

Maternal Vaccinations Coverage And Reasons For Non-Compliance - A Cross-Sectional Observational Study

David Drezner

Tel Aviv University Sackler Faculty of Medicine

Michal Youngster

Yitzhak Shamir Medical Center

Hodaya Klainer

Yitzhak Shamir Medical Center

Ilan Youngster (✉ ilanyoungster@yahoo.com)

Shamir (Assaf Harofeh) Medical Center <https://orcid.org/0000-0001-5233-1213>

Research article

Keywords: pertussis, influenza, vaccine, compliance, pregnancy

Posted Date: July 30th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-41850/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published on September 16th, 2020. See the published version at <https://doi.org/10.1186/s12884-020-03243-w>.

Abstract

Background: Maternal influenza and pertussis vaccination has been proven a safe and effective strategy to reduce maternal and infant morbidity and mortality. Though recommended, not all pregnant women receive these important vaccinations. We aimed to evaluate the vaccine coverage of maternal immunization in pregnancy for seasonal influenza and acellular pertussis and elucidate the reasons for non-vaccination among pregnant women. The secondary objective was to describe factors that affect vaccine uptake.

Methods: A cross sectional observational study using anonymous questionnaires distributed to women in the maternity ward or pregnant women (>37 weeks) hospitalized in the high-risk ward, thru Nov 2017- June 2018.

Results: Of 321 women approached, 313 were eligible and 290 questionnaires were retrieved (92.6%). We found a 75.9% (95% CI 0.71, 0.81) and 34.5% (95% CI 0.29, 0.40) vaccination rate for pertussis and influenza vaccines respectively. The most prominent reason for not receiving the pertussis vaccination was being under-informed (24%). Influenza vaccine was not received mainly due to concerns about vaccine efficacy (28%). Other factors influencing vaccination uptake included education, prior childbirth and vaccine recommendations made by the provider.

Conclusion: Although maternal vaccination of pertussis and influenza is officially recommended, vaccine uptake is suboptimal. Our study suggests a central role for medical providers in diminishing the concerns about safety and efficacy, and presents novel factors influencing compliance rates, like seasonality and number of prior births.

Background

Bordetella Pertussis and Influenza are causes of potentially lethal, but preventable, respiratory infections in infants and pregnant women¹⁻³.

Infant vaccination programs are administered worldwide and have been an extremely effective strategy in reducing infection, morbidity and mortality for numerous pathogens. Like many countries, Israel has initiated a vaccination program against pertussis and influenza for children. In Israel, pertussis vaccines are administered from the age of two months, but protection is acquired only after receiving the third dose at the age of six months. Influenza vaccines are recommended from the age of six months, leaving young infants vulnerable to both pathogens during the first six months of life.

Maternal immunization for pertussis and influenza are a safe and effective way to reduce both mother and infant morbidity and mortality⁴⁻⁶. Infant immunization is achieved by increasing maternal immunity therefore preventing vertical transmission, and by the transfer of protective immunoglobulins to the fetus via the placenta⁷. In the UK, following the 2012 pertussis epidemic, maternal vaccinations were administered resulting in a 78% reduction in pertussis cases and a 68% reduction in hospital admissions

in infants younger than 3 months of age during the first 9 months of 2013 compared with the same period in 2012⁸. As for influenza, pregnant women are more likely to experience severe complications compared with the general population. Maternal infection is also hazardous to the fetus and may cause serious morbidities such as preterm birth, fetal death and even possible fetal malformations⁹. Maternal vaccinations are effective in preventing maternal infection¹⁰ and reduce infant morbidity if infected¹¹.

In 2015, Israeli health authorities introduced a recommendation for maternal pertussis vaccine during gestational weeks 27–36 in addition to the influenza vaccine recommendation for pregnant women that are in their second or third trimester during the influenza season (November – March). Despite its proven efficacy and safety, not all women receive these vital vaccines during pregnancy¹². In order to improve uptake, it is critical to understand the reasons for non-compliance. Focused interventions targeting factors contributing to low vaccine coverage have been shown to significantly improve vaccination rates¹³. In this study we aim to estimate the actual national vaccination coverage, and to uncover the main hindrances for receiving maternal vaccines, helping the development of focused strategies for increasing vaccine uptake.

Methods

A cross sectional observational study was performed. A questionnaire (**Supplement 1**) was composed based on the possible causes for not receiving vaccinations, as described in previous studies¹⁴⁻¹⁵.

⁵Financial barriers as a potential cause of noncompliance were omitted from our survey due to the fact that these vaccines are administered at no personal cost in Israel. Demographic details included age, prior number of children and their vaccination status, education, religious grouping and health maintenance organization (HMO) membership. The questionnaire included inquiries about vaccination status, recommendations received and personal opinions.

The questionnaire was handed out personally by an investigator (DD) to consecutive women in the Maternity ward and High-Risk ward of the Shamir Medical Center, Israel, on random days during the winter-spring season of 2017-2018 (December 2017 – July 2018). Only women above the age of 18 were approached. Women in the high-risk ward had to be in their 37th week of pregnancy or later for them to have had sufficient time to be vaccinated. Women in the maternity ward were required to be within 4 weeks from childbirth to minimize recall bias. All subjects were at least 28 weeks pregnant at the time of delivery and were pregnant during the influenza season sometime in their second or third trimester, the Israeli indication for administration of this vaccine during pregnancy. Verbal informed consent was obtained during initial encounter and confirmed by questionnaire retrieval.

Statistical analysis

All data was stored in a Microsoft Excel spreadsheet on a secured hospital network. The rate of coverage for each vaccine was estimated with 95% confidence interval for proportion. Continuous variables were compared between vaccinated women & non-vaccinated women using independent t-test. The

categorical variables were compared using chi-square. A logistic regression model was applied to identify the significant factors contributing to vaccination separately for Influenza & pertussis. Significance level was defined as $p=0.05$. Analyses were carried out using IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Ethical approval

Shamir Medical Center Institutional Review Board approval was received on November 23, 2017.

Results

Three hundred and twenty one women were approached, while 313 met the inclusion criteria (7 women had inadequate language fluency and 1 woman was a foreign citizen that received her healthcare abroad). 290 completed questionnaires were retrieved (92.7% compliance rate). Four questionnaires had missing data concerning influenza vaccine uptake and 5 were missing demographic details. Characteristics of the study population are shown in **Table 1**.

Seventy six percent (95% CI 0.71, 0.81) and 34.5% (95% CI 0.29, 0.40) of participants reported being vaccinated for pertussis and influenza respectively (Table 1). Of the 286 women who reported vaccination status for both pertussis and influenza only 33% reported receiving both vaccines and 21% received neither (Figure 1).

Figure 2 shows the primary reasons reported by responders for not receiving the recommended vaccines during pregnancy. The most common reason for not vaccinating against pertussis was being uninformed of vaccination recommendations or lack of information about the vaccine (24%). Influenza vaccine was not received mainly due to concerns about poor vaccine efficacy (28%). Both were followed by concerns about side effects, (23% and 22% respectively).

The mean age of respondents at the time of the survey was 30.5 years (19-44, SD ± 5.2). Age group did not significantly impact vaccine uptake. Gestational week at delivery/hospitalization averaged 38.9 (28.0-42.0, SD ± 1.8) weeks for both groups and no significant difference was found between vaccinated and non-vaccinated groups.

Table 1 presents the vaccination coverage according to demographic characteristics. Having three or more prior children or having non-vaccinated children had a negative effect on maternal vaccination status. Women defining themselves as Jewish ultra-orthodox had lower vaccination rates compared to other groups. Academic education had a positive effect on vaccination status, as did receiving a recommendation from a health care worker, irrespective of the role of the recommending person. Regarding Health Maintenance Organization (HMO) influence, significantly better pertussis vaccine coverage was reported by those who belonged to Maccabi Healthcare compared to the other groups. As for influenza the trend remained but did not reach significance.

Season of birth significantly affected vaccination rates, influencing influenza uptake more than pertussis. Those in late pregnancy (>37 weeks in the high risk ward) or whom delivered during the influenza season (Nov-March) were more likely to be vaccinated compared to those who reached the end of their pregnancy during spring months (April-July) even though indications to be vaccinated applied to all women in this study. Figure 3 shows the distribution of vaccination rate per month.

A multi-variate analysis was conducted in order to account for cross-interactions between demographic and behavioral variables. Table 2 presents the odds ratio when considering multiple variables. Noticeably, for pertussis the most influencing factors were fewer prior children, followed by the age group 35-44 which tended to vaccinate more than the younger age group. Folic acid uptake during pregnancy (possibly as a general marker of compliance) indicated higher uptake as well. As for influenza, only educational status and winter season birth correlated significantly to higher vaccine acceptance. These factors were not found to be statistically significant in the pertussis uptake analysis.

During the course of this study a question regarding exposure to social media was added to the questionnaire. One hundred and two out of 182 women (56%) stated that they had been exposed to discussions regarding vaccinations on different social media platforms. 37.3% of those exposed (n=38) admitted that these discussions had an influence on their decision to receive or not receive these vaccinations.

Discussion

We describe a maternal vaccination rate of 75.9% for pertussis and 34.5% for influenza. This maternal pertussis vaccination coverage in Israel is comparable to that reported in other countries (for example: England –70-75 %¹⁶ , United States - 54.4%¹²) but still falls short of target rates. Influenza coverage, on the other hand, is far from satisfactory even when compared to coverage in other countries (for example: United States - 49.1%¹² , Belgium - 45%¹⁷), despite comparable recommendation rates by primary caregivers, found to be a strong predictor of maternal acceptance. In a study published by the Center for Disease Control, 81.0% received recommendation for influenza vaccine resulting in a 49.1% vaccination rate¹², compared to 77.3% who reported receiving a recommendation in our study resulting in only 34.5% vaccination. This implies that providing vaccine recommendations as a stand-alone strategy is not enough. This observation may in part be due to a difference in perception of prevalence or severity of these diseases. These results highlight the need for health authorities to implement strategies to actively increase uptake of these vaccines, with an emphasis on influenza.

We report here several reasons for declining maternal vaccinations. Our results point out that 24% of pregnant women did not receive the DTaP vaccine primarily because they were uninformed regarding vaccine recommendation and benefits, information that could have been provided by practitioners. Moreover, concerns about safety played a role in reducing uptake in 39% of women who did not vaccinate (including concerns about side effects to themselves and potential harm to their fetus). As for influenza, the reasons were quite different as 28% declined the vaccine due to the belief that influenza vaccine is

not effective and only 18% were uninformed of vaccination recommendations. Safety concerns were still an issue as 29% deferred for these reasons. Emphasis of vaccine recommendation is apparently crucial and should be an important first step in any program to increase vaccine uptake in this population. We suggest that the protective effects and overall efficacy and safety should be actively presented to patients. These results largely reflect current data in numerous studies concluding that knowledge concerning vaccine recommendations, safety and efficacy have a large impact on maternal uptake^{12,15 5}

Our results highlight multiple determinants influencing vaccine uptake. As previously reported by others, higher education and vaccine recommendation by the provider were predictors of vaccination. Prior children had an incremental negative effect on vaccine uptake - the more children at home, the larger the proportion of unvaccinated mothers. These findings may be an indirect reflection of economic status, a well-known determinant not directly assessed in this study. An alternative explanation may be the fact that these vaccines are a relatively recent addition to the health recommendations in pregnancy and mothers who have been through multiple pregnancies may be uninformed, relying on previous pregnancies to decide what procedures are necessary. This emphasizes the important role of the healthcare provider, even in highly experienced patients.

The HMO had an impact on vaccine uptake suggesting a difference in organizational procedures to promote vaccinations. Israel has four public HMOs that every citizen can choose freely to belong to. Our sample largely reflects the national distribution of membership between these providers, albeit Maccabi is slightly over-represented in this study. The smaller providers were merged into a single reference group for statistical measures. Regarding pertussis, 'Maccabi' stood out with a remarkable 86.8% coverage. In contrast, Influenza coverage was highest by members of the 'Meuhedet' group. This discrepancy may hint that different policies of the healthcare-providing organization can influence vaccine uptake, urging local officials to investigate the differences between HMOs vaccination publicity efforts and increase their efforts to promote uptake of all recommended vaccines.

Lastly, we introduce a new variable affecting vaccine uptake - season of pregnancy/delivery. We found a significant difference in vaccine uptake for both pertussis and influenza, depending on season. Those who were in late pregnancy or gave birth during the influenza season were more likely to vaccinate than those pregnant during the late influenza season. The difference in influenza uptake is not surprising, as women who approach their second or third trimester in late influenza season may be inclined to believe the danger of contracting Influenza has passed. However, we were surprised that the same trend was found in the pertussis vaccine uptake, even though the recommendation is not season dependent. The linkage between the vaccinations should make providers emphasize the importance of the pertussis vaccine during the warm months. Another concern is that many surveys regarding pertussis coverage are collected in parallel to influenza uptake, meaning that studies performed during peak influenza season are potentially causing over-estimations of yearly pertussis uptake.

Our observation regarding exposure to social media and its impact upon vaccine acceptance should be taken into consideration by regulators and policy makers as well. We showed that in one-fifth (20.9%) of

women their decision whether to receive the vaccines was influenced by social media. It is essential that we make sure reliable information is spread through these channels. Furthermore, providers need to inquire about their patients' sources of information and point them towards reliable sources.

The strengths of this study include a >90% compliance rate, and the institution in which we conducted this study, that is, a tertiary center with >9000 yearly deliveries representing all local ethnic and demographic groups. However, as this was a self-reported questionnaire study, limitations include a possible recall bias and social desirability bias which may have caused overestimation of actual coverage. Another limitation was the language barrier potentially causing some selection bias. However, only 7 out of 320 subjects were excluded from the study due to language barriers, having a minimal influence on the results.

Conclusions

Although maternal vaccination against pertussis and influenza in pregnancy is nationally recommended and is provided free of charge to the Israeli population, local vaccine uptake of pertussis was suboptimal, while influenza uptake was extremely low. The main reasons we found for non-compliance are consistent with previous data and suggest a strong role for medical staff in recommending and explaining the necessity of maternal vaccination and diminishing safety and efficacy concerns. These recommendations should be further emphasized in certain populations we found in our study to be more likely to forego vaccination, such as low maternal education, higher number of prior children and ultra-orthodox Jewish populations. Moreover, the season of pregnancy is significant as we found a trend suggesting lower vaccination rates in women giving birth or being in late pregnancy towards the end of the influenza season. Further studies are needed to validate our results. Evaluation of specific intervention programs directed at non-compliant populations may be a valuable resource in planning nationwide strategies for improving vaccination uptake.

List Of Abbreviations

HMO - health maintenance organization

DTaP - Diphtheria, Tetanus and acellular Pertussis

Declarations

Ethical approval - Shamir Medical Center Institutional Review Board approval was received on November 23, 2017. Verbal informed consent was obtained during initial encounter and confirmed by questionnaire retrieval. This was approved by the institutional ethical review board.

Consent for publication – Not applicable.

Availability of data and materials - The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests – The authors declare that they have no competing interests.

Funding – The authors received no funding.

Acknowledgements – Not applicable

Author's contribution – Author's contribution: IY conceptualized the study, DD and IY designed the study, DD IY MY and HH contributed to data acquisition, DD and IY were responsible for Data analysis, DD wrote the first draft of the manuscript, DD IY MY and HH reviewed and approved the final manuscript.

References

1. Moerman L, Leventhal A, Slater PE, et al. The re-emergence of pertussis in Israel. *Isr Med Assoc J*. 2006;8:308–11.
2. Carlsson RM, von Segebaden K, Bergstrom J, et al. Surveillance of infant pertussis in Sweden 1998–2012; severity of disease in relation to the national vaccination programme *Euro Surveill* 2015;20:10.2807/1560,7917.es2015.20.6.21032 doi:21032 [pii].
3. Straney L, Schibler A, Ganeshalingham A, et al. Burden and Outcomes of Severe Pertussis Infection in Critically Ill Infants. *Pediatr Crit Care Med*. 2016;17:735–42. doi:10.1097/PCC.0000000000000851 [doi].
4. Bednarczyk RA, Adjaye-Gbewonyo D, Omer SB. Safety of influenza immunization during pregnancy for the fetus and the neonate. *Am J Obstet Gynecol*. 2012;207:38. doi:10.1016/j.ajog.2012.07.002 [doi].
5. Munoz FM, Bond NH, Maccato M, et al. Safety and immunogenicity of tetanus diphtheria and acellular pertussis (Tdap) immunization during pregnancy in mothers and infants: a randomized clinical trial. *JAMA*. 2014;311:1760–9. doi:10.1001/jama.2014.3633 [doi].
6. Poehling KA, Szilagyi PG, Staat MA, et al. Impact of maternal immunization on influenza hospitalizations in infants. *Am J Obstet Gynecol*. 2011;204:141. doi:10.1016/j.ajog.2011.02.042 [doi].
7. Vilajeliu A, Gonce A, Lopez M, et al. Combined tetanus-diphtheria and pertussis vaccine during pregnancy: transfer of maternal pertussis antibodies to the newborn. *Vaccine*. 2015;33:1056–62. doi:10.1016/j.vaccine.2014.12.062 [doi].
8. Amirthalingam G, Andrews N, Campbell H, et al. Effectiveness of maternal pertussis vaccination in England: an observational study. *Lancet*. 2014;384:1521–8. doi:10.1016/S0140-6736(14)60686-3 [doi].
9. Rasmussen SA, Jamieson MD,MS, Uyeki DJ,MD,MPH, MPH TM,MD. MPP. Effects of influenza on pregnant women and infants. *Am J Obstet Gynecol*. 2012;207:3–8. doi:10.1016/j.ajog.2012.06.068.

10. Legge A, Dodds L, MacDonald NE, et al. Rates and determinants of seasonal influenza vaccination in pregnancy and association with neonatal outcomes. *CMAJ*. 2014;186:157. doi:10.1503/cmaj.130499 [doi].
11. Benowitz I, Esposito DB, Gracey KD, et al. Influenza vaccine given to pregnant women reduces hospitalization due to influenza in their infants. *Clin Infect Dis*. 2010;51:1355–61. doi:10.1086/657309 [doi].
12. Kahn KE, Black CL, Ding H, et al. Influenza and Tdap Vaccination Coverage Among Pregnant Women - United States, April 2018. *MMWR Morb Mortal Wkly Rep*. 2018;67:1055–9. doi:10.15585/mmwr.mm6738a3 [doi].
13. McCarthy EA, Pollock WE, Nolan T, et al. Improving influenza vaccination coverage in pregnancy in Melbourne 2010–2011. *Aust N. Z J Obstet Gynaecol*. 2012;52:334–41. doi:10.1111/j.1479-828X.2012.01428.x [doi].
14. Yuen CY, Tarrant M. Determinants of uptake of influenza vaccination among pregnant women - a systematic review. *Vaccine*. 2014;32:4602–13. doi:10.1016/j.vaccine.2014.06.067 [doi].
15. Myers KL. Predictors of Maternal Vaccination in the United States: An Integrative Review of Literature. *West J Nurs Res*. 2017;39:1366–7. doi:10.1177/0193945917715261b [doi].
16. Public Health England. Health Protection Report. 25.02.2020 Pertussis vaccination programme for pregnant women update: vaccine coverage in England, October to December 2018, HPR 13(14) infection report. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/867575/hpr0420_prtsss-vc2.pdf.
17. Maertens K, Braeckman T, Top G, et al. Maternal pertussis and influenza immunization coverage and attitude of health care workers towards these recommendations in Flanders. Belgium *Vaccine*. 2016;34:5785–91. doi:S0264-410X(16)30882-9 [pii].

Tables

Table 1

Selected characteristics of diphtheria, tetanus and acellular pertussis (Dtap) and influenza virus vaccine uptake in late pregnancy or post-partum women, winter-spring 2017–2018, Shamir Medical Center, Israel

Characteristic	Pertussis			Influenza		
	No. (Weight %)	Vaccinated %	P value	No. (Weight %)	Vaccinated %	P value
Total	290 (100)	75.9		286 (100)	34.5	
Ward						
Maternity	272 (93.8)	75.7	<i>0.854</i>	268 (93.7)	35.1	<i>0.881</i>
High Risk	18 (6.2)	77.8		18 (6.3)	33.3	
Age (19–44)						
18–24	37 (13.1)	64.9	<i>0.237</i>	35 (12.5)	28.6	<i>0.241</i>
25–34	183 (64.7)	76.5		182 (65.2)	39.0	
35–44	63 (22.3)	79.4		62 (22.2)	29.0	
Prior children (0–7)						
0	79 (28.0)**	86.1	<i>0.001</i>	78 (28.1)	48.7	<i>0.034</i>
1	96 (34.0)**	79.2		96 (34.5)	32.3	
2	59 (20.9)	74.6		58 (20.9)	31.0	
3+	48 (17.1)*	54.2		46 (16.5)	26.1	
Prior children vaccinated						
Yes	178 (91.8)	75.8	<i>0.006</i>	175 (91.6)	33.7	<i>0.023</i>

^ - other religions: Christian, Muslim, Bedoin or 'others'

* Reference group in categories with 3 or more subgroups

** Statistically significant difference versus reference group within subgroup

	Pertussis			Influenza		
No/partial	16 (8.2)	43.8		16 (8.4)	6.3	
Education						
No degree	136 (48.1)	66.9	0.001	133 (47.7)	26.3	0.002
≥First degree	147 (51.9)	84.4		146 (52.3)	43.8	
Religious group						
Jewish	231 (81.9)**	79.2	0.013	228 (82.0)	37.3	0.25
Jewish ultra-orthodox	17 (6.0)*	52.9		17 (6.1)	17.6	
Other religion^	34 (12.1)	64.7		33 (11.9)	33.3	
Health care provider						
Clalit	149 (52.3)**	71.8	0.009	147 (52.3)	30.6	0.174
Maccabi	91 (31.9)*	86.8		90 (32.0)	42.2	
Others	45 (15.8)**	66.7		44 (15.7)	38.6	
<i>Meuchedet</i>	28 (9.8)	71.4		28 (10.0)	57.1	
<i>Leumit</i>	13 (4.6)	46.2		13 (4.6)	7.7	
<i>IDF</i>	4 (1.4)	100.0		3 (1.1)	0	
Vaccine recommended						
Yes	272 (93.8)	80.5	< 0.01	221 (77.3)	43.9	< 0.01
No	18 (6.2)	5.6		65 (22.7)	4.6	

^ - other religions: Christian, Muslim, Bedoin or 'others'

* Reference group in categories with 3 or more subgroups

** Statistically significant difference versus reference group within subgroup

	Pertussis			Influenza		
If so, who recommended						
Obstetrician only	152 (56.9)	83.6	0.22	95 (43.8)	44.2	0.941
Obstetrician and others	68 (25.5)	73.5		57 (26.3)	43.9	
Others only	47 (17.6)	80.9		65 (35.0)	41.5	
Season of delivery/late pregnancy						
Nov-March	105 (36.8)	82.9	0.033	103 (36.7)	47.6	< 0.001
April-July	180 (63.2)	71.7		178 (63.3)	27.0	
Folic acid uptake						
Yes	258 (92.1)	78.3	0.003	254 (92.0)	36.6	0.192
No	22 (7.9)	50.0		22 (8.0)	27.7	
Prior influenza vaccination (not during pregnancy)						
Yes	92 (33.3)	85.9	0.009	92 (33.6)	57.6	< 0.01
No	184 (66.7)	71.7		182 (66.4)	22.5	
^ - other religions: Christian, Muslim, Bedoin or 'others'						
* Reference group in categories with 3 or more subgroups						
** Statistically significant difference versus reference group within subgroup						

Table 2

Odds Ratio and 95% confidence interval (CI) for multi-variate analysis applying to variables influencing vaccine uptake in pregnant women.

	Pertussis		Influenza	
	OR (95% CI)	P value	OR (95% CI)	P value
Age group				
18–24	1.00		1.00	
25–34	2.26 (0.88–5.83)	<i>0.091</i>	1.22 (0.48–3.06)	<i>0.676</i>
35–44	4.60 (1.38–15.37)	<i>0.013</i>	0.80 (0.26–2.50)	<i>0.705</i>
Prior children				
0	7.36 (2.38–22.73)	<i>0.001</i>	1.84 (0.67–5.04)	<i>0.236</i>
1	3.34 (1.28–8.69)	<i>0.013</i>	0.88 (0.33–2.33)	<i>0.795</i>
2	2.01 (0.78–5.16)	<i>0.147</i>	0.85 (0.31–2.35)	<i>0.750</i>
3+	1.00		1.00	
Education				
No degree	1.00		1.00	
≥First degree	1.83 (0.94–3.57)	<i>0.078</i>	1.98 (1.09–3.58)	<i>0.024</i>
Religious group				
Jewish	1.00		1.00	
Jewish ultra-orthodox	0.61 (0.19–1.94)	<i>0.404</i>	0.46 (0.12–1.87)	<i>0.280</i>
Other religion [^]	1.05 (0.41–2.70)	<i>0.922</i>	1.45 (0.60–3.55)	<i>0.411</i>
Health care provider				
Clalit	1.00		1.00	
Maccabi	2.26 (0.98–5.18)	<i>0.055</i>	1.62 (0.87–3.03)	<i>0.130</i>
Others	0.59 (0.25–1.38)	<i>0.222</i>	1.17 (0.52–2.63)	<i>0.708</i>
Season of delivery/late pregnancy				
Nov-March	1.98 (0.98–3.99)	<i>0.058</i>	2.58 (1.47–4.53)	<i>0.001</i>
April-July	1.00		1.00	
Folic acid uptake				
Yes	3.15 (1.09–9.09)	<i>0.034</i>	1.68 (0.55–5.15)	<i>0.361</i>

	Pertussis	Influenza
No	1.00	1.00

Figures

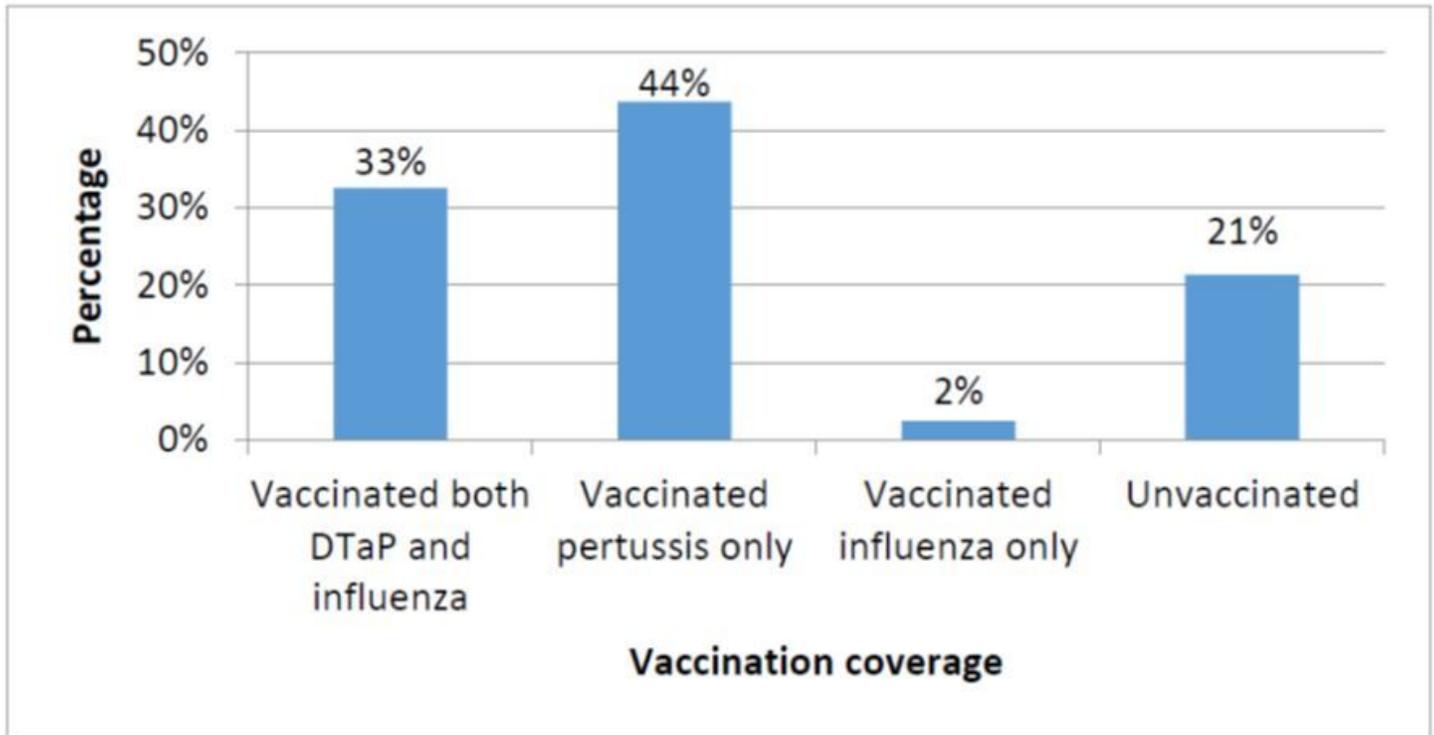


Figure 1

Diphtheria, tetanus and acellular pertussis (Dtap) and influenza virus vaccine uptake (n=286) in late pregnancy or post-partum women, winter-spring 2017-2018, Shamir Medical Center, Israel

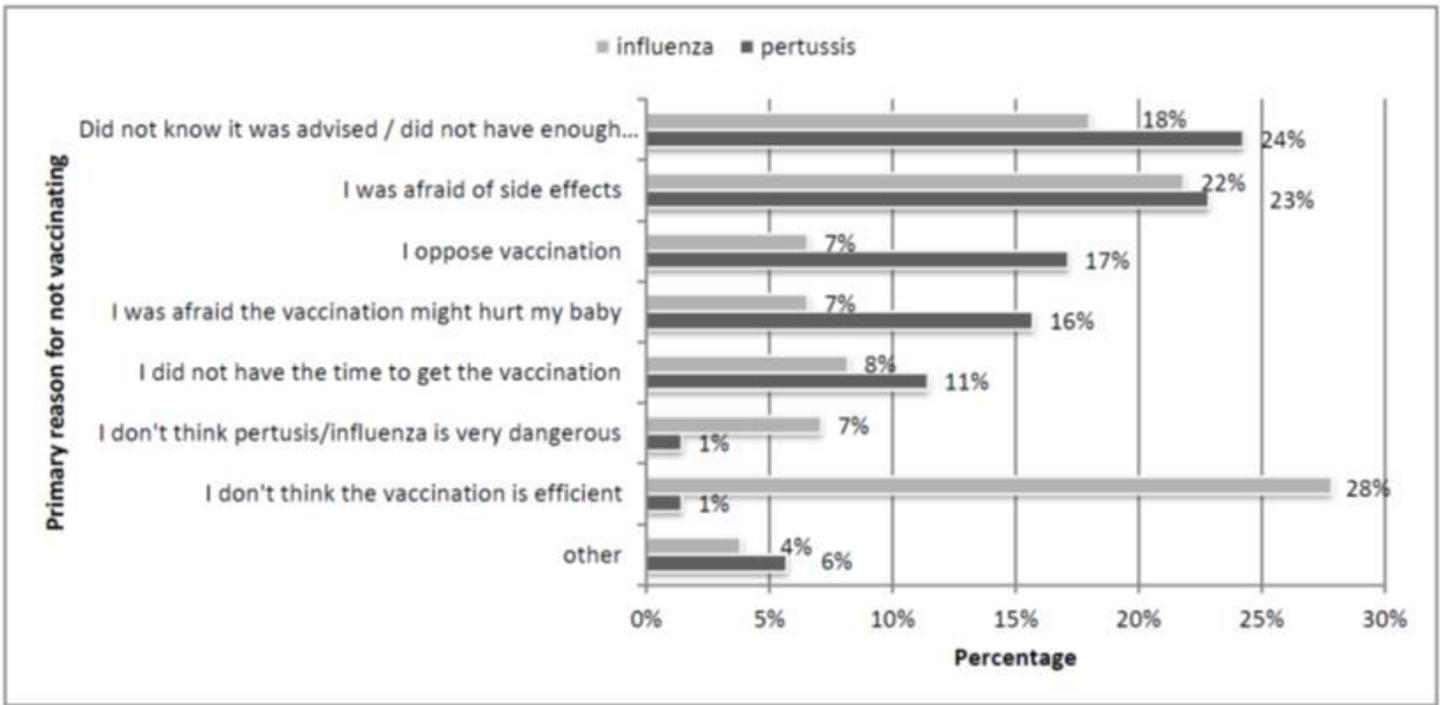


Figure 2

Primary reasons for not vaccinating for pertussis (n=70) and influenza (n=183) reported by survey population

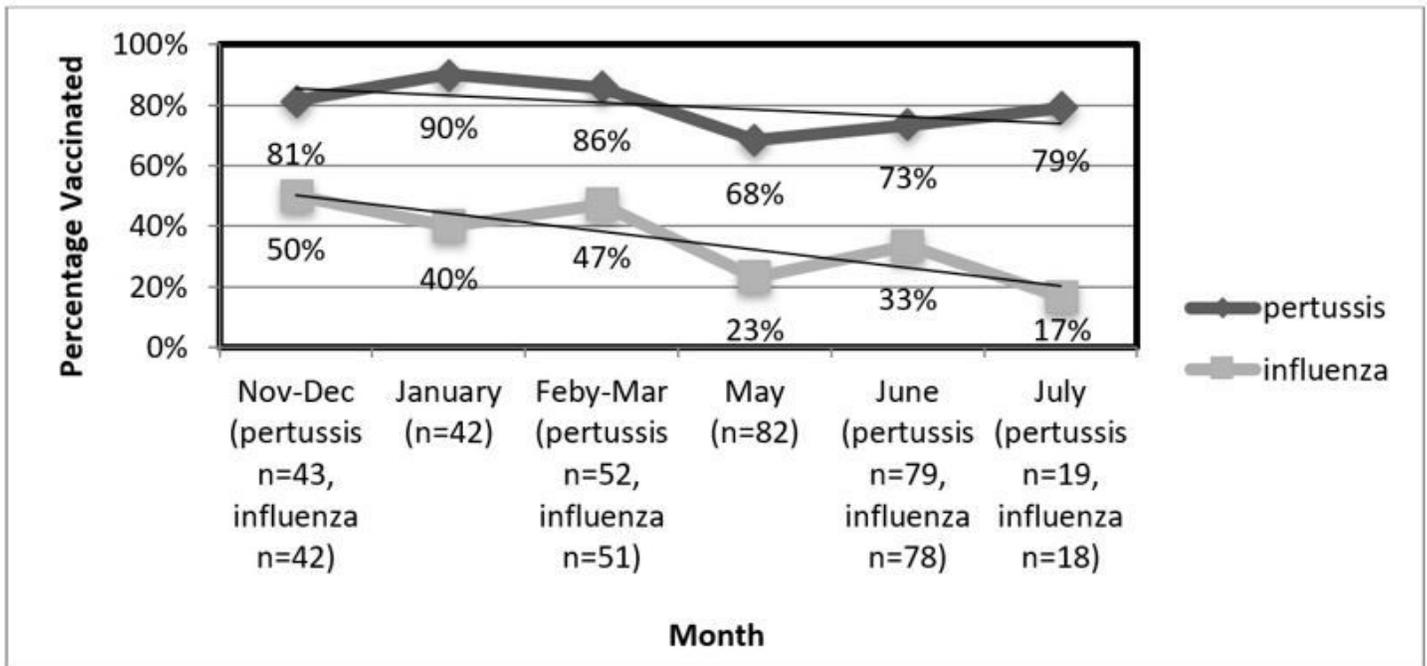


Figure 3

Pertussis and influenza vaccine coverage by month of delivery or late pregnancy (in High Risk ward)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [AdditionalFiles.docx](#)
- [Questionnaire.pdf](#)
- [STROBEchecklistBMC.docx](#)