 with a total of 141 parents (34.7%) scored a value ≥50 and were defined hesitant about the childhood vaccinations. Vaccine hesitancy was significantly more common among those who were concerned and among those were not sure that any one of the childhood shots might not be safe, among those who were concerned that their children might have a serious side effect from a shot, among those who were concerned that a shot might not prevent the disease, among those who delayed and refused at least a shot of vaccine for their children, and in those who are not sure and uncertain in the pediatrician. More than half of parents (53.8%) expressed a desire to receive additional information about the childhood vaccinations. Parents who were not sure and uncertain that to follow the recommended shot schedule is a good idea for their children and those who were parents of first-born children were more likely to need additional information. This study finds a high prevalence of vaccine hesitancy among parents suggesting that in the immunization program is necessary to achieve a higher quality of the relationship between pediatricians and the community.

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## Introduction

Immunization programs are one of the most effective tools to protect individuals and to prevent transmission to unvaccinated individuals with a reduction of the morbidity, mortality, and health care costs.[1] However, in recent years, a steadily decrease of many levels of childhood vaccine coverage has been observed in several Western countries with values that are still far from the global goal of achieving and sustaining 90% vaccination coverage. For example, in Italy 85% of the children less than 12–23 months of age had received one dose of measles-containing vaccine, in Austria 87% of the one-year-olds received three doses of the combined diphtheria, tetanus toxoid and pertussis vaccine and of the polio vaccine, and in Canada 55% of the one-year-olds received the three doses of the hepatitis B vaccine.[2] Other data in Italy, indicated that the coverage rate for up to 24-month old children against poliomyelitis, tetanus, diphtheria, hepatitis B, pertussis, and *Haemophilus influenzae* type b was 93.4%, and for mumps and rubella was 85.2%.[3] Moreover, the Italian Immunization Prevention Plan included the achievement and maintenance of a coverage ≥95% for mandatory and recommended vaccines and the vaccines against *Haemophilus influenzae* type b, measles, mumps, pertussis, rubella, and varicella have recently been made mandatory for children up to 6 years in addition to those already required against diphtheria, hepatitis B, poliomyelitis, and tetanus.[3,4]

It is well recognised that vaccine uptake may be greatly influenced by multiple factors such as, for example, lack of recommendation by general practitioners, concerns about vaccination effectiveness and safety, lack of knowledge and information, low perception of risk, difficult access to preventive activities, and socio-economic predictors.[5-10] Among the user-related determinants affecting decisions about whether to vaccinate, parents' vaccine hesitancy represents a recent and growing concern in developed and developing countries.[11] It is well known that vaccine hesitancy refers to all kind of concerns that parents express by refusing some vaccines, delaying vaccines or accepting others, but they are unsure of doing so, despite availability of services and it is complex and context specific, varying across time, place, and vaccines.[11-13] Moreover, it is important to understand that primary care providers and parental knowledge of and attitudes towards both the efficacy and safety of vaccines may have an effect on the decision of vaccinating the children[8,14-17] and the primary care providers play a crucial role in promoting prevention and education interventions to achieve high immunization rates. For this reason, it is vitally important to improve acceptance and trust of parents in vaccinations by studying the phenomenon of vaccine hesitancy and understanding why they delay or refuse to vaccinate their children for the purposes of an effective vaccination planning.

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Several studies regarding the hesitancy in both parents[18-21] and in health care workers[22-24] have been published, but to the best that we could ascertain no previous research are currently available in Italy regarding childhood vaccine hesitancy among parents. Thus, to address this knowledge gap, the present cross-sectional survey was designed to assess the prevalence of vaccine hesitancy and to identify factors associated with vaccine hesitancy among a sample of parents of children aged 2 to 6 years in Italy and the results could be used to target optimal public health strategies to improve overall vaccination coverage.

## Results

### Characteristics of the participants

Internal consistency reliability of the questionnaire using Cronbach's $\alpha$ was 0.91. Of the 727 parents invited to participate in the study, 437 agreed to participate and returned the questionnaire, for an effective return rate of 60.1%. The socio-demographic characteristics of the investigated parents are outlined in Table 1. The sample consisted of predominately female (82.1%) and married (86.2%) participants, the mean age was 37.1 years, approximately half had a high level of school education (46.9%), more than half were employed (60.5%), and 69.2% had more than one child.

### Parents' behaviors and attitudes regarding childhood vaccinations

The median PACV score among participants was 45.8 with a total of 141 parents (34.7%) scored a value ≥50 and were defined hesitant about the childhood vaccinations. Univariate analysis using appropriate test showed that being mother ($p = 0.009$), younger ($p = 0.009$), with lower educational level ($p < 0.001$), not working as healthcare professional ($p = 0.04$), belief that many of the illnesses that shots prevent are not severe ($p < 0.001$), to be concerned about a serious side effect from a shot ($p < 0.001$), to be concerned that any one of the childhood shots might not be safe ($p < 0.001$), having delayed ($p < 0.001$) and refused at least one shot of vaccine for children ($p < 0.001$), and not trusting in pediatricians ($p < 0.001$) were statistically significantly associated with hesitancy about the childhood vaccinations. Next, multivariate logistic regression analysis was conducted to identify the factors associated with the different outcomes of interest and the results are presented in Table 2. The results partially confirmed the variables that were significantly associated with a higher likelihood of being hesitant. When considering each of the variables included, the variable that appeared to be the most important in determining parents' vaccine hesitancy was to be not sure (OR = 16.14; 95% CI = 3.21–81.03) and uncertain in the pediatrician (OR = 3.56; 95% CI = 1.36–9.36). Furthermore, vaccine hesitancy was significantly more common among those who were concerned that a shot might not prevent the disease (OR = 6.36; 95% CI = 2.8–14.44), among those who were concerned that their children might have a serious side effect from a shot (OR = 10.03; 95% CI = 1.15–87.24), and among those who were concerned (OR = 9.66; 95% CI = 1.79–52.03) and not sure (OR = 12.56; 95% CI = 1.4–112.4) that any one of the childhood shots might not be safe. Moreover, vaccine hesitancy was significantly more common among those who delayed (OR = 14.54; 95% CI = 5.79–36.51) and refused (OR = 11.63; 95% CI = 4.06–33.34) at least a shot of vaccine for their children (Model 1).

One in five (22%) and 18% of study respondents had declared that they delayed and refused at least a shot of vaccines for their children, respectively. Among these parents, the shot of vaccine that more frequently has been delayed and refused was against varicella (40.9% and 68.5%), followed by measles (44.3% and 19.2%), rubella (42.1% and 19.2%), and mumps (42.1% and 19.2%). The most frequent reasons of those delaying and of those refusing immunizations were respectively forgetfulness (18.5%) and the lack of recommendation by the pediatricians (35.1%) (Table 3).

Only 29.9% and 22% of parents were respectively not sured or agreed that their children were getting too many vaccines and nearly half (44.5%) agreed that they should get fewer vaccines at the same time. Approximately two-thirds (63.1%) were at least a little worried that their children would have a serious vaccine side effect and 28.2% was very worried that vaccines could not be safe. Only 39% agreed that they could trust the information they received about vaccinations, instead respectively 51.6% and 33.6% agreed and strongly agreed that they can discuss their concern with the pediatrician. Overall, the parents' trust in their children's pediatrician was very high, reaching an average value of 8.4 on a scale of 1 to 10.

### Sources of information

When respondents were asked about the source of information regarding the childhood vaccinations, 99.8% reported being informed. Parents used a variety of sources of vaccine-related information and pediatricians were indicated as their main

**Table 1.** Main characteristics of the study respondents.

| | Total ($n = 437$) | |
|---|---|---|
| | N | % |
| *Parent* | | |
| Father | 78 | 17.9 |
| Mother | 359 | 82.1 |
| *Age (years)* | 37.1 ± 5.8 (19–57)* | |
| *Marital status* | | |
| Married | 374 | 86.2 |
| Other | 60 | 13.8 |
| *Educational level* | | |
| Primary school | 4 | 1 |
| Middle school | 49 | 11.2 |
| High school | 203 | 46.9 |
| Baccalaureate/graduate degree | 177 | 40.9 |
| *Employment status* | | |
| Employed | 256 | 60.5 |
| Unemployed | 167 | 39.5 |
| *At least one parent who is a healthcare professional* | | |
| No | 401 | 94.1 |
| Yes | 25 | 5.9 |
| *Birth order of the selected child* | | |
| First | 205 | 52.6 |
| Second | 149 | 38.2 |
| ≥Third | 36 | 9.2 |
| *Number of children* | | |
| 1 | 133 | 30.8 |
| 2 | 231 | 53.5 |
| >2 | 68 | 15.7 |

Number for each item may not add up to total number of study population due to missing value.
*Mean ± Standard deviation (Range).

**Table 2.** Results of multivariate regression analysis to explore the characteristics associated with the outcomes of interest.

| Variable | OR | SE | 95% CI | *p* value |
|---|---|---|---|---|
| Model 1. Parents' vaccine hesitancy | | | | |
| Having delayed at least a shot of vaccine for their children | 14.54 | 6.83 | 5.79–36.51 | <0.0001 |
| Having refused at least a shot of vaccine for their children | 11.63 | 6.25 | 4.06–33.34 | <0.0001 |
| Who was concerned that a shot might not prevent the disease | | | | |
| Not concerned | 1* | | | |
| Concerned | 6.36 | 2.66 | 2.8–14.44 | <0.0001 |
| Who was concerned that any one of the childhood shots might not be safe | | | | |
| Not concerned | 1* | | | |
| Concerned | 9.66 | 8.29 | 1.79–52.03 | 0.008 |
| Not sure | 12.56 | 14.04 | 1.4–112.4 | 0.024 |
| Who trust in the pediatrician | | | | |
| Sure | 1* | | | |
| Uncertain | 3.56 | 1.75 | 1.36–9.36 | <0.0001 |
| Not sure | 16.14 | 13.28 | 3.21–81.03 | 0.001 |
| Who was concerned about a serious side effect from a shot | | | | |
| Not concerned | 1* | | | |
| Concerned | 10.03 | 11.07 | 1.15–87.24 | 0.037 |
| Not sure | 8.67 | 12.99 | 0.46–163.6 | 0.15 |
| Birth order of the selected child | | | | |
| Second | 1* | | | |
| First | 0.56 | 0.19 | 0.28–1.13 | 0.108 |
| Mothers | 1.97 | 1.15 | 0.63–6.18 | 0.244 |
| At least one parent who is a healthcare professional | 0.41 | 0.35 | 0.07–2.16 | 0.297 |
| Age | | | | |
| ≤35 | 1* | | | |
| 36–45 | 0.71 | 0.26 | 0.35–1.45 | 0.350 |
| **Model 2.** Parents need of additional information about the childhood vaccinations | | | | |
| Who perceived that to follow the recommended shot schedule is a good idea for their children | | | | |
| Sure | 1* | | | |
| Not sure | 2.34 | 0.73 | 1.27–4.31 | 0.006 |
| Uncertain | 2.09 | 0.65 | 1.13–3.85 | 0.018 |
| Birth order of the selected child | | | | |
| Second | 1* | | | |
| First | 1.76 | 0.41 | 1.12–2.76 | 0.014 |
| ≥Third | 1.87 | 0.76 | 0.84–4.16 | 0.122 |
| Mothers | 1.54 | 0.44 | 0.88–2.69 | 0.129 |
| Who trust in the pediatrician | | | | |
| Sure | 1* | | | |
| Uncertain | 1.78 | 0.58 | 0.94–3.76 | 0.078 |
| Who received information on childhood vaccinations from the pediatrician | 0.73 | 0.25 | 0.37–1.43 | 0.358 |

*Reference category.

trusted source (86%), followed by internet (36.9%), mass media (28.7%), and family/friends (20.6%). More than half (53.8%) of the participants expressed their wishes to have more information about the childhood vaccinations. The bivariate analysis conducted to test the association between the need of additional information about the childhood vaccinations and various explanatory variables showed that three explanatory variables were significantly associated. Mothers ($p = 0.025$), perceiving that to follow the recommended shot schedule is a good idea for their children ($p < 0.001$), and not trusting in pediatricians ($p < 0.001$) were each associated with intending to acquire additional information. Finally, to assess which variables independently predict the need of additional information about the childhood vaccinations, a full logistic regression model was estimated with all of the explanatory variables with a $p < 0.25$ in univariate analysis. In the full model three predictors remain significant when controlling for other variables. Parents who were not sure (OR = 2.34; 95% CI = 1.27–4.31) and uncertain (OR = 2.09; 95% CI = 1.13–3.85) that to follow the recommended shot schedule is a good idea for their children, and those who were parents of first-born children (OR = 1.76; 95% CI = 1.12–2.76), compared to parents of second-born children, were more likely to need additional information about the childhood vaccinations. Parents' hesitancy was not a significant predictor of the need of additional information (Model 2 in Table 2).

**Table 3.** Most frequent reasons reported by parents for having delayed or refused at least a shot of vaccines.

| Reasons for having delayed | N | % |
|---|---|---|
| Forgetfulness | 17 | 18.5 |
| Vaccine not available in the vaccination center | 16 | 17.4 |
| Concerns about side effects | 14 | 14.6 |
| Fear of the vaccine administration for their children | 12 | 12.5 |
| Lack of recommendation by the pediatricians | 10 | 10.9 |
| **Reasons for having refused** | | |
| Lack of recommendation by the pediatricians | 27 | 35.1 |
| Having an objection to the administration of the vaccines | 23 | 29.9 |
| Forgetfulness | 7 | 9.5 |
| Concerns about side effects | 5 | 6 |
| Vaccine not available in the vaccination center | 3 | 3.9 |

## Discussion

The results of the current survey presented here add to the literature by assessing the prevalence of childhood vaccinations

hesitancy among a sample of parents in Italy and by identifying a wider range of factors that were related to an individual's hesitancy.

More than one third of parents had a PACV score ≥50 indicating childhood vaccinations hesitancy. Comparison with other experiences reported in the literature, although the methods of recruitment and the use of measurement varied greatly across these different studies, showed that this value was similar to the 30.4% of parents in the United States,[25] whereas lower values have been observed elsewhere ranging from 11.6% to 19.5% .[26-28] Moreover, approximately one in five of this sample had delayed or had refused at least a shot of vaccines for their children. In other studies conducted in several countries, a lower proportions of parents who delayed or refused an immunization has been observed with values ranging beetween 2% and 7.9%.[19,21,29-31] These findings are worrying as they negatively affect the coverage rate and suggest the need for the vaccination services to reinforce the belief strategies towards parents. It is important, to significantly decrease the burden of the childhood diseases that can be prevented by vaccines, to understand the reasons why parents are not vaccinating their children in order to implement adequate and communication program accordingly. In the present study, among the several reasons indicated by participants who have delayed or refused there were the objection to the vaccine administration, concerns about side effects, fear of the vaccine administration for their children, and the lack of recommendation by the pediatricians. These results are in accordance with previous studies.[18,25,32-36] The results of the multivariate regression analysis showed that vaccine hesitancy was more likely among parents who were worried about the side effects and safety of the vaccines. Thus, these findings highlight the need to develop educational materials promoting vaccinations and also suggest that health care workers are encouraged to inform the parents about the childhood vaccine's importance to potentially increase parental knowledge regarding the safety of vaccines. Furthermore, in the present study none of the socio-demographic characteristic of the respondents has been identified as significant determinant of vaccine hesitancy. However, it has been found that being younger emerged, although not significantly, associated with the hesitancy. These findings are consistent with previous research in the literature.[26,28,32,37] This observation may be explained with the eradication and reductions over the past years of the incidence of vaccine-preventable diseases, like smallpox and poliomielitis, and, therefore, younger parents do not have previous experiences of their severity. Indeed, if most people have never experienced the disease, they might start to worry less about the disease, and to question whether the vaccine is necessary and some of them will stop getting immunized.[38,39] In addition, it was found that parents who do not trust pediatricians were more likely to be hesitant. These results support the existing literature, demonstrating a relationship between trust in health care professionals and a positive behaviors of the individuals about vaccinations.[34,40-43] This finding has important implications for vaccination programs. The most obvious issue is that health care providers should be made aware about the fact that they are in an excellent position to address barriers perceived by parents and, therefore, for influencing them in the decisions regarding vaccination.

The source of information about the childhood vaccinations for parents participating in the study was examined. Almost all reported that they have received this information. The most commonly mentioned source was the health care worker, since pediatricians were ranked as the most preferred for 86% of the sample. Similar results were also seen in previously studies.[17,31,34,40,44-46] Despite this finding, it is interesting to observe that, as already reported, the main reason provided by participants for having refused the vaccinations was that the pediatricians, contrary to the expectations, did not recommend the vaccines during the childhood. This observation is alarming, since the primary responsibility of the pediatricians is to protect individual children and by a public health point of view the immunization can not be optional. Moreover, pediatricians should play a key role in increasing the coverage, again properly informing parents about the benefit of all vaccines and that they are one of the safest interventions recommended for children. Furthermore, more than half of the sample declared that they needed to acquire additional information about the childhood vaccinations and, therefore, pediatricians should discuss about recommended and mandatory vaccines with each family. In the multivariate analysis it has been observed that birth-order was determinant of this outcome, since parents of first-born children, compared to second-born children, have a higher need of additional information about the childhood vaccinations. A possible explanation underlying the fact that birth order plays a significant role relates to caregivers' practices since inexperienced first-time parents were more anxious for their children's health than those of later-born children.[47-51] Furthermore, it should be noted that more than one-third of the respondents was using Internet to search information and we are confident that this source must be consulted with caution because it can play a role in the activity of producing mistrust.[52,53] Indeed, this information may be uncontrolled and parents may be exposed to misleading information on the usefulness and safety of vaccines. Previous research examining this type of information, concerning vaccines, demonstrated that many blog posts and subsequent comments take an anti-vaccination standpoint although the overall quality of pro-vaccination webpages is superior to anti-vaccination online sources.[54-56]

There were some potential limitations of the current study that must take into account in the interpretation of the results. Firstly, although the associations between the main explanatory variables and the different outcomes of interest were identified, caution should be taken into account when interpreting the results owing to the cross-sectional study design applied, which limited us from making any conclusion on causal relationship between these factors. Secondly, as in all studies on retrospective data collected using self-administered questionnaires and not verified using medical records, there is a risk of potential recall bias because participants may not remember or report the information. Thirdly, as the subjects of this study may have been sensitive to some respondents, the answers may be not necessarily objective and may be different from their true opinions with a risk of vaccination coverage over-estimate, there is the potential for social desirability bias. However, because it has been emphasized to all participants the confidentiality of the collected data, the potential for this type of social desirability bias is somewhat mitigated. Lastly, a potential shortcoming

is the fact that the majority of the sample was represented by the mothers. We doubt, however, that this accounts for a bias because we are confident that, although the mothers usually takes the child to the vaccination centres, the decision to vaccinate is made by both parents before attending the centre. Despite these limitations, the data are relevant for understanding factors associated with vaccine hesitancy and such information can be useful in order to its reduction in Italy.

In conclusion, this study highlight a high prevalence of vaccine hesitancy and the lack of recommendation of vaccines by the pediatricians as the main reason toward uptake of the vaccinations. In the light of the new immunization plan, the fact that many of the respondents who had refused the vaccination did so because the pediatricians did not recommend the vaccination suggests that in the immunization program is necessary, in order to increase childhood vaccination rates, a higher quality of the relationship between pediatricians, because they are an important source of vaccine-related information, and the community.

## Materials and methods

### Study setting and population

The survey was conducted from October to December 2017 among a random sample of 727 parents or caregivers whose children were within the age group 2 to 6 years attending five randomly selected pre-schools in the geographic area of Naples, Italy. A one stage cluster sampling was used in this study. In particular, from the list of the public pre-schools, five of them were randomly selected and all children who attending the schools were recruited. The sample size was estimated assuming that 25% of parents was hesitant in accordance with published literature,[25,28] with a confidence interval of 95%, and an error of 5%. In order to select a representative sample of the population, assuming a response rate of 60%, the final sample size was calculated to be of 481 subjects.

### Procedure

The heads of the selected pre-schools were contacted by the research team and received an information letter where was requested permission to carry out the survey and through which were clarified the purposes of the investigation, the study procedures, and was assured the anonymity and confidentiality of the collected data. After the approval, in each pre-school, all children of the classes received a sealed envelope addressed to the parents with an invitation letter describing the objectives of the study and asking if they were interested in participating in the study, the confidentiality and that their responses were not linked with the participants' identification, contact details and instructions to return the completed questionnaire to the pre-schools within seven days, an informed consent form, a two-page anonymous self-administered questionnaire to be completed by only one parent, and two self-addressed envelopes for returning the questionnaire and the signed informed consent to the research team. Respondents were never contacted directly by the research team. Study participants were not monetarily compensated. To improve the response rate, the research team went to the schools about every three days after the first invitation to give a replacement questionnaire to the non respondents.

### Instrument

The self-administered questionnaire aimed to collect data in the following three sections: (i) socio-demographic characteristics (gender, age, marital status, educational level of respondent and of husband\wife\partner, occupation of respondent and of husband\wife\partner, number and ages of their children, birth-order of the selected child); (ii) self-reported vaccination status of the children and reasons for having delayed or refused at least a shot of the vaccines. Parents were asked if they had ever delayed or refused a shot of the following vaccines for their children: diphtheria, hepatitis B, *Haemophilus influenzae* type B, measles, mumps, poliomyelitis, rubella, tetanus, and varicella and the questions included categorical responses, such as yes, no, and do not know. Moreover, to investigate the reasons for having delayed or refused a shot of vaccines, the respondents had to choose from a list of reasons given. Vaccine hesitancy was measured using the Parent Attitudes about Childhood Vaccines Survey (PACV)[57] translated in Italian language and internal reliability was estimated through Cronbach's $\alpha$.[58] The PACV contain 15 items under 3 domains: vaccine behavior, beliefs about vaccine safety and efficacy, and general attitudes and trust. The total raw score range from 0 to 100 and a non-hesitant parent was defined with a score $<50$ and a hesitant with a value $\geq 50$; and (iii) trusted sources of information regarding vaccinations and if they perceive to need additional information. Survey questions were pretested on a random sample of 20 parents (not included in the final sample) for reliability, validity, and exhaustiveness and no changes were made in the questionnaire.

Ethical approval was sought from and granted by the Ethics Committee of the Teaching Hospital of the University of Campania "Luigi Vanvitelli" prior to study initiation.

### Statistical analysis

Data were analysed using the software Stata version 10.1.[59] The first level of analysis comprised a descriptive statistics of the main socio-demographic characteristics of the sample and of the answers to different questions. The second level of analysis has been completed using the strategy suggested by Hosmer & Lemeshow.[60] In particular, firstly, univariate analysis using chi-square test for the categorical variables and Student's t-test for the continuous variables were performed to identify association by comparing each independent variable with the different outcomes, and the variables with a $p$-value $< 0.25$ in univariate analysis were included in multivariate analysis. Secondly, multivariate logistic regression models were constructed to identify the association of independent characteristics which could affect the following dichotomous outcomes of interest: vaccine hesitancy (PACV score $<50 = 0$; PACV score $\geq 50 = 1$) (Model 1) and need of additional information about the childhood vaccinations (no = 0; yes = 1) (Model 2). The following characteristics of each respondent were included in both models: parent (father = 0; mother = 1), age in years ($\leq 35 = 1$; 36–45 = 2; $>45 = 3$), marital status

(unmarried = 0; married = 1), at least one parent with a baccalaureate/graduate degree (no = 0; yes = 1), at least one parent who is a healthcare worker (no = 0; yes = 1), birth-order of the selected child (first = 0; second = 1; ≥third = 2), number of children in household (none = 0; one = 1; more than one = 2), believed that many of the illnesses that shots prevent are severe (agree = 1; not sure = 2; disagree = 3), trust in pediatricians (sure = 1; uncertain = 2; not sure = 3), and receive information on childhood vaccinations from the pediatrician (no = 0; yes = 1). Moreover, concerned that vaccines might not prevent the diseases (concerned = 1; not sure = 2; not concerned = 3), concerned about a serious side effect from a shot (concerned = 1; not sure = 2; not concerned = 3), concerned that any one of the childhood shots might not be safe (concerned = 1; not sure = 2; not concerned = 3), need of additional information on the childhood vaccinations (no = 0; yes = 1), having delayed at least a shot of vaccine for their children (no = 0; yes = 1), and having refused at least a shot of vaccine for their children (no = 0; yes = 1) were included in Model 1. While, vaccine hesitancy according to PACV (no = 0; yes = 1), confident that following the recommended shot schedule is a good idea for the child (sure = 1; uncertain = 2; not sure = 3), and trust in the information received on childhood vaccinations (agree = 1; not sure = 2; disagree = 3) were included in Model 2.

A stepwise procedure was used to obtain the final models according with *p*-values for the variable inclusion and exclusion in the models respectively of >0.2 and <0.4. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated in the multivariate logistic regression analysis. The *p*-values were assessed using two-sided tests, with statistical significance taken as a cut-off of less or equal to 0.05.

## Disclosure of potential conflicts of interest

The authors report no conflict of interest.

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