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Original article

The determinants of vaccination against pertussis in pregnancy: A survey at the Obstetrics and Gyneacology Unit of the University Hospital of Parma

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Abstract. *Background and aim of the work:* Vaccination of pregnant women against pertussis is highly effective in decreasing the risk of pertussis among them and their infants. This study aimed to assess the determinants of pertussis vaccination uptake in pregnant women. *Research design and Methods:* A monocentric study was conducted at the Obstetrics and Gyneacology Unit of the University Hospital of Parma, from July to September 2021. An anonymous questionnaire was administered to pregnant women on a voluntary basis. The questionnaire comprised 31 questions and provided socio-demographic characteristics and information on determinants of maternal dTaP vaccination. *Results:* A total of 100 pregnant women were enrolled in the study, of whom 72% had been vaccinated against pertussis, with dTaP vaccine. Eighty-six per cent of the participants stated that they had received adequate information from health professionals, with a statistically significant association between this determinant and vaccination adherence. The main reasons for adherence were the health of their child (91.6%) and the attention to the recommended vaccinations (34.7%). Among the reasons for non-adherence, were the difficulty in making an appointment at the vaccination centre (39.2%) and not considering the vaccination necessary (25%). Citizenship, educational level, number of children and knowledge of vaccination were not statistically significant. *Conclusions:* The results of the study highlight a satisfactory adherence to vaccination and a good knowledge of the safety of the vaccine during pregnancy. However, a higher level of adherence could be achieved by implementing educational interventions on vaccination during checkups and antenatal classes, as well as by including the dTaP vaccination as part of routine antenatal care. (www.actabiomedica.it)

Key words: pertussis, pregnancy, vaccination, women, healthcare professional

Introduction

Pertussis is a highly contagious acute respiratory disease caused by a Gram-negative coccobacillus, *Bordetella pertussis*, which can infect the ciliated epithelial cells of the human respiratory tract (1). Humans are the only known reservoir of the bacterium, and consequently, transmission of the disease occurs exclusively between humans. It spreads through airborne droplets (Flügge droplets) and can affect all age groups, particularly infants. In newborns and children under one year of age, pertussis can be very severe and even fatal;

particularly in the first three months, infants are at a higher risk of morbidity and mortality due to early infections, often requiring hospitalization in neonatal intensive care units (2-5). After a few years of limited circulation in the EU/EEA, particularly during the COVID-19 pandemic, more than 25,000 cases of pertussis were reported in 2023, and more than 32,000 between January and March 2024 (6). In Italy, in March 2024 there was an incidence of pertussis of 9.9 cases per million inhabitants (6). The main measure to address the problem is the use of safe and effective vaccines both in early childhood and during pregnancy (6-8). Vaccinating pregnant women with the acellular pertussis vaccine is safe for both mother and baby (9-12). The maternal antibodies (IgG) produced and transplacental transferred to the fetus, persist in the neonatal circulation after birth, providing protection against infection, delaying its onset, and reducing the severity of the disease in the newborn during the first months of life. Consequently, maternal immunization is increasingly recognized worldwide as a unique approach to protecting newborns during their most vulnerable period until they are able to respond adequately to active immunization. In Italy, the National Vaccination Prevention Plan (PNPV) 2017-2019 (13) represented a new paradigm for promoting vaccination across all ages. One of the key innovations of PNPV 2017-2019 was the introduction of the active offer of pertussis vaccination during pregnancy, with the combined dTaP (diphtheria-tetanus-acellular pertussis) vaccine, recommending it be administered in the third trimester, preferably between the 27th and 36th weeks of gestation. Despite the benefits of pertussis immunization, vaccination coverage rates among pregnant women remain low (12,14,15). The success of a vaccination program depends on several factors, including knowledge and awareness of the benefits of vaccines for those at risk (16-19). Investigating the reasons why pregnant women accept or refuse vaccination can provide valuable insights for optimizing preventive interventions through a combination of strategies. Vaccine hesitancy may stem from a lack of accurate information, making it essential for healthcare professionals to create more opportunities for the population to access reliable information. A vaccine education intervention delivered during pregnancy, when women are particularly sensitive to their health and that of their child, can have a highly positive impact and should always be included in the structure of childbirth preparation courses. Although several studies have been conducted about the adherence to vaccination against pertussis during pregnancy, the available literature is still limited. This study aims to investigate the determinants of maternal pertussis vaccination adoption among pregnant women attending the "Full-Term Pregnancy Care Clinic" at the Obstetrics and Gyneacology Unit of the University Hospital of Parma.

Materials and Methods

This observational monocentric study was conducted at the "Full-Term Pregnancy Care Clinic" at the Obstetrics and Gyneacology Unit of the University Hospital of Parma, after receiving ethical approval from the Area Vasta Emilia Nord Ethics Committee (session held on July 6, 2021). All pregnant women aged 18 years or older who accessed the Full-Term Pregnancy Care Clinic within the childbirth preparation pathway, from July to September 2021, were enrolled. The care service included an interview, the completion of the mother and newborn's medical records, the review of pre-labor tests, a maternal-fetal well-being check, and the provision of information on childbirth. Access to the Clinic was by appointment through CUP (Unified Booking Centre) or in emergencies, with appointments recommended between the 32nd and 34th weeks of pregnancy to ensure care was provided around the 36th week. The service was available to women with physiological pregnancies who have been followed by the family clinic or a private Gyneacologist. A previously validated questionnaire (14) was proposed at the end of the "taking charge" interview, filled out by the women who expressed their consent to participate in the study and returned at the end of the service care. The questionnaire was administered in English to women with a language barrier. The responders were informed and agreed to the use of anonymous data by Italian and European Data Protection legislation. The questionnaire contained 31 questions and was divided into 2 sections. The first section provided socio-demographic items, and the

second section gathered information on determinants of maternal dTaP vaccination during pregnancy. For data analysis, a descriptive analysis of the variables was performed, reporting percentage frequencies. Contingency tables and statistical significance tests, including Chi-square tests, Fisher's exact test, and Mann-Whitney tests, were performed to analyze the correlation with certain variables, regarding factors that could represent determinants of adherence to the recommended maternal pertussis vaccination during pregnancy. A p value <0.05 was considered statistically significant.

Results

A total of 100 women who accessed the "Full-Term Pregnancy Care Clinic," at the Obstetrics and Gyneacology Unit of the University Hospital of Parma, were enrolled in the study between July and September 2021: 98 completed the questionnaire in Italian and 2 in English. The socio-demographic characteristics of the respondents are shown in Table 1.

Seventy percent of women enrolled were aged 30 or older, 79% were Italian, and 93% of participants resided in the province of Parma. Forty-five percent of the women were primiparous, 55% were multiparous. Regarding education level, most women had a medium-high level of education: 44% had a university degree, 43% had a high school diploma, and 13% had a middle school degree.

Seventy-six percent of women reported being employed, 13% were homemakers, 10% were unemployed,

Table 1. Socio-demographic characteristics of women enrolled at the "Full-Term Pregnancy Care Clinic".

	N. (%)
Age (years)	**< 30** 30 (30%)
	≥30 70 (70%)
Parity	**Primiparous** 45 (45%)
	Multiparous 55 (55%)
Residence	**Province of Parma** 93 (93%)
	Outside of province of Parma 7 (7%)
Citizenship	**Italian** 79 (79%)
	Other 21 (21%)
Education	**Middle school** 13 (13%)
	High school 43 (43%)
	University degree 44 (44%)
Employment status	**Homemaker** 13 (13%)
	Employed 76 (76%)
	Unemployed 10 (10%)
	Student 1 (1%)
Marital status	**Married** 52 (52%)
	Unmarried 46 (46%)
	Separated/Divorced 2 (2%)
	Widow 0
Partner's citizenship	**Italian** 76 (76.7%)
	Other 23 (23.3%)
Partner's education	**Middle school** 20 (20.3%)
	High school 57 (57.5%)
	University degree 22 (22.2%)
Partner's employment status	**Employed** 98 (99%)
	Unemployed 1 (1%)
	Student 0

and 1% were a student. Almost all the women had a partner, and among them, 76.7% were in a relationship with an Italian citizen. Among the partners, 57.5% had a high school diploma, 22.2% a university degree, and 20.3% a middle school degree. Furthermore, 98% of the partners were employed, while only 1% were unemployed. Thirty-six percent of the pregnant women were in their 36th week of gestation, 29% were in their 37th week, 21% were in a gestational period before the 36th week, 11% were in their 38th week, and 3% were in their 39th week (Table 2). When pregnant women were questioned about the healthcare professional responsible for their antenatal care, 58% stated that it was the Gyneacologist, and the Midwife in 40% of cases. Additionally, 62 % of participants were followed at a family clinic, 32% in a private practice, and 6% in a hospital.

Table 2. Information on the current pregnancy of women enrolled at the "Full-Term Pregnancy Care Clinic".

	N. (%)
Gestational Age (weeks)	<36th 21 (21%)
	36th 36 (36%)
	37th 29 (29%)
	38th 11 (11%)
	39th 3 (3%)
Current pregnancy	Single 100 (100%)
	Twin 0
Healthcare provider	Gyneacologist 58 (58%)
	Midwife 40 (40%)
	General Practitioner 0
	Other 2 (2%)
Location of pregnancy visits	Gyneacologist 6 (6%)
	Private Practice 32 (32%)
	The consulting room 62 (62%)
	Other 0

Regarding maternal pertussis vaccination, 90% of women had discussed the possibility of being vaccinated during pregnancy with one or more healthcare professionals, while 10% had not received any information. Eighty-six percent of vaccinated women reported receiving exhaustive information, while 8% said not receive exhaustive information. In 55% of cases, the healthcare professional who recommended dTaP vaccination during pregnancy was the Gyneacologist and in 42% of cases, it was the Midwife. The recommendation occurred mainly during a routine visit (85%), with 6% mentioning another way (not specified) and 2% during a childbirth preparation course. Seventy-two of the participants reported being vaccinated, with 56 (77%) receiving the vaccine at a vaccination centre, 8 (11%) at a hospital, 6 (8.3%) at a family clinic, 1 (1.3%) at a general practitioner's office, and 1 (1.3%) at a private clinic. Regarding the awareness of pertussis vaccination during pregnancy, ninety-six percent of women answered "False" to the statement that the pertussis vaccine during pregnancy could cause pertussis in the mother or baby, while 4% answered "True." To the question "Does the pertussis vaccine protect the newborn during the first months of life?", 97% answered "True," and 3% answered "False".

A total of 28 women (28%) declared that they had not been vaccinated during pregnancy and 11 (39.2%) indicated in the answer "other" the difficulty in finding an appointment at the vaccination centre as the reason, while 7 (25%) did not consider vaccination necessary (Table 3).

Regarding the reasons for adherence to vaccination reported by the 72 vaccinated women, in a single response, 91.6% stated that they adhered to vaccination to "Protect their child", followed by 10.8% who stated that they vaccinate both to protect their child and because they usually follow all recommended vaccinations (Table 4).

Regarding the most trusted sources of information about vaccination during pregnancy, 16.7% of participants identified both the Gyneacologist and Midwife as the most reliable sources, while 10.8% considered

Table 3. Reasons for *non-adherence* to pertussis vaccination in pregnancy stated* by the 28 unvaccinated women enrolled at the "Full-Term Pregnancy Care Clinic".

	N. (%)
No health professionals advised me to do this	4 (14.2%)
I do not believe that vaccines are safe and/or effective	(3.5%)
I do not believe that vaccines are safe	2 (7.1%)
I do not believe vaccination is necessary	7 (25%)
Relatives/friends advised me against it	2 (7.1%)
I was advised against it by a health professional	0
I had an unwanted reaction to a vaccine	1 (3.5%)
Other	11 (39.2%)

*Women had the possibility of indicating more than one answer

Table 4. Reasons for adherence to pertussis vaccination in pregnancy declared* by the 72 vaccinated women enrolled at the "Full-Term Pregnancy Care Clinic".

	N. (%)
I wanted to protect my baby	66 (91.6%)
I wanted to protect myself	8 (11.1%)
All pregnant women should be vaccinated	7 (9.7%)
I usually get all recommended vaccinations	25 (34.7%)
Relatives/friends have advised against it	1 (1.4%)
Other	0

*Women had the possibility of indicating more than one answer

the Gyneacologist, Midwife, and Paediatrician to be the most trustworthy (Table 5).

Statistically significant associations were found between vaccination adherence and the healthcare provider managing the pregnancy, information received from healthcare professionals, and the perceived influence of healthcare professionals (Table 6).

Among the vaccinated women, 47 (65.2%) were followed during pregnancy by a Gyneacologist, 23 (31.9%) by an Obstetrician and 2 (2.7%) by a General Practitioner; among the non-vaccinated women, 11 (39.2%) were followed by a Gyneacologist, 17 (60.7%) by an Obstetrician and none by a General

Table 5. Sources considered reliable regarding vaccination in pregnancy declared* by women enrolled at the "Full-Term Pregnancy Care Clinic".

	N. (%)
Gyneacologist	88 (88%)
Obstetrician	76 (76%)
General Practitioner	37 (37%)
Paediatrician	49 (49%)
Nurse	12 (12%)
Pharmacist	9 (9%)
Internet (social media, blogs, unofficial websites)	3 (3%)
Information campaigns promoted by the Ministry of Health	17 (17%)
Official websites	9 (9%)
Media	2 (2%)
Family and friends	4 (4%)

*Women had the possibility to indicate more than one answer

Practitioner (p=0.020). Among the vaccinated women, 69 (95.8%) had received information from one or more health professionals about the possibility of maternal pertussis vaccination in pregnancy, while 3 (4.2%) stated that they had not received it. Among the unvaccinated women, 21 (75%) had received the information and 7 (25%) had not (p=0.005). Participants were also specifically asked to express an opinion on the approach they had with the various health professionals regarding the topic of the importance of maternal dTaP vaccination during pregnancy; possible answers ranged from 'Very influential' to 'Not influential' (Table 6). The results were statistically significant in the case of the Gyneacologist, Midwife, General Practitioner, Nurse and Paediatrician, except for the Pharmacist (Table 6). Other potential determinants, such as citizenship, educational qualification, number of children and women's knowledge of vaccination against pertussis during pregnancy, were not found to have a significant influence.

Discussion

The PNPV 2017-2019 (13) and the recent PNPV 2023-2025 (20) both recommend diphtheria-tetanus-acellular pertussis (dTaP) vaccination for pregnant

Table 6. Analysis of potential determinants of adherence to dTaP vaccination in pregnancy declared by women enrolled at the "Full-Term Pregnancy Care Clinic".

Variables	Answers	Vaccinated women N=72	Unvaccinated women N=28	*p* value
Citizenship	Italian	60 (83.3%)	19 (67.8%)	Chi-square test *p=0.088*
	Other	12 (16.6%)	9 (32.2%)	
Education	Middle school	5 (6.9%)	6 (21.4%)	Fisher's test *p=0.119*
	High school	35 (48.6%)	10 (35.7%)	
	University degree	32 (44.4%)	12 (42.8%)	
Health professional who managed the pregnancy	Gyneacologist	47 (65.2%)	11 (39.2%)	Fisher's test ***p=0.020***
	Midwife	23 (31.9%)	17 (60%)	
	General Pratictioner	2 (2.7%)	0	
	Other	0	0	
Information from one or more health professionals	Yes	69 (95.8%)	21 (75%)	Fisher's test ***p=0.005***
	No	3 (4.2%)	7 (25%)	
Exhaustive information*	Yes	62 (91.2%)	25 (89.2%)	Fisher's test *p=0.717*
	No	6 (8.8%)	3 (10.7%)	
The dTaP vaccine can cause pertussis in mother and baby	Correct answer	71 (98.7%)	25 (89.3%)	Fisher's test *p=0.065*
	Wrong answer	1 (1.3%)	3 (10.7%)	
The dTaP vaccine protects the newborn in the first months of life	Correct answer	72 (100%)	25 (89.3%)	Not calculable
	Wrong answer	0	3 (10.7%)	
Parity	Primiparous Multiparous	34 (47,2%) 38 (52,8%)	11 (39,3%) 17 (60,7%)	Chi-square test *p=0.510*
Women's consideration of the Gyneacologist's opinion on vaccination	Very influential	48 (66.6%)	5 (17.9%)	Mann-Whitney test Two-tailed significance ***p=0.000***
	Influential	23 (32%)	12 (42.9%)	
	Neutral	0	7 (25%)	
	Not very influential	0	1 (3.5%)	
	Not influential	1 (1.4%)	3 (10.7%)	
Women's consideration of the Midwife's opinion on vaccination	Very influential	37 (51.5%)	5 (17.9%)	Mann-Whitney test Two-tailed significance ***p=0.000***
	Influential	28 (38.9%)	12 (42.8%)	
	Neutral	5 (6.9%)	6 (21.4%)	
	Not very influential	0	2 (7.2%)	
	Not influential	2 (2.7%)	3 (10.7%)	
Consideration of women on the General Practitioner's opinion on vaccination	Very influential	18 (25%)	2 (7.2%)	Mann-Whitney test Two-tailed significance ***p=0.003***
	Influential	36 (50%)	10 (35.7%)	
	Neutral	10 (13.9%)	10 (35.7%)	
	Not very influential	2 (2.7%)	2 (7.2%)	
	Not influential	6 (8.4%)	4 (14.2%)	
Consideration women on the Nurse's opinion on vaccination	Very influential	10 (13.8%)	1 (3.5%)	Mann-Whitney test Two-tailed significance ***p=0.015***
	Influential	21 (29.1%)	2 (7.2%)	
	Neutral	25 (34.7%)	16 (57.2%)	
	Not very influential	4 (6.5%)	3 (10.7%)	
	Not influential	12 (16.6%)	6 (21.4%)	

Variables	Answers	Vaccinated women N=72	Unvaccinated women N=28	*p* value
Women's consideration of the Paediatrician's opinion on vaccination	Very influential	35 (48.6%)	5 (17.9%)	Mann-Whitney test Two-tailed significance ***p=0.001***
	Influential	24 (33.3%)	8 (28.6%)	
	Neutral	4 (5,6%)	7 (25%)	
	Not very influential	0	1 (3.5%)	
	Not influential	9 (12.5%)	7 (25%)	
Consideration of women on the pharmacist's opinion on vaccination	Very influential	3 (4.2%)	1 (3.5%)	Mann-Whitney test Two-tailed significance *p=0.642*
	Influential	12 (16.6%)	7 (25%)	
	Neutral	27 (37.5%)	8 (28.6%)	
	Not very influential	13 (18%)	7 (25%)	
	Not influential	17 (23.7%)	5 (17.9%)	

*For 4 women data was missing

women, with administration suggested between the 27th and 36th weeks of gestation. In Italy, adherence to vaccination among mothers remains low, and national data on vaccination coverage are either fragmented or absent (21,22). In order to give a contribute on this topic, we performed this study to evaluate adherence to pertussis vaccination during pregnancy, with a particular focus on identifying the factors influencing this decision. Despite the small sample size, the present study reveals that adherence to pertussis vaccination among pregnant women enrolled is fair with a solid understanding of vaccine safety during pregnancy. Of the 100 participating women, 72% were vaccinated against pertussis, contrary to what emerged in a multicentre survey conducted in Italy in 2018, where vaccination compliance was reported at 4.8% (14). Studies on the determinants of vaccine refusal have identified several key barriers to vaccination, including a low perception of vaccine safety, insufficient information, and a lack of encouragement from healthcare professionals. These factors are often cited as the primary reasons why individuals, including pregnant women, choose not to be vaccinated (23-29). In this study, 90% of pregnant women stated that they had been adequately informed by one or more health professionals and statistical analysis demonstrated a statistically significant association between this determinant and vaccination adherence (p=0.005). Furthermore, 86% of participants considered the information received to be exhaustive, but this did not appear to be a determining factor for adherence to dTaP vaccination (p=0.717). The Gyneacologist and the Obstetrician were the health professionals who most recommended the dTaP vaccination during pregnancy and, for 85% of cases, this occurred during a routine visit. Among the vaccinated women, 47 (65.2%) were followed during pregnancy by the Gyneacologist, and 23 (31.9%) by the Midwife. The professional figure who followed the pregnant women was found to positively influence the choice to undergo vaccination (p=0.020). In fact, regarding the impact of healthcare professionals'opinions on adherence to vaccination, women stated that the views expressed by the Gyneacologist, the Midwife and the Paediatrician were "Very influential" and "Influential" in their decision, both for those who adhered to vaccinations and for those who refused them (p=0.000; p=0.000; p=0.001). The opinion expressed by the Nurse, on the other hand, was mainly considered by both categories of women as "Neutral", followed by "'Influential'" and "'Not influential" (p=0.015). Therefore, the opinions of health workers, particularly the Gyneacologist and the Midwife, are fundamental in women's decision-making processes. In fact, in 16.7% of cases, both the Gyneacologist and the midwife were considered the most reliable sources regarding vaccinations during pregnancy, as reported in several studies (30-32). One of the primary reasons for non-adherence to vaccination was the lack of information about the importance and safety of vaccination during pregnancy. Therefore, the recommendations provided by healthcare professionals, particularly Obstetricians and Gyneacologists, play a crucial role in influencing

the decision to vaccinate. Based on the study results, the main reasons for non-adherence to vaccination were the difficulty in making an appointment at the vaccination centre and the perception that vaccination was not necessary. This highlights, on the one hand, the importance of proper planning and the need to optimize vaccination services for pregnant women and, on the other hand, it reiterates the essential role of health workers in ensuring effective communication and promoting the benefits of vaccination. When recommending dTaP vaccination during pregnancy, it is important to remember that the primary goal is the health of the child, as reported by the 66 vaccinated women and highlighted in several studies (31,33). Pregnancy is an important time to develop attitudes and beliefs about childhood vaccinations. The results of our study confirm that it is essential to include the vaccine prevention education interventions in routine visits and antenatal classes, using clear and informative materials. Furthermore, it would be useful to strengthen the local booking system and to consider incorporating the administration of the pertussis vaccine, as well as other recommended vaccinations during pregnancy, into routine prenatal care.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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