



# Differences between influenza and pertussis vaccination uptake in pregnancy: a multi-center survey study in Italy

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**Background:** A suboptimal maternal vaccination coverage in 2017–18 has been reported in Italy. The study aims were to (i) assess changes in maternal influenza and tetanus, diphtheria and acellular pertussis vaccination coverage during 2018–19 influenza season compared to the previous season (ii) estimate influenza vaccine coverage among maternal care providers (MCPs) and (iii) explore the characteristics of vaccine delivery to pregnant women.

**Methods:** We conducted a cross-sectional survey among pregnant women and MCPs about influenza and pertussis immunization during pregnancy. We also collected information regarding prenatal care characteristics and vaccine delivery among four centers in Italy. **Results:** We recruited 483 pregnant women and 452 MCPs. The influenza and pertussis vaccine uptake among pregnant women for the season 2018–19 was 14.9% and 60.9%, respectively. MCPs' influenza vaccine uptake was 33.6%. Knowing that the flu vaccine was safe for mothers and their infants and being vaccinated in the previous influenza season were associated with higher vaccine uptake. Regarding pertussis, being a housewife was associated to lower vaccine uptake, while knowing the vaccine is effective and safe for mothers and newborns were associated with higher pertussis vaccine uptake. The single most important factor associated to higher coverage of both influenza and pertussis vaccines was receiving a health-care provider's vaccine advice. Most pregnant women (69.4%) stated that they preferred to be vaccinated in their same prenatal care setting. **Conclusions:** Receiving a health-care provider's vaccine advice and the availability of vaccines during prenatal care visits might improve vaccination coverage among pregnant women.

## Introduction

Several studies have demonstrated that pregnant women have higher hospitalization and outpatient visit rates for acute cardio-respiratory illness during influenza seasons compared with non-pregnant women.<sup>1–3</sup> Additionally, infants under 6 months have higher rates of hospitalization and increased mortality associated with influenza infection relative to older infants and children in other age groups.<sup>4</sup> As influenza poses a significant threat to maternal and infant health, the recommendation of routine flu vaccine to pregnant women has the potential to significantly reduce much of the influenza-associated morbidity and mortality among pregnant women and their newborns during the first months of life when they are not able to receive a flu vaccine.<sup>5</sup> Recent data also confirm that maternal influenza vaccination offers a protective effect against pre-term birth and low birth weight.<sup>6</sup>

On the other hand, pertussis has not only persisted, but also resurged in countries with high vaccination coverage, where epidemic episodes have also been recorded.<sup>7</sup> Young immunized infants represent the most vulnerable group with the highest rates of complications and death. In Italy, 64% of pertussis-related hospitalizations involved subjects under 1 year of life.<sup>8</sup> Prevention of infant pertussis cases is best achieved by immunizing the pregnant mother

with tetanus, diphtheria and acellular pertussis (Tdap) during each pregnancy, irrespective of women's prior history of vaccination.<sup>9</sup>

According to the 2017–19 National Plan of Vaccine Prevention, the Italian Ministry of Health recommends administering the influenza vaccine to pregnant women prior to or during the influenza season and the Tdap vaccine ideally around the 28th gestational week, or any time between 27th and 36th gestational week, in order to ensure an adequate maternal antibody transfer to the fetus and maximize newborn's protection after birth.<sup>10</sup>

Even though both influenza and pertussis vaccines have been shown to be safe and effective for both mothers and their infants, maternal vaccine acceptance still remains low worldwide.<sup>11</sup> In Italy, a previous report from our group found a suboptimal maternal vaccination coverage for influenza and pertussis with figures of 6.5% and 4.8%, respectively, during the 2017–18 influenza season. The lack of healthcare provider (HCP) vaccine recommendation was identified as the most important vaccination barrier among pregnant women and interestingly, we also found that the difficulty of access to maternal immunization at prenatal consultations could represent a barrier to achieve optimal vaccination coverage.<sup>12</sup> Training for healthcare professionals and developing educational resources for pregnant women are well-known interventions that may impact the maternal vaccination acceptance;<sup>13,14</sup> however,

they do not guarantee the receipt of vaccination due to competing priorities during prenatal care and difficulty accessing vaccination.<sup>15</sup> Consequently, the optimal location for vaccine delivery to pregnant women has become a priority worldwide.<sup>14</sup> For all these reasons, the aim of our study was 3-fold: first, to assess changes in maternal influenza and Tdap vaccination coverage during the 2018–19 influenza season compared to the previous season; second, to estimate influenza vaccine uptake among maternal care providers (MCPs); and third, to collect information regarding the characteristics of vaccine delivery to pregnant women.

## Methods

We conducted a cross-sectional survey among pregnant women and MCPs between March and June 2019, in the maternity care centers of four tertiary care public university hospitals in Milan, Rome, Naples and Cesena. These tertiary care hospitals attend between 1830 and 4000 births annually.

A convenience sample of pregnant women who satisfied the eligibility criteria was recruited during their routine third trimester obstetric appointment in each one of the participating centers. To recruit women to the survey, the researchers approached eligible women and invited them to participate. If the pregnant woman gave her consent to participate, then the survey was administered at the obstetric waiting rooms.

The eligibility criteria were: (i) being between 18 and 45 years of age, (ii) no contraindications to influenza or pertussis vaccines, (iii) having good command of Italian language and (iv) giving consent to participate in the survey. All included patients were asked to fill a questionnaire with 49 questions regarding socio-demographic characteristics, information on prenatal care characteristics and knowledge and practices regarding maternal vaccination. The survey used was an adapted version of the one described in a previous report from our study group.<sup>12</sup> See [Supplementary file S1](#) for the printed version in English.

Additionally, all the MCPs working in the participants' centers were asked to fill in a brief survey including questions about socio-demographic characteristics and MCP's influenza vaccine status. Finally, we collected detailed information from every participating center regarding the characteristics of their maternal immunization program (vaccine information, vaccine recommendation, vaccine prescription, vaccine delivery mechanisms, vaccine registry and the responsibility of maternal immunization programs).

Response frequency distribution was tabulated for each question of both surveys, excluding non-responses from the denominators. Mean and standard deviation or median and interquartile range were estimated for continuous variables. Chi-square test and Fisher's exact tests were performed to compare categorical variables between vaccinated and non-vaccinated subjects. McNemar test was used to compare the answers to influenza vs. pertussis vaccine questions asked to pregnant women.

Independent factors of maternal influenza and pertussis vaccine receipt were sought with backward stepwise logistic regression ( $P$ -entry/ $P$ -exit  $< 0.05$ ) and are presented as odds ratios (OR) and 95% confidence intervals (95% CI). Candidate factors for both multivariable models were selected among variables exhibiting a  $P < 0.10$  in univariate analyses. Findings were reported as significant at  $P < 0.05$ . The statistical package R Core Team (R Foundation for Statistical Computing, Vienna, Austria, 2013) was used for analysis.

## Results

From March to June 2019, a total of 483 pregnant women were recruited from four study centers. The mean maternal age was  $32.1 \pm 5.4$  years and the median gestational age was 38.6 weeks (interquartile range: 38, 39.3). Socio-demographic and clinical characteristics of study participants are reported in [table 1](#).

**Table 1** Socio-demographic and clinical characteristics of surveyed pregnant women in Italy

Socio-demographic and clinical characteristics	N (%) of pregnant women N=483
Study center	
Milan	130 (26.9)
Naples	185 (38.3)
Cesena	91 (18.8)
Rome	77 (15.9)
Age group (years)	
<25	37 (7.7)
25–35	295 (61.1)
>35	151 (31.3)
Origin	
Italian	443 (91.7)
Immigrant	40 (8.3)
Marital status	
Married	281 (58.2)
Cohabiting	194 (40.2)
Single	8 (1.7)
Partner's origin	
Italian	444 (91.9)
Immigrant	39 (8.1)
Education level <sup>a</sup>	
High	267 (55.3)
Low–middle	216 (44.7)
Partner's education level <sup>a</sup>	
High	219 (45.3)
Low–middle	261 (54.0)
Unknown	3 (0.6)
Work status	
Employed	355 (73.5)
Housewife	66 (13.7)
Unemployed	62 (12.8)
Partner's work status	
Employed	456 (94.0)
Unemployed	21 (4.3)
Unknown	6 (1.2)
Monthly household income <sup>b</sup>	
High	161 (33.3)
Middle	266 (55.1)
Low	56 (11.6)
Comorbidity	
No	448 (92.8)
Yes	35 (7.2)
Body mass index	
<30	454 (94.0)
≥30	29 (6.0)
Current pregnancy	
Singleton	471 (97.5)
Twins	12 (2.5)
Parity	
Primiparous	296 (61.3)
Multiparous	187 (38.7)
Number of children	
None	296 (61.3)
1	157 (32.5)
2 or more	30 (6.2)
Number of antenatal care visits	
1–5	24 (5.0)
6–10	246 (50.9)
>10	213 (44.1)
Illness during current pregnancy	
No	373 (77.2)
Yes	110 (22.8)
Hospitalization during current pregnancy	
No	397 (82.2)
Yes	86 (17.8)

a: Lower education, no secondary school diploma; Middle education, completed secondary school with diploma; Higher education, continued education beyond secondary school.

b: High income, >3000 euros; Middle income, 1000–3000 euros; Low income, <1000 euros.

Overall, 395 (81.8%) pregnant women received prenatal care only from an ob-gyn, 20 (4.1%) only from a midwife and 56 (11.6%) from both an ob-gyn and a midwife. Also, 11 (2.3%) women received prenatal care from an ob-gyn and a general practitioner (GP) and 6 (1.2%) from an ob-gyn, midwife and a GP.

The most common cited prenatal care sites were a private practice (65.2%), followed by an outpatient clinic of a public hospital (36.9%) and an outpatient clinic of a family center (15.7%), and there were women who attended more than one prenatal care site. The percentage distribution of all pregnant women by prenatal care site globally and by study center is described in [figure 1](#).

Among 347 (71.8%) pregnant women who were advised to be vaccinated during pregnancy by a HCP, only 174 (36%) were advised to be vaccinated against influenza compared to 339 (70.2%), who were advised to receive pertussis vaccine ( $P < 0.001$ ). Additionally, only 166 (34.4%) women were advised to receive both vaccines. Most women who were advised to be vaccinated stated that they received this recommendation from their ob-gyns (87.9% for influenza and 82.2% for pertussis,  $P = 0.05$ ). The proportion of pregnant women who received an influenza vs. pertussis vaccine recommendation from midwives, GPs and pediatricians were 18.4% vs. 18.3% ( $P = 0.5$ ); 10.3% vs. 3.5 ( $P = 0.001$ ) and 3.4% vs. 3.8% ( $P = 0.15$ ), respectively. Most women advised to be vaccinated, received this recommendation during a prenatal care visit (80.5% for influenza vs. 84.4% for pertussis;  $P = 0.32$ ), followed by antenatal class (8.6% for influenza vs. 14.7% for pertussis,  $P = 0.06$ ) and by other outpatient visit not considered prenatal care (7.5% for influenza vs. 84.7% for pertussis,  $P \leq 0.001$ ). Surveyed women reported that the most influent HCP on pregnant women's decision to be vaccinated were ob-gyns (92.1%), followed by midwives (80.3%), pediatricians (71.4%), GPs (67.5%) and other HCPs (26.7%). Moreover, 97.7% of women stated that they considered ob-gyns/midwives as the most reliable sources of information followed by GPs/pediatricians (93%), and public health authorities (86.5%). In contrast, only 21.5% and 14.3% of women considered as reliable sources, the internet and media, respectively.

The self-reported influenza and pertussis vaccine uptake among pregnant women for the 2018–19 season was 14.9% (72/483) and 60.9% (294/483), respectively. Only 64 (13.3%) women received both vaccines recommended during pregnancy. Among vaccinated pregnant women, most received influenza and pertussis vaccines

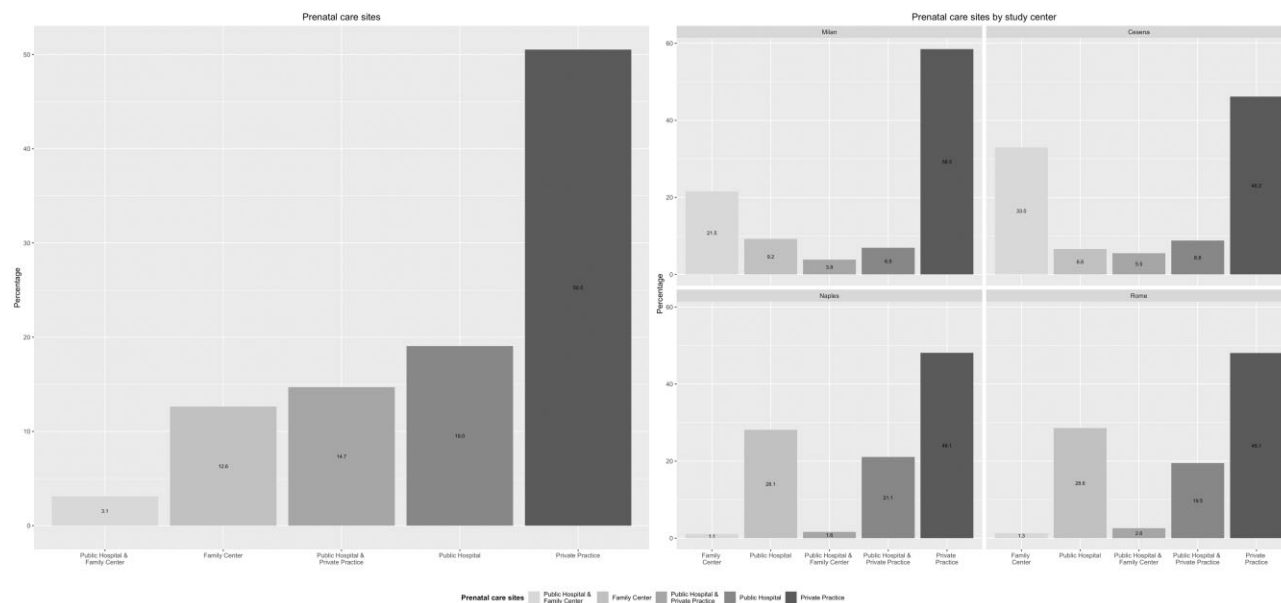
(54.2% vs. 77.5%, respectively) in the vaccination centers (vaccination services located in the local health units of every Italian region), while only 16.7% vs. 14.6% received the influenza and pertussis vaccines, respectively, in an outpatient clinic of a hospital. Also, more influenza vaccinated women compared to pertussis vaccinated women (19.4% vs. 0.7%, respectively) received the vaccine in the GP's office. The percentages of pregnant women vaccinated against influenza and pertussis by prenatal care site and by vaccination site globally and by study center are shown in [Supplementary figures S1](#) and [S2](#), respectively. None of the participants were vaccinated in a private practice.

Regarding vaccination preferences, most surveyed women stated that they would prefer to be vaccinated in their respective prenatal care sites (69.4%), followed by vaccination centers (18.4%) and GP's offices (18.4%).

The main barriers and facilitators regarding maternal immunization are described in [table 2](#). Among unvaccinated women, the main reason for not being immunized was 'Vaccination was not recommended by any HCP' for both influenza and pertussis vaccines (57.7% vs. 60.3%;  $P = 0.64$ ). Similarly, among vaccinated women, the main reason for accepting vaccination was 'HCP recommended to be vaccinated' for both influenza and pertussis vaccines (72.2% vs. 78.6%;  $P = 0.15$ ). Also, a significantly higher proportion of vaccinated pregnant women stated they got the flu shot to protect themselves against the disease compared to the pertussis vaccine (40.3% vs. 23.1%;  $P = 0.005$ ). Finally, more women who had received influenza vaccine mentioned that they get the vaccine because 'I usually get the recommended vaccines' compared to women who were vaccinated against pertussis (5.6% vs. 0.7%;  $P = 0.02$ ).

Knowledge questions regarding maternal influenza and pertussis vaccinations are summarized in [Supplementary table S1](#). Compared to pertussis vaccine [464 (96.1%) women], only 276 (57.1%) women knew influenza vaccine is effective protecting newborns during their first months of life. Additionally, 144 (29.8%) pregnant women believed that flu vaccine could cause influenza disease to mothers and newborns, while only 67 (13.9%) women had the same concern regarding pertussis vaccine.

The factors associated to influenza and pertussis vaccine uptakes are detailed in [table 3](#). Regarding the variables associated to influenza vaccine uptake during pregnancy, knowing that influenza vaccine could not cause the disease to mother or newborns [aOR = 2.5,



**Figure 1** Percentage distribution of all surveyed pregnant women by prenatal care site globally and by study center ( $N=483$ )<sup>a</sup>

<sup>a</sup>As several pregnant women attended more than one prenatal care site, combined categories were created to show this variability.

**Table 2** Vaccination barriers and facilitators among surveyed pregnant women in Italy

Vaccination barriers among unvaccinated pregnant women	Influenza vaccine N (%) of women N=411	Pertussis vaccine N (%) of women N=189	P-value
Vaccine was not recommended by any HCP	237 (57.7)	114 (60.3)	0.64
I do not believe this vaccine is necessary	95 (23.1)	21 (11.1)	0.004
I do not believe this vaccine is effective for pregnant women/fetus	19 (4.6)	2 (1.1)	0.05
I do not believe this vaccine are safe for pregnant women/fetus	24 (5.8)	14 (7.4)	0.58
I had a vaccine adverse event in the past	14 (3.4)	7 (3.7)	1.0
General practitioner advised me against vaccination during pregnancy	14 (3.4)	7 (3.7)	1.0
Relatives/friends advised me against maternal vaccination	11 (2.7)	7 (3.7)	0.67
Other barriers	52 (12.7)	34 (18.0)	0.11
Vaccination facilitators among vaccinated pregnant women	N (%) of women N=72	N (%) of women N=294	
HCP recommended to be vaccinated	52 (72.2)	231 (78.6)	0.15
I want to protect my baby	44 (61.1)	201 (68.4)	0.30
I want to protect myself	29 (40.3)	68 (23.1)	0.005
General practitioner recommended to be vaccinated	3 (4.2)	17 (5.8)	0.30
All pregnant women should get this vaccine	17 (23.6)	74 (25.2)	0.90
I usually get the recommended vaccines	4 (5.6)	2 (0.7)	0.02
Relatives/friends recommended it	1 (1.4)	11 (3.7)	0.47
Other facilitators	2 (1.4)	0	–

HCP, healthcare provider.

95% CI (1.2–6.2)] and being vaccinated the previous flu season [aOR = 5.5, 95% CI (2.0–16.3)] were both associated with higher vaccine uptake.

Regarding pertussis vaccination, housewives were less prone to being vaccinated [aOR = 0.3, 95% CI (0.1–0.8)] compared to employed women, while knowing the vaccine is effective protecting newborns their first months of life [aOR = 3.5, 95% CI (1.5–8.7)] and the vaccine could not cause pertussis disease for mothers and newborns [aOR = 2.5, 95% CI (1.1–6.0)] were both associated with higher pertussis vaccine uptake.

The most important factor associated to influenza and pertussis vaccination uptake was receiving an HCP's vaccine recommendation during current pregnancy [aOR = 29.8, 95% CI (13.1–78.4) and aOR = 55.8, 95% CI (27.0–127.6), respectively].

Of 452 MCPs who completed the survey, 262 (58%) were ob-gyns (specialists and residents) and 190 (42%) were midwives. Among the 152 (33.6%) MCPs who stated they have been vaccinated against influenza, the flu vaccine uptake was higher among ob-gyns compared to midwives (46.2% vs. 16.3%,  $P < 0.001$ ). Additionally, influenza vaccine coverage was higher among MCPs with 1–5 years vs. those with more than 15 years of professional experience (46.2% vs. 23.2%,  $P < 0.001$ ).

Among the 236 (52.2%) MCPs who stated they plan to receive flu vaccine during 2019–20 season, a higher proportion of ob-gyns compared to midwives agreed to this statement (64.1% vs. 35.8%,  $P < 0.001$ ).

According to all study sites, immunization of pregnant women falls under the responsibility of the vaccination centers and this was cited as the main location for vaccine administration and registry. Also, influenza vaccine could be administered by GPs in all study sites and only Milan and Rome reported to have dedicated maternal immunization services at their hospital antenatal clinics. The characteristics of the maternal immunization program by study centers are shown in [Supplementary table S2](#).

## Discussion

Given the significant impact of vaccination during pregnancy in maternal and neonatal health, the findings of this multi-center study conducted in four Italian obstetric healthcare settings are relevant to both MCPs and public health policy makers to reshape the current maternal immunization services in Italy. The self-reported influenza and pertussis vaccine coverage among surveyed pregnant women was 15% and 61%, respectively, for the season 2018–19. Only 13%

of women received both vaccines recommended during pregnancy. The maternal influenza vaccine coverage identified in this study was slightly higher (15%) than previous Italian reports for the season 2017–18 (1–7%).<sup>12,16</sup> However, even though influenza vaccine has been recommended to pregnant women for almost a decade in Italy, flu coverage falls well behind neighbor countries and remains below the European average rate of 25%.<sup>17</sup> In contrast, maternal pertussis vaccination recommended since 2017, has reached a better uptake (61%), not only much higher than influenza but also significantly higher than the 5% coverage previously reported by our research group.<sup>12</sup> This pertussis vaccine uptake places Italy close to other European countries like UK and Spain with figures of 73% and 80%, respectively, in 2018<sup>18</sup> and surpasses other developed countries like USA (54% in 2018).<sup>19</sup>

The poor compliance of influenza compared to pertussis vaccine among pregnant women could be related to several factors. First, several studies suggest that HCP's vaccine recommendation may be the strongest determinant of uptake in pregnant women (even those with vaccine hesitancy).<sup>3,12,20–27</sup> In our study, being advised to be vaccinated by an HCP was a very strong predictor of both influenza and pertussis vaccination. Unfortunately, the fact that only 36% pregnant women received flu vaccine advice compared to 70% who received pertussis vaccine advice could explain the different uptake of both vaccines. Our findings are also in line with a recent scoping review which found that low HCP recommendation rates (<50%) were consistently reported with low coverage rates among pregnant women (<20%).<sup>28</sup>

Second, several studies in high-income countries most frequently cited own uptake of providers as the main determinant of vaccine recommendation to pregnant women.<sup>28–31</sup> If vaccinated HCPs are more likely to recommend vaccines to their patients, it is not surprising that the influenza vaccine recommendation rate was very low in our study because the flu coverage among MCPs was only 34%. Moreover, midwives showed a significantly lower uptake compared to ob-gyns (16% vs. 46%,  $P < 0.001$ ). Our results are in line with a previous study among HCPs during several influenza seasons (from 2005–06 to 2013–14) in Genoa, Italy. In this study, Alicino et al.<sup>32</sup> reported a mean vaccination coverage rate of 21.6%, ranging from 11% to 34%. The low uptake among MCPs should be a major concern because this also influences their role as vaccinators.

In our study, most pregnant women (88% for influenza and 82% for pertussis, respectively) received the vaccine recommendation from an ob-gyn and only 18% (for both vaccines) from a midwife. Our results are similar to other European studies in which more

**Table 3** Factors associated to influenza and pertussis vaccination uptake among surveyed pregnant women in Italy (univariate and multivariate analysis)

Socio-demographic and clinical variables	Influenza vaccination					Pertussis vaccination				
	N (%) n=72	Odds ratio	95% CI	Adjusted odds ratio	95% CI	N (%) n=294	Odds ratio	95% CI	Adjusted odds ratio	95% CI
Survey center										
Milan	24 (18.5)	Ref.		Ref.		68 (52.3)	Ref.		Ref.	
Cesena	19 (20.9)	1.2	0.6–2.3	0.5	0.2–1.2	64 (70.3)	2.2	1.2–3.9	1.4	0.6–3.5
Naples	21 (11.4)	0.6	0.3–1.1	0.2	0.1–0.5	112 (60.5)	1.4	0.9–2.2	1.3	0.6–2.9
Rome	8 (10.4)	0.5	0.2–1.2	0.3	0.1–0.9	50 (64.9)	1.7	1.0–3.0	1.0	0.4–2.3
Age group (years)										
<25	3 (8.1)	Ref.				18 (48.6)	Ref.		Ref.	
25–35	50 (16.9)	2.3	0.8–9.9			193 (65.4)	2.0	1.0–4.0	1.4	0.4–4.4
>35	19 (12.6)	1.6	0.5–7.2			83 (55.0)	1.3	0.6–2.7	1.1	0.3–4.3
Origin										
Italian	63 (14.2)	Ref.				277 (62.5)	Ref.		Ref.	
Immigrant	9 (22.5)	1.8	0.8–3.7			17 (42.5)	0.4	0.2–0.9	0.6	0.2–1.8
Partner's origin										
Italian	62 (14.0)	Ref.				274 (61.7)	Ref.		Ref.	
Immigrant	10 (25.6)	2.1	0.9–4.5			20 (51.3)	0.7	0.3–1.3	1.7	0.5–6.2
Education level										
High	45 (16.9)	Ref.				177 (66.3)	Ref.		Ref.	
Low–middle	27 (12.5)	0.8	0.4–1.4			117 (54.2)	0.6	0.4–0.9	1.6	0.7–3.5
Partner's education level										
High	38 (17.4)	Ref.				155 (70.8)	Ref.		Ref.	
Low–middle	34 (13.0)	0.7	0.4–1.2			137 (52.5)	0.5	0.3–0.7	0.5	0.3–1.0
Unknown	0 (0.0)	Inf.	inf.			2 (66.7)	0.8	0.8–18.0	inf.	inf.
Work status										
Employed	61 (17.2)	Ref.		Ref.		238 (67.0)	Ref.		Ref.	
Housewife	5 (7.6)	0.4	0.1–0.9	0.7	0.2–2.1	24 (36.4)	0.3	0.2–0.5	0.3	0.1–0.8
Unemployed	6 (9.7)	0.5	0.2–1.2	0.9	0.3–2.6	32 (51.6)	0.5	0.3–0.9	0.4	0.2–1.1
Partner's work status										
Employed	67 (14.8)	Ref.				279 (61.5)	Ref.		Ref.	
Unemployed	4 (19.0)	1.4	0.4–3.8			8 (38.1)	0.4	0.2–0.9	1.4	0.3–6.6
Unknown	1 (12.5)	0.8	0.0–4.7			7 (87.5)	4.4	0.8–82.4	inf.	inf.
Marital status										
Married	40 (14.2)	Ref.				179 (63.7)	Ref.			
Cohabiting	32 (16.5)	1.19	0.7–2.0			112 (57.7)	0.8	0.5–1.1	–	0.5–1.1
Single	0 (0.0)	Inf.	Inf.			3 (37.5)	0.3	0.1–1.4	–	0.1–1.4
Monthly household income										
High	28 (17.4)	Ref.				110 (68.3)	Ref.		Ref.	
Middle	39 (14.7)	0.8	0.5–1.4			166 (62.4)	0.8	0.5–1.2	1.8	0.9–3.6
Low	5 (8.9)	0.5	0.2–1.2			18 (32.1)	0.2	0.1–0.4	0.8	0.2–2.6
Current pregnancy										
Singleton	71 (15.1)	Ref.				288 (61.1)	Ref.			
Twins	1 (8.3)	0.5	0.0–2.7			6 (50.0)	0.6	0.2–2.1	–	0.2–2.1
Parity										
Primiparous	51 (17.2)	Ref.		Ref.		192 (64.9)	Ref.		Ref.	
Multiparous	21 (11.2)	0.6	0.4–1.0	0.5	0.3–1.0	102 (54.5)	0.7	0.5–0.9	0.6	0.3–1.1
Number of antenatal care visits										
1–5	3 (12.5)	Ref.				7 (29.2)	Ref.		Ref.	
6–10	40 (16.3)	1.4	0.4–6.0			152 (61.8)	3.9	1.6–10.5	0.6	0.1–3.1
>10	29 (13.6)	1.14	0.4–4.9			135 (63.4)	4.2	1.7–11.3	0.6	0.1–3.1
Comorbidity										
No	64 (14.3)	Ref.				270 (60.3)	Ref.			
Yes	8 (22.9)	1.8	0.7–3.9			24 (68.6)	1.4	0.7–3.1	–	0.7–3.1
Body mass index										
<30	68 (15.0)	Ref.				–	–	–	–	–
≥30	4 (13.8)	0.9	0.3–2.4							
Flu vaccine previous season										
No	57 (12.6)	Ref.		ref		–	–	–	–	–
Yes	15 (46.9)	6.1	2.9–12.9	5.5	2.0–16.3					
Received vaccine recommendation by HCP during current pregnancy										
No	7 (2.3)	Ref.		Ref.		12 (8.3)	Ref.		Ref.	
Yes	65 (37.4)	25.7	12.2–63.2	29.8	13.1–78.4	282 (83.2)	54.4	29.3–109.8	55.8	27.0–127.6
Knowledge variables										
Influenza vaccine confers protection against influenza-associated complications during pregnancy (true)						–	–	–	–	–
Incorrect answer	6 (5.7)	Ref.		Ref.						
Correct answer	66 (17.5)	3.4	1.6–9.2	1.7	0.7–5.0					

(continued)



Table 3 Continued

Socio-demographic and clinical variables	Influenza vaccination					Pertussis vaccination				
	N (%) n=72	Odds ratio	95% CI	Adjusted odds ratio	95% CI	N (%) n=294	Odds ratio	95% CI	Adjusted odds ratio	95% CI
Flu or pertussis vaccine is effective protecting newborns during their first months of life (true)										
Incorrect answer	25 (12.1)	Ref.				16 (25.4)	Ref.		Ref.	
Correct answer	47 (17.0)	1.5	0.9–2.6			278 (66.2)	5.8	3.2–10.8	3.5	1.5–8.7
Flu or pertussis vaccine could cause the influenza or pertussis disease to mother and babies (false)										
Incorrect answer	9 (6.2)	Ref.		Ref.		19 (28.4)	Ref.		Ref.	
Correct answer	63 (18.6)	6.2	3.1–13.8	2.5	1.2–6.2	275 (66.1)	4.9	2.8–8.9	2.5	1.1–6.0
Pertussis could cause serious disease to infants specially during their first months of life (true)										
Incorrect answer	–	–	–	–	–	6 (31.6)	Ref.		Ref.	
Correct answer						288 (62.1)	3.5	1.4–10.3	0.3	0.1–1.3

Ref., reference category; 95% CI, 95% confidence interval.

frequent recommendations come from ob-gyns, gynecologists or nurses than midwives.<sup>31,33</sup> As both ob-gyns and midwives are the main providers delivering prenatal care in Italy, more research is necessary to explore other determinants of vaccine advice among these MCPs like awareness of vaccination policies, knowledge and training regarding maternal immunization, and levels of vaccine confidence.

The third factor potentially associated to different uptakes between both vaccines may be a lower acceptance of flu vaccine compared to pertussis vaccine among pregnant women. O'Leary et al.<sup>34</sup> had shown that ob-gyns reported more influenza vs. Tdap vaccine refusals for 10% or greater of pregnant women (62% vs. 32%, respectively). In our study, we found that a significantly higher proportion of women who were not vaccinated against influenza stated that they do not believe this vaccine was necessary compared to women who gave the same reason for not being vaccinated against pertussis (23% vs. 11%,  $P < 0.004$ ). Moreover, when we analyzed the knowledge regarding influenza vaccine effectiveness, we found that a higher proportion of women knew that flu vaccine confers protection against influenza disease to themselves compared to those who were aware this vaccine also confers protection to their newborns (78% vs. 57%, respectively). In contrast, almost all women (96%) were aware that pertussis could be a severe disease for their infants, and a higher proportion (87%) of women believed Tdap vaccine was effective protecting newborns. In general, trusting in vaccine safety was an important predictor of vaccination, increasing the likelihood of vaccination up to 6 times in the case of influenza and up to 2.5 times in the case of pertussis. However, more pregnant women wrongly believed maternal influenza vaccination could cause disease to mother and infants compared to pertussis vaccination (30% vs. 14%, respectively).

Vaccine refusal is clearly multifactorial, but our findings reveal that specific barriers to each vaccine should be taken into account during vaccine counseling. MCPs should discuss the protective effects on newborns of both influenza and Tdap vaccines and emphasize the vaccine safety of both vaccines for mothers and their fetuses. Our findings also highlight the pivotal position that MCPs have in pregnant women's health decisions. Most pregnant women stated that ob-gyns and midwives were the most influential HCP in their decision to be vaccinated and they also agreed that both professionals were the most reliable sources of information regarding maternal immunization.

Educational interventions like specific training for MCPs to increase their vaccine knowledge and improve their awareness of vaccination policies, and providing educational resources for pregnant

women (brochures, websites, among other tools) constitute important strategies to optimize maternal immunization coverage.<sup>13</sup> However, several institutional-level barriers (e.g. inadequate staffing and resources, lack of suitable settings for vaccine storage and delivery, absence of IIS and lack of updated prenatal care guidelines) need to be assessed in order to identify bottlenecks to successful vaccine delivery to pregnant women. When we assessed the immunization pathways in each study center, we identified that most women received prenatal care in an ob-gyn's office (65%); surprisingly, none of them were vaccinated in this setting. The second most common prenatal care site was the outpatient clinic of a public hospital (37%); however, only 17% and 15% of women were vaccinated against flu and pertussis, respectively, in this setting. Interestingly, only two study centers reported to have dedicated maternal immunization services at their hospital antenatal clinics. The most frequent vaccination site was a vaccination center for half of pregnant women, in the case of influenza, and for 8 out of 10 women, in the case of pertussis. Our findings show that national maternal immunization program is not currently embedded in the routine prenatal care in Italy. The fact that pregnant women would need to arrange additional appointments besides the ones for routine prenatal care has been shown as a logistical barrier to accessing vaccination.<sup>35</sup> Moreover, in our study sample, the mean of prenatal care visits was 9 visits and 7 out of 10 women stated that they preferred to be vaccinated in their respective prenatal care sites. Thus, it is clear that many opportunities for vaccination are being currently missed in the Italian maternity care services.

It has been shown that pregnant women were more likely to be vaccinated if they were advised to get the vaccine by an antenatal care provider and they were offered vaccination in an antenatal care setting.<sup>15</sup> Additionally, where a doctor's order has been required for vaccination, removing this requirement with a standing order for midwife or nurse-administered vaccination has been successful in increasing uptake.<sup>36</sup> Other successful strategies include the use of a dedicated onsite immunization service and pharmacist-delivered vaccination.<sup>37</sup> One issue of concern with widespread of maternal immunization in different healthcare settings is the generation of multiples vaccination charts. Optimally, all vaccines administer to pregnant women should be recorded in a national immunization information system (IIS). Such IIS will be useful for monitoring vaccination coverage, understanding gaps and trends in coverage and assessing the impact of the program.

Our study has some limitations. We included only pregnant women with a good command of Italian language. Nonetheless, the fact that we recruited pregnant women from different maternity

care services could have mitigated a potential selection bias. Another potential limitation is that we used a self-administered survey and self-reported vaccine receipt could not be verified with official sources due to the anonymous characteristic of the survey.

In conclusion, maternal immunization uptake for the 2018–19 influenza season has significantly improved compared to the 2017–18 season; however, we identified that influenza vaccine uptake is well behind that of the pertussis vaccine among pregnant women in Italy, with only one-third of pregnant women who have received both vaccines. The fact that vaccines are not offered alongside routine prenatal visits in Italy represents that many vaccination opportunities are missed. MCPs play a major role in improving vaccine uptake among pregnant women. Nonetheless, besides encouraging MCPs' education, challenges remain in the integration of immunization into prenatal care services.

## Supplementary data

Supplementary data are available at *EURPUB* online.

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## Key points

- The maternal influenza and pertussis vaccine uptakes were 15% and 61%, respectively.
- The main vaccination barrier during pregnancy was the lack of HCP's recommendation.
- Among MCPs, the flu coverage was 33.6% with higher uptake among younger ob-gyns.
- Immunization within prenatal care will reduce missed opportunities for vaccination.

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## 'I'm not an anti-vaxer!'—vaccine hesitancy among physicians: a qualitative study

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**Background:** Over the last years, research interest in vaccine hesitancy has increased. Studies usually focus on perceptions of parents and have largely neglected the group of health care providers. However, doctors' notions on vaccination have a major impact on the decision-making process of their patients. We were interested to understand the phenomenon of vaccine hesitancy among physicians, with a particular focus on the measles vaccine. Furthermore, we aimed to understand the underlying perceptions of measles that may be associated with vaccine hesitant decisions. **Methods:** In order to get an in-depth view, semi-structured interviews with physicians were conducted. Doctors were eligible for the study if they articulated vaccine hesitant views and/or demonstrated vaccine hesitancy in their medical practice. **Results:** We interviewed 12 physicians, of whom 11 had a medical practice with no contract with the Austrian social insurance ('Wahlarzt') and additional training in complementary and alternative medicine. We found perceptions of immunology, health and illness that were discordant with evidence-based medicine and closely related to alternative and complementary medicine. All participants argued for a delayed administration of the measles vaccine. We found a consistent inclination towards 'individual vaccination', which was explained as empowering parents and to strengthen their decision-making competencies. Most participants expressed doubts about the reliability of vaccine studies and were concerned with possible long-term effects. **Conclusions:** Paying closer attention to doctors' concerns on vaccination might help to design target-oriented interventions to specifically strengthen vaccine confidence.

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## Introduction

In 2019, global measles cases reached an all-time high of the last quarter-century. Between 2016 and 2019, global annual case numbers climbed up from 132 325 to 869 770. Austria reported 77 cases in 2018 and 151 cases in 2019, hence, it ranks in the midrange of the EU.<sup>1–3</sup> Measles is a highly contagious viral disease. Stable vaccination coverage rates of  $\geq 95\%$  with two doses of a measles containing vaccine (MCV) are therefore crucial, as only a slight reduction in coverage would result in multiple times increased case numbers.<sup>4,5</sup> Vaccine hesitancy (VH), defined by the SAGE working group as 'delay in acceptance or refusal of vaccines despite availability of vaccine services',<sup>6</sup> is of growing scientific interest and has the potential to undermine measles immunization rates.<sup>7</sup> The term VH comprises a broad spectrum of attitudes and beliefs, associated with different vaccination behaviour and increased request for alternative vaccination schedules.<sup>8</sup>

Research on VH has mainly focussed on parents.<sup>9,10</sup> Among them, key elements of VH include risk conceptualization (e.g. the weighting of the perceived risk of a vaccine vs. the disease), alternative health beliefs (e.g. 'the vaccine is not natural' and 'children's bodies are overcharged by vaccines'), philosophical considerations on parents' responsibility (e.g. parents want to take self-determined health decisions for their children and they do not want to be pushed towards a certain decision) and distrust towards the pharmaceutical industry, public health authorities and health providers (e.g. these institutions only have financial interests and health providers are influenced by them).<sup>10,11</sup>

There is no data available on the quantity of VH among Austrian doctors. Studies from other European countries, however, showed that the vast majority of medical doctors is favourable towards vaccination, and that there is a small percentage who is sceptical.<sup>12–15</sup> The use of complementary and alternative medicine (CAM) is regarded as a possible factor for VH.<sup>16,17</sup> According to Bean et al.<sup>18</sup> common beliefs among CAM practicing doctors included