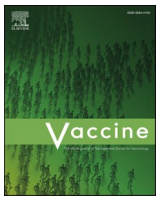
Vaccine 62 (2025) 127528

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine



Assessing vaccination intentions and perceptions among pregnant women in Italy: A multicenter cross-sectional study in the context of mandatory policies and the COVID-19 pandemic

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https://doi.org/10.1016/j.vaccine.2025.127528

Available online 31 July 2025

ARTICLE INFO

Keywords:
Vaccines
Children
Pregnancy
Survey
Beliefs

ABSTRACT

Background/objectives: Vaccinations significantly reduce the incidence of preventable diseases. Despite their benefits, childhood vaccination rates have declined in Italy since the mid-2010s, prompting the government to mandate certain vaccinations. This cross-sectional study aims to assess the intention to vaccinate their children and the perception of mandatory vaccinations among pregnant women in Italy after the COVID-19 pandemic and post-mandatory vaccination policies.

Methods: Participants over 18 years old recruited from 18 cities in Italy completed a questionnaire covering socio-demographic information, vaccination intentions, sources of information, and trust in vaccinations and the healthcare system. Descriptive analyses of the intention to vaccinate their children were carried out, and logistic regressions were performed to identify predictors of being in favor of mandatory vaccinations.

Results: Out of 2472 women, 98.8 % intended to vaccinate their upcoming children. High intentions were reported for rubella (91.7 %), measles (91.0 %), hepatitis B (90.4 %), and pertussis (90.4 %), while only 30.3 % intended to vaccinate against COVID-19. Healthcare professionals were the most trusted source of information. A total of 89.1 % of the women were in favor of mandatory vaccinations. Multivariable regression indicated that higher knowledge, risk perception, and trust scores were significant predictors of support for mandatory vaccinations.

Conclusions: These findings highlight the crucial role of healthcare professionals in shaping positive vaccination intentions, providing valuable insights for policymakers seeking to enhance vaccination coverage in the post-pandemic era.

1. Introduction

Vaccinations represent one of the most essential innovations in Public Health [1–3]. Vaccination programs significantly decreased the incidence of major preventable diseases [3]. However, like most preventive measures, the effectiveness of vaccines is not immediately tangible and perceptible, which leads to a portion of the population that poorly tolerates vaccinations, considers them dangerous, or has a low risk/benefit ratio perception (the so-called "prevention paradox") [4–6]. The recent SARS-CoV-2 pandemic and the consequent debate on the importance of vaccination against this disease demonstrated how vaccine hesitancy is still an issue [7].

In Italy, vaccination remains a cornerstone of disease prevention [8,9]; however, since the second half of the 2010s, coverage data have shown a decreasing trend for childhood vaccinations, especially for exanthematous diseases such as measles and rubella [10,11]. In response, in 2017, the Italian government increased the number of pediatric mandatory vaccinations from 4 to 10: Polio, Diphtheria, Tetanus, Hepatitis B, Pertussis (Whooping Cough), *Haemophilus influenzae* type B (Hib), Measles, Mumps, Rubella, Varicella (Chickenpox). People who do not comply with this obligation cannot attend school (from zero to five years old) or their parents receive pecuniary sanctions (children and adolescents from six to 16 years old) [12]. Mandatory vaccination seems to have positively affected vaccination coverage rates [13–15]; data from the years following the introduction of mandatory vaccination have shown a general improvement in vaccination coverage in early childhood compared to previous years [13–16]. In recent years, regions have made increased efforts in catch-up activities following the decline in coverage due to the impact of the SARS-CoV-2 emergency on routine vaccination activities [13,14]. However, coverage for Polio, used as a proxy for vaccinations contained in the hexavalent vaccine, and measles at 24 months, did not reach the 95 % threshold used as a general benchmark in public health communication to indicate optimal coverage levels for population protection [1,3]. The data, therefore, show that mandatory vaccination alone is not the only solution to the problem of low vaccination coverage. A recent study, conducted among Italian mother-child pairs, also showed modest or low vaccination coverage among pregnant women and for certain pediatric vaccines. While the 2017 mandatory vaccination law does not directly cover these populations, the findings underscore the role of inadequate information and counseling in contributing to suboptimal vaccine uptake [17]; thus, demographic and social determinants should be assessed and considered to understand the concerns and barriers that might affect correct vaccination choice [18–20]. Greater awareness of the importance of vaccines in the general population, especially among parents of infants and young children, who are responsible for deciding whether to administer pediatric vaccinations, needs to be raised [5]; in this context, it becomes necessary for healthcare professionals to equip themselves with all the necessary tools to promote the vaccination schedule to future and new parents. To make these tools as effective as possible, it is crucial to have objective data that evaluates the knowledge, perception, and behavioral intentions in the field of vaccination of future mothers.

Numerous studies have been conducted internationally on vaccine hesitancy, especially among parents [13,21–24]. In 2016, the Department of Public Health and Pediatric Sciences of the University of Turin coordinated a multicenter study (NAVIDAD - *Nozioni e Attitudini sui Vaccini dell'Infanzia nelle Donne in Attesa e loro Decisioni*— Knowledge and Attitudes about Childhood Vaccines in Pregnant Women and their Decisions) conducted in 14 Italian cities involving 1820 pregnant women, to assess attitudes and behaviors in the field of vaccination among future mothers [25,26]. However, the study was conducted before the mandatory vaccination policy and the SARS-CoV-2 pandemic, which likely influenced public perception of vaccinations [27,28].

The general objective of the entire study is to analyze, seven years after the previous survey and following the SARS-CoV-2 pandemic [4,5], knowledge, beliefs, and attitudes of future mothers about vaccination with pediatric vaccines. The aim is to lay the foundations for a useful tool to initiate effective prevention actions consistent with the context in which healthcare professionals operate.

Primary objectives of the present paper are:

- To investigate the vaccination intentions of future mothers for pediatric vaccines included in the national vaccination schedule;
- To analyze future mothers' perceptions of the mandatory nature of certain vaccinations for nursery and preschool enrollment;
- To analyze potential predictors of future mothers' perceptions of the mandatory nature of certain vaccinations for nursery and preschool enrollment (such as age, education level, occupation, trust in healthcare personnel, and vaccination knowledge).

The secondary outcome of the paper is to analyze the information sources that future mothers use to learn about vaccinations scheduled during childhood.

2. Materials and methods

This multicenter cross-sectional study involved 19 Centers from 18 Cities in the north, center, and south of Italy (Fig. 1), according to the division performed by the Italian Constituencies at the Elections for the European Parliament, as for the previous study [25,29]. The centers involved were all public hospitals providing gynecological and obstetric care under the Italian National Health Service (Servizio Sanitario Nazionale– SSN), which offers universal coverage. These centers serve as primary access points for pregnancy care in their respective geographic areas.

The sample included pregnant women over 18 years old who could understand what was written in the information and/or questionnaire and were recruited among patients awaiting gynecological examination, ultrasound examination, or hematological sampling in the reference hospitals of the participating centers. Women underwent a brief interview with adequately trained doctors. Potential interviewees were asked about their willingness to participate in the study, and they freely chose whether to participate once informed about its purposes and objectives. A detailed study description was provided, and the participants were asked to sign an informed consent form after an exhaustive explanation, a privacy information sheet, and a data processing consent form. The interview, lasting about 15–20 min, was conducted in a place suitable for the interviewee's privacy. Participation was voluntary, unpaid, and anonymous. Data was collected between February 2023 and April 2024. The Ethics Committee of the University of Turin approved the study (Prot. n. 0631966 30/12/2022).

2.1. The questionnaire

The questionnaire comprised seven sections with multiple questions/statements, following the structure of the previous study on this topic [25,26]. A few changes have been made to add items about COVID-19 and to update a statement about the perception of mandatory vaccinations. Specifically, two additional vaccine-related items were included (HPV and COVID-19). The HPV item was added to explore anticipatory attitudes toward adolescent vaccines, which can be shaped by early parental perceptions [25,26]. The COVID-19 item was included due to its relevance in the recent public health context, despite national recommendations at the time focusing on at-risk children only.

The first section of the questionnaire investigated socio-demographic and pregnancy-related variables (such as the trimester of pregnancy or the number of children); the second section assessed whether the future mother would vaccinate her child and, if yes, for which type of vaccines; the third section investigated the sources of information about vaccinations; the fourth section assessed the degree of trust about the actors involved in the entire vaccination process; the fifth section explored risk perception about vaccine-preventable diseases; the sixth section the knowledge and beliefs about vaccinations; and the last section (composed of only one question) the interviewees' perception of the restoration of mandatory vaccines. Further information about the questionnaire is available in the supplementary material (S1).

2.2. Sample size

As for a previous study on the same topic [25], the expected prevalence of complete trust in the effectiveness, safety, and usefulness of

Fig. 1. Italian cities involved in the study.

vaccinations among pregnant women was estimated at 9 %. Based on this estimate, the sample size was calculated using EpiInfo software, assuming a 95 % confidence level and a precision of ±1 %. This yielded a required sample size of 100 to 170 pregnant women per city, depending on the number of newborns in the municipalities of each participating center. A total of 2472 questionnaires were collected. Although all eligible pregnant women accessing the participating centers during the data collection period were invited, no log was systematically kept of those who refused participation. Thus, the acceptance rate could not be calculated.

2.3. Statistical analysis

Questionnaires were processed using Stata18 Statistical software (Stata Corp, 2023). A descriptive analysis of all the variables was conducted. The Shapiro-Wilk test assessed the normality of the variables included in the analysis. Therefore, absolute numbers and percentages were used for categorical variables and means and standard deviations for continuous variables.

Primary outcome variables of the study were:

- willingness to vaccinate the children (WV outcome);
- being in favor of the vaccination obligation for attending nursery school and kindergarten (MV – "mandatory vaccination" outcome);

The secondary outcome assessed which information sources pregnant women used about vaccination. This outcome is composed of thirteen potential sources of information, for each of which women have to indicate the usefulness on a scale from 1 (less useful) to 5 (more useful) and the reliability on a scale from 1 (less reliable) to 5 (more reliable). In this classification, healthcare professionals (e.g., gynecologists, pediatricians, general practitioners) were considered as sources of information when the communication occurred face to face, during consultations or direct interactions. Conversely, tools such as television, social media, websites, and smartphone applications were considered as communication channels, since in these cases the information was accessed indirectly, without personal interaction. See supplementary material (S1) for the details.

Chi^2 and *t*-tests were performed to assess statistically significant differences in socio-demographic characteristics, knowledge, trust, and risk perception scores between women who declared to be in favor of mandatory vaccination for access to nursery school and kindergarten (MV outcome) and those who did not; *t*-tests were also performed to assess the perceived usefulness and reliability of various information sources between women who used no-vax sources and those who did not.

Univariable and multivariable logistic regression models were then conducted to estimate the impact of socio-demographic, pregnancy-related, trust in healthcare system-related, knowledge-related, and beliefs-related variables on the same MV outcome. Regarding knowledge and beliefs about vaccination, a score (KB score) composed of the answers to thirteen questions in the sixth section of the questionnaire was implemented based on what had been done in the previous NAVIDAD study [25], to ensure continuity and comparability across the two surveys conducted seven years apart. Although this score is not based on internationally validated tools [18,19], it was developed through expert consensus, piloted, and refined within the Italian context during the NAVIDAD study. The score ranged from zero (no knowledge) to thirteen (complete knowledge). "Don't know" answers were included as wrong answers. Internal consistency of the KB score was assessed using Cronbach's alpha, which yielded a value of 0.82, indicating good reliability of the scale.

Regarding risk perception, a score (RP score) that summed the answers to the fourteen statements in the fifth section of the questionnaire was used. The statements indicated the perceived risk for sixteen vaccine-preventable diseases. The answers ranged from 1 (low-risk perception) to 4 (high-risk perception), and the overall score ranged from 14 to 56. Each disease was given equal weight in the final score. This choice was made to reflect the subjective perception of risk rather than an epidemiological assessment of severity or incidence, and to allow comparison with the 2016 NAVIDAD study, which used the same structure [25]. Internal consistency of the RP score was assessed using Cronbach's alpha, which yielded a value of 0.92, indicating strong internal reliability of the scale.

Trust in vaccines, vaccination, vaccination actors, and the national Italian healthcare system was assessed through a score (TV score) made by the sum of the nine answers to the statements of the fourth section of the questionnaire. Potential answers to the statements were "completely disagree," "disagree," "agree," and "completely agree." The final score ranged from zero (no trust) to 27 points (complete trust), with higher scores representing higher trust. Internal consistency of the score was assessed using Cronbach's alpha, which yielded a value of 0.68. Although the internal consistency was within the lower acceptable range, the multidimensional nature of the construct—encompassing trust in professionals, institutions, and motivations—may explain the alpha value obtained [30]. Therefore, the score was retained due to its theoretical relevance, alignment with previous literature, and its contribution to the explanatory model. [31,32]. Further details can be found in the supplementary material (S1).

All the covariates included in the final multivariable regression models were selected using a stepwise forward selection process, with the criterion of a *p*-value at univariable <0.25 [33]. These associations were expressed as odds ratios (OR) at a 95 % confidence interval (CI), and a *p*-value of 0.05 was considered significant for all analyses.

3. Results

3.1. Descriptive analysis of independent variables

A total of 2472 women completed the interview, of which 90.7 % were Italians. The mean age was 32.4 years (Standard Deviation (SD) ±5.4), and the most represented study title was "higher education" (47,7 %). A total of 1475 women (59.9 %) were at their first pregnancy, and 18.6 % were in the first trimester (Table 1). Regarding the Knowledge and Beliefs (KB) score, the results showed a mean of 9.0 (SD ± 3.1). The mean Risk Perception (RP) score was 35.1 (SD ±8.4). The mean Trust in vaccines (TV) score was 18.6 (SD ± 4.0) (Table 1). These results are in line with the socio-demographic characteristics of the sample of the previous study on this topic, that have been published elsewhere [25].

3.2. Primary outcomes

Overall, 2427 women (98.9 %) were willing to vaccinate their future children (Table 1). Regarding the vaccinations, 91.7 % of the sample intended to vaccinate them against rubella, 91.0 % against measles, 90.4 % against hepatitis B, 90.4 % against pertussis, and only 30.3 % against COVID-19. The mean of vaccinations the women declared they wanted to administer to their children was 12,1 (SD ±3.9) (out of 16 vaccines/vaccine-preventable diseases considered). About the ten mandatory vaccinations (against Diphtheria, Tetanus, Pertussis, *Haemophilus influenzae* type B, Hepatitis B, Poliomyelitis, Rubella, Mumps, Chickenpox, Measles), the mean of vaccinations that women declared they wanted to be administered to their upcoming child was 8.1 (SD ±2.4). The full results of this section are presented in Table 1, Fig. 2 and supplementary material S2.

Concerning future mothers' opinions about the mandatory nature of certain vaccinations for nursery and preschool enrollment (MV outcome), a total of 2112 women (89.1 %) stated that they favor this legislative measure (Table 1). Significantly higher percentages of women who declared to favor "mandatory" vaccinations were observed among Italians, those who were married or cohabitants, those who had a higher educational level, those who lived in the north of Italy, and also among healthcare professionals. The KB score, TV score, and RP score

Table 1
Descriptive analysis of the sample ($N = 2472$).

Variable		N	%
Nationality	Italian	2216	90.7 %
Age	Mean (standard deviation)	32.4	±5.4
Marital status	Married or cohabitant	2317	94.0 %
Study title	Lower than college degree	1276	52.3 %
	College degree or higher	1165	47.7 %
Location in which the questionnaire has been administered	North of Italy	907	36.7 %
	Center of Italy	672	27.2 %
	South of Italy	893	36.1 %
Profession	Manager /self-employed	341	13.9 %
	Employee	1152	46.9 %
	Healthcare professional	227	9.2 %
	Not employed /student	736	30 %
First pregnancy	Yes	1475	59.9 %
Trimester	1	456	18.6 %
	2	426	17.4 %
	3	1567	64.0 %
Willingness to vaccinate the child	Yes	2427	98.9 %
Number of vaccines women were willing to administer to their child	Mean (standard deviation)	12.1	±3.9
KB[a] score	Mean (standard deviation)	9.0	±3.1
TV[2]score	Mean (standard deviation)	18.6	±4.0
RP[3] score	Mean (standard deviation)	35.1	±8.4
In favor of mandatory vaccinations	Mean (standard deviation)	2112	89,1 %

[1] "knowledge and beliefs" score
[2] "trust in vaccinations" score
[3] "risk perception" score

were significantly higher among women who declared that they were in favor of "mandatory" vaccinations. Full results are presented in supplementary material (S3).

The logistic regressions conducted to identify potential predictors of being in favor of the mandatory nature of certain vaccinations for preschool enrollment (MV outcome) showed that, after adjusting for potential confounding factors, the number of vaccines the mother is willing to deliver to her child is positively associated with MV (adj Odds Ratio (OR) 1.06, $p = 0.009$). Also, higher KB, RP, and TV scores were positively associated with MV (adjOR 1.29, $p < 0.001$, adjOR 1.10, $p < 0.001$, and adjOR 1.05, $p < 0.001$, respectively) (Fig. 3). Full results (including univariable analysis) were presented in the supplementary material (S4).

3.3. Secondary outcome and other independent variables

A total of 1948 women (79.7 %) received information about vaccinations from healthcare professionals and/or independently informed themselves about vaccines and vaccinations (data not shown). Among those, 41.1 % declared they got information from their gynecologist, 38.6 % from pediatricians, 34.6 % from GPs, 39.8 % from peers, friends, and acquaintances (namely "word of mouth"), and only 6.4 % from smartphone applications. About the information sources pregnant women declared to use about vaccination, the most useful one was the pediatrician, with a mean of 4.5, SD ±0.9. The less useful was considered the non-institutional websites (mean 1.5, SD ±1.6), the mass-media mean 2.6, SD ±1.2), and the no-vax associations (mean 2.0, SD ±1.4). Regarding the reliability of the information sources, the more reliable were considered the pediatrician and the gynecologist, while the less reliable were the noninstitutional websites and the no-vax associations. Complete results of the information sources are available in Fig. 3 and the supplementary material (S5).

Women who reported using no-vax sources of information rated most institutional and healthcare-related sources as significantly less useful and less reliable compared to those who did not use no-vax sources. For example, mean usefulness scores for general practitioners, pediatricians, and institutional websites were lower among no-vax source users ($p = 0.02$, 0.03, and 0.0002, respectively). Similarly, reliability scores for pediatricians, vaccination clinics, and institutional websites were significantly lower among no-vax users ($p = 0.02$, 0.0074, and 0.0002, respectively). In contrast, non-institutional websites and apps were rated as more useful and reliable by those who used no-vax sources ($p < 0.01$) (table S6-S7).

Regarding knowledge and beliefs, it must also be highlighted that 37.1 % of the sample believe that the disease for which vaccination is given is often less dangerous than the vaccine itself, and 37 % that serious vaccine side effects are hidden (data not shown).

4. Discussion

The present multicenter cross-sectional study aimed to assess vaccine trust, perception about mandatory vaccinations, and behavioral intentions about pediatric vaccines included in the national vaccination schedule among pregnant women in Italy seven years after a survey in the same setting and in the context of the post-COVID-19 pandemic and mandatory vaccination policies [25,26]. The study revealed that a significant majority of women (98.9 %) intend to vaccinate their children. This is in line with the previous study on this topic, which shows a percentage of no willingness of 1.9 % [25]. Intention levels for vaccines such as rubella (91.7 %), measles (91.0 %), hepatitis B (90.4 %), and pertussis (90.4 %) were relatively high, but still below the threshold of 95 %. These values reflect a generally favorable attitude, though they fall short of what might be expected following the implementation of mandatory vaccination policies. In this regard, national immunization coverage data confirm an overall improvement in pediatric vaccine uptake since the introduction of the mandatory vaccination law in 2017. For example, measles vaccine coverage at 24 months increased from approximately 87 % in 2016 to over 94 % in 2018, while tetanus vaccine coverage rose from below 94 % to above 95 % in the same period [10,34]. These gains have mainly been sustained over time, despite the disruptive impact of the COVID-19 pandemic, suggesting a positive effect of the legislative measure on actual vaccination behaviors. Several factors may have contributed to this increase, including public health communication efforts during and after the COVID-19 pandemic, broader media exposure, and the implementation of mandatory vaccination policies in 2017 [5]. However, the decline in childhood vaccination rates observed since the mid-2010s underscores ongoing challenges. A study by Lo Moro et al. highlighted the impact of misinformation and the importance of continuous education and outreach efforts to maintain high vaccination rates [35]. The positive impact of mandatory vaccination policies introduced in 2017 is evident, but the present study indicates that further efforts are needed to address vaccine hesitancy comprehensively [36]. Nevertheless, it should be acknowledged that, due to the cross-sectional design of the present study and of the previous one on this topic [25,26], it is not possible to establish causal relationships or to disentangle the specific impact of individual factors—such as the 2017 mandatory vaccination law, pandemic-related communication efforts, or changes in public perception—on the

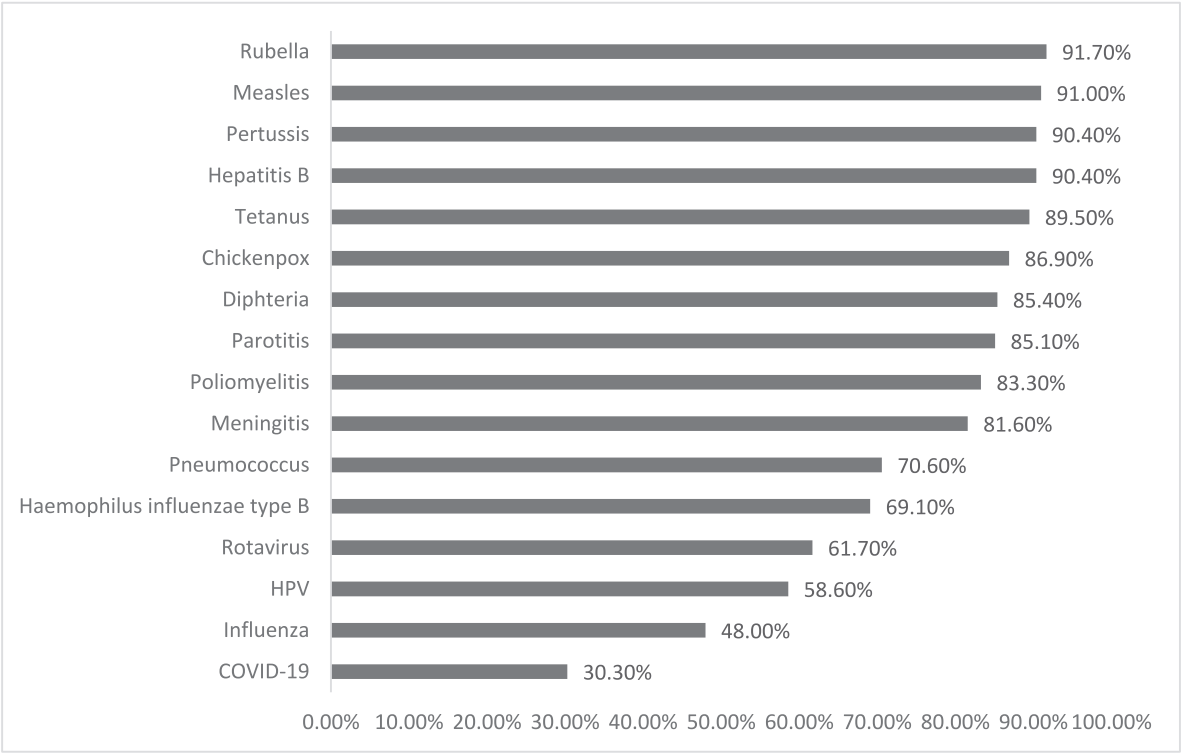

Fig. 2. Percentages of women who are willing to vaccinate their future child.

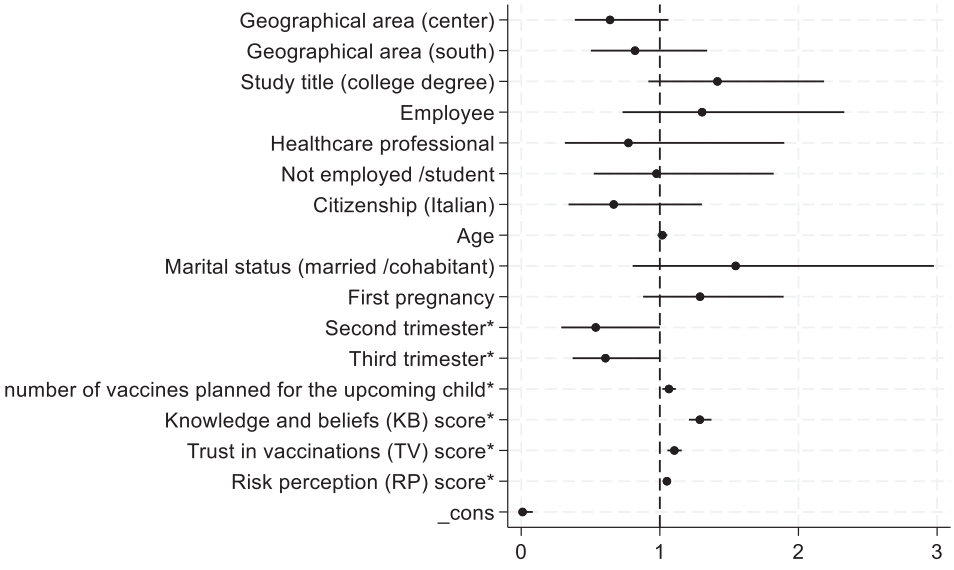

Fig. 3. Logistic multivariable regression model assessing predictors of being in favor of the vaccination obligation for attending nursery school and kindergarten. The model is adjusted for all the independent variables included in the figure, and for the willingness to vaccinate the upcoming child. Results are expressed as odds ratio and 95 % confidence interval.

observed vaccination intentions.

Regarding mandatory vaccinations, the study's findings on the willingness to vaccinate are consistent with national trends observed before the COVID-19 pandemic [10,11,37]. Data shows that the intention to vaccinate was generally high for most mandatory vaccines, such as rubella, measles, and hepatitis B. However, other mandatory vaccines, such as *Haemophilus influenzae* type B, received notably lower levels of intention, suggesting that mandatory status alone may not fully explain vaccine acceptance. These findings highlight the potential influence of other factors, such as perceived disease severity, trust, and familiarity with the vaccine [25,26]. Further research is needed to better understand whether and how partial adherence to mandatory vaccination affects acceptance of recommended vaccines.

Conversely, the very low intention to vaccinate against COVID-19 somehow contrasts with studies conducted on the same or similar topics in other countries during the pandemic. The comparison must be approached cautiously, considering the evolution of recommendations over time. When the questionnaire was administered, the recommendations only included COVID-19 vaccination for children deemed "at risk," specifically those with certain chronic conditions [38]. It must also

be noted that the present survey was conducted after the pandemic, with a lower risk perception about COVID-19, which also affected adult vaccinations [39]. Previous studies about the willingness to vaccinate their children showed percentages of vaccine hesitancy of 30–35 % [40,41]. Studies that investigated the willingness of future mothers to vaccinate themselves against COVID-19 showed percentages of vaccine hesitancy lower than 50 % [42,43]. Other vaccinations, particularly those against HPV and influenza, have not reached satisfactory percentages besides COVID-19 [44]. These lower intention rates may reflect different underlying reasons, including perceived irrelevance to early childhood, limited familiarity with the diseases, lower perceived severity, or the absence of a legal requirement, [45–47], even though the Italian Ministry of Health has recommended that children as young as six months be vaccinated against seasonal influenza [48,49]. The low intention to vaccinate against COVID-19 and HPV was somehow expected, considering current recommendations and target ages. However, their inclusion in the questionnaire of questions about COVID-19 and HPV provided useful insight into anticipatory attitudes and residual hesitancy. The low scores reported for these vaccines may also reflect not only a lack of urgency but also limited familiarity or lingering concerns, especially regarding COVID-19. As such, lower scores may be interpreted more as a reflection of current guidelines and target age groups, rather than outright refusal or vaccine hesitancy.

Regarding the sources of information women use about vaccinations, the present study highlighted the importance of healthcare professionals, with pediatricians, gynecologists, and GPs being rated as the most useful and reliable, emphasizing the influence of healthcare professionals on parental decision-making regarding vaccinations [25,26]. Only “word of mouth” was used as a source of information by similar percentages of women (around 39 %) but with less declared usefulness and reliability. This underscores the importance of healthcare professionals in building knowledge, attitudes, and behaviors about vaccinations among future mothers [5,50]. Institutional websites and vaccination centers were also used by future mothers as information sources and considered reliable. Since healthcare professionals managed both these sources of information, this confirms the need for healthcare professionals to be the first and most “vaccine enthusiasts” [5,50]. It is also interesting to notice that “no-vax associations” were consulted as a source of information by only a very small percentage of women. In the previous study conducted in 2016 [25], the primary sources of vaccination information were websites, pediatricians, institutional and noninstitutional websites, and word of mouth and mass media, highlighting a more heterogeneous use of sources of information.

However, the observed differences in perceived usefulness and reliability of information sources suggest that women who report using no-vax sources may also exhibit lower trust in institutional and healthcare communication channels. This finding is consistent with the hypothesis that vaccine-hesitant individuals may be less receptive to traditional sources of information and more inclined to trust alternative or informal channels [51]. These insights highlight the importance of identifying effective strategies to reach this subgroup — possibly through diversified communication pathways or trusted intermediaries — to counteract misinformation and promote informed vaccination decisions.

The results of the present paper also showed that almost 90 % of the women interviewed were in favor of “mandatory” vaccinations for preschool enrollment (MV). These results were higher than those of the previous survey (85.5 %) [25]. A comprehensive systematic review on this topic also showed lower percentages [27]. Chi^2 tests, *t*-tests, and logistic regression models identified several predictors for being in favor of “mandatory” vaccination, including the total number of vaccines mothers intended to administer, higher knowledge and beliefs about vaccinations (KB score), higher risk perception (RP score), and greater trust in vaccines and the healthcare system (TV score). The previous survey on this topic, conversely, showed that support for mandatory vaccination was higher among women intending to vaccinate their next child, those seeking information from official vaccination services, and those trusting healthcare professionals. Conversely, agreement with compulsory vaccination was lower among individuals influenced by anti-vaccination sources or those perceiving economic or biased motives behind healthcare professionals’ communication [25]. A systematic review found that parents with higher knowledge about vaccines and their benefits were more likely to support mandatory vaccination policies. This study emphasized the role of comprehensive knowledge in shaping positive attitudes toward vaccination mandates [52]. Risk perception also plays a crucial role; higher perceived susceptibility to vaccine-preventable diseases correlates with greater acceptance of vaccines. A European study by Karafillakis et al. (2019) found that parents who perceived higher risks associated with diseases like measles were more supportive of vaccination requirements [53]. This is consistent with our findings, where a higher RP score was a significant predictor of support for mandatory vaccination. Trust in vaccinations and the healthcare system (TV score) emerged as another critical factor influencing vaccination thoughts and consequent behaviors. International studies in different settings have consistently highlighted the importance of trust in healthcare providers and systems influencing vaccination hesitancy [52,54,55]. A study demonstrated that parents with greater trust in the medical community were more likely to vaccinate their children and support vaccination mandates [56]. This mirrors the results of the present paper, where higher TV scores were linked to more robust support for mandatory vaccination policies. Other studies found similar results concerning the relationship between the education and age of the mothers and the support for mandatory vaccinations [27]. A recent study found that caregivers who have higher education and older caregivers were more likely to plan to vaccinate their children against COVID-19 [36]. Conversely, no significant differences in attitudes and perceptions between primiparous and multiparous women were observed across the main outcomes, suggesting that prior parental experience does not appear to be a strong determinant of vaccination attitudes during pregnancy [57].

4.1. *Strengths and limitations of the project*

One of this study’s strengths is its large and geographically diverse sample, encompassing 2472 pregnant women from 19 centers across Italy. This comprehensive coverage enhances the generalizability of the findings to the broader population of future mothers in Italy. The study also benefits from a robust methodology, including face-to-face interviews conducted by trained professionals, which likely improved the accuracy and reliability of the collected data. Another strength is the detailed assessment of various factors influencing vaccination intentions, including socio-demographic variables, knowledge, perceptions, and trust. This multifaceted approach provides a comprehensive understanding of the determinants of vaccine acceptance and highlights areas for targeted interventions. Furthermore, following the implementation of mandatory vaccination policies and the COVID-19 pandemic, the study’s timing allows for comparing future mothers’ beliefs, attitudes, and behaviors regarding vaccinations in the pre-and post-mandatory and pre-and post-pandemic periods. Moreover, the study was conducted seven years after a similar study on this topic, allowing a comparison between the results and offering a broad panoramic view of things that improved and those that remain critical [25,26].

Despite its strengths, the study has some limitations. Firstly, the cross-sectional design only captures a snapshot and cannot establish causal relationships between the identified predictors and the outcomes. Longitudinal studies would be necessary to confirm these associations and understand attitude changes over time. Secondly, the reliance on survey data may introduce response bias, as participants may provide socially desirable answers, particularly in a face-to-face interview setting. Due to the setting in which the study was performed, another limitation is represented by the potential “loss” of pregnant women who are under the care of private gynecologists. Another limitation is the lack

of a random sampling design and the unavailability of data on the number of women who declined participation, which prevents the calculation of a response rate and limits the representativeness of the sample. Moreover, despite collecting detailed socio-demographic data, post-stratification weighting was not applied, which may have resulted in the overrepresentation of specific subgroups. E.g., the percentage of women in higher education in the present study was 47.7 %. This proportion is higher than the national average for persons aged 25–34 in Italy, which is around 30 % according to recent ISTAT data, suggesting a potential overrepresentation of more educated individuals [58].

Furthermore, although the knowledge, risk perception, and trust scores were based on structured multi-item sections of the questionnaire and showed good internal coherence, they were not constructed using internationally validated tools [18,19]. This limits direct comparison with international studies and should be considered when interpreting the results. However, the choice was deliberate to ensure consistency with the previous NAVIDAD study and facilitate national comparisons over time. Regarding the moderate internal consistency of the trust score (TV score), with a Cronbach's alpha of 0.68, although this value is below the conventional threshold of 0.70, it is considered acceptable in public health research when dealing with complex and multidimensional constructs. [30] The decision to retain the score was based on its theoretical relevance, comparability with previous studies, and its added explanatory value in the multivariable model. It should also be noted that, although this study focused on pregnant women, decisions regarding childhood vaccination are often made jointly by both parents. Emerging literature suggests that fathers can play a significant role in shaping vaccine attitudes and decisions within the family context [59]. Future studies could benefit from including both parents to better understand the dynamics of shared decision-making and the influence of paternal perspectives. Finally, the study did not explore the reasons behind the low intention to vaccinate in detail, which could have provided valuable insights into addressing specific concerns related to this vaccine.

5. Conclusions

This study comprehensively analyzes the perception of mandatory vaccinations and behavioral intentions about pediatric vaccines included in the national vaccination schedule among pregnant women in Italy in the context of post-pandemic and post-mandatory vaccination policies. It highlights the high overall willingness to vaccinate and the critical role of healthcare professionals in influencing these decisions. The findings of this study have important implications for public health, particularly in the context of improving vaccination coverage among children. The high willingness to vaccinate their children with most of the vaccines included in the vaccination schedule is encouraging and suggests that existing public health strategies are effective in these areas. However, the lower intention to vaccinate against some diseases highlights a critical area for intervention. Enhancing the role of pediatricians and gynecologists in vaccination counseling could be a key strategy, given their high perceived reliability and usefulness as information sources [60].

Additionally, the study underscores the need for targeted education efforts to improve vaccination knowledge and risk perception. This could include developing educational materials that address common misconceptions and provide evidence-based information about the benefits and safety of vaccines, as well as specific vaccination education programs during the birthing preparation course [61]. In addressing vaccine hesitancy, it is crucial to recognize the importance of knowledge and enabling and reinforcing factors. Enhancing knowledge is essential, but it must be accompanied by developing skills and competencies to be effective [60]. Enabling factors, including supportive policies and robust healthcare infrastructures, significantly shape attitudes and behaviors toward vaccination. Moreover, the influence of peer relationships is paramount; social support and peer norms can reinforce positive vaccination behaviors [62,63].

The study also emphasizes the need for continued monitoring and research to understand the evolving attitudes toward vaccinations, particularly considering significant public health events like the COVID-19 pandemic. Addressing the identified gaps and leveraging the strengths of healthcare systems can further improve vaccination rates and protect public health.

CRediT authorship contribution statement

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Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Institutional review board statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the University of Torino (Prot. n. 0631966 30/12/2022).

Funding

This research received no external funding.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Pier Luigi Lopalco received financial support for consultancy and/or participation to conferences and advisory boards from GSK, Moderna, MSD, Novavax, Pfizer, Sanofi, Seqirus. All the other authors declare no conflict of interest.

Acknowledgments

Diana Caputo, Maria Rosaria Sponziello, Emanuela Pitardi, Maria Costa, Adriana Romano, Maria Giovanna Argentieri, Bee Vega, Aprile Totaro, Cosima De Filippo, Valeria Viva, Emanuela Maniera, Maria Grazia Varì, Riccardo Mimmo, Gaia Baccarini, Roberta Carestia, Dania Clemente, Anna Dominici, Paola Fioretti, Camilla Gobbetti, Ivana Lanzafame, Elisa Lorenzini, Chiara Lupi, Cristina Martino, Francesco Paciosi, Monica Paoloni, Laura Piergentili, Michele Vece.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2025.127528.

Data availability

Data will be made available on request.

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