



Published in final edited form as:

Vaccine. 2020 April 16; 38(18): 3474–3479. doi:10.1016/j.vaccine.2020.02.051.

Impact of media reports regarding influenza vaccine on obstetricians' vaccination practices

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Abstract

Background: In 2017, three media stories regarding influenza vaccine may have impacted obstetricians' (OB) influenza vaccination practices: reports of reduced influenza vaccine effectiveness, a severe influenza season, and a possible increased risk of miscarriage among pregnant women receiving 2009 H1N1 vaccine in the 1st trimester who had received H1N1 vaccine the previous season (later disproven).

Objective: Describe OB's: (1) awareness of; (2) attitudes and experiences related to; and (3) reported alterations in practice as a result of these reports.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Methods: A survey among a nationally representative sample of OBs April to June 2018.

Results: Response rate was 65% (302/468). 88% of OBs were “very aware” of the severe season, 74% of lower effectiveness, and 25% of the miscarriage study (47% “completely unaware” of miscarriage study). Among those aware, 58%, 57%, and 16% reported 10% of pregnant patients initiated discussions about the severe season, lower effectiveness, and miscarriage study, respectively. Most (83%) agreed reports about increased severity increased their enthusiasm for recommending influenza vaccine; fewer agreed reports about the miscarriage study (18%) and lower vaccine effectiveness (12%) decreased their enthusiasm for recommending influenza vaccine. Providers were more likely to initiate discussion with patients about increased severity of the season than the other reports. However, 35% agreed the miscarriage study reports increased their concerns about influenza vaccine safety; 18% (n = 48) reported changing the way they recommended influenza vaccine. Of those, 17 (6% of all respondents) reported not recommending influenza vaccine to women during the 1st trimester and 26 (10% of all respondents) recommended it but were willing to delay until the 2nd trimester.

Conclusions: During a season in which media stories could have influenced OB influenza vaccination behaviors in different directions, reports underscoring importance of influenza vaccine may have had more impact on OBs’ recommendations than reports questioning vaccine safety or effectiveness.

Keywords

Influenza; Vaccination; Pregnancy; Media

1. Introduction

Influenza can be associated with severe illness and hospitalization in pregnant women and infants [1-3]. Influenza vaccination has been recommended for pregnant women in the US since 2004 [4]. Influenza vaccine given during pregnancy has a good safety record, and has shown effectiveness in preventing influenza in mothers and their infants in the first months of life [5-8]. However, uptake is suboptimal for a variety of reasons, including lack of provider recommendation or offer [9]. Even among women who receive a recommendation and an offer, refusal of the vaccine is common [10]. The primary concerns related to influenza vaccine expressed by pregnant women pertain to safety, effectiveness, and whether the vaccine is necessary [11].

In 2017, there were three major stories reported in the media that were specifically related to these concerns. First, in September of 2017, a study from the Vaccine Safety Datalink (VSD) was published suggesting a possible association between miscarriage and receipt of influenza vaccine in the 1st trimester of pregnancy among women who had previously received a pandemic influenza A/H1N1-virus containing vaccine, which received coverage in the lay media [12-14]. Shortly thereafter, there were numerous media reports following a New England Journal of Medicine commentary reporting that influenza vaccine effectiveness for the Southern Hemisphere was about 10% [15,16]. As the season progressed, there also were numerous reports of preliminary estimates showing reduced vaccine effectiveness of the 2017–2018 influenza vaccine formulation for the US population

[17,18]. Subsequently, there were numerous reports in the media based primarily on CDC surveillance that the 2017–2018 US influenza season was severe and widespread [19-21].

In this study, conducted through a national survey network of obstetricians, we sought to assess the impact these media reports may have had on influenza vaccination delivery for pregnant women. Our specific objectives were to describe: (1) obstetricians' awareness of these issues; (2) obstetricians' attitudes and experiences related to these reports; and (3) any alterations in their practice as a result of these reports.

2. Materials and methods

Between April and July 2018, we administered an Internet and mail survey to a national network of obstetricians representative of American College of Obstetricians and Gynecologists (ACOG) membership. The Colorado Multiple Institutional Review Board approved this study as exempt research not requiring written informed consent.

2.1. Study population

We conducted this study as part of the Vaccine Policy Collaborative Initiative (VPCI) [22], a program designed and implemented collaboratively with the Centers for Disease Control and Prevention (CDC) to perform rapid turnaround surveys to assess physician practices and attitudes regarding vaccine-related issues. As we have described previously [23,24], we created a network of obstetrician/gynecologists in the US by recruiting from ACOG membership. To do this, we first created sampling matrices using demographic data from random samples of ACOG membership. We then determined proportions of obstetrician/gynecologists falling into each cell of a 3-dimensional matrix that crossed US region (Northeast, South, Midwest, or West) and practice location (urban inner city, suburban, or rural). We applied proportions for each cell in the 12-cell matrix to a total sample size of 475 to create cell sampling quotas. We have shown previously that survey responses from network physicians compared to those of physicians randomly sampled from American Medical Association physician databases had similar demographic characteristics, practice attributes, and attitudes about a range of vaccination issues [22].

2.2. Survey design

We developed the survey with CDC and solicited input from experts in vaccination and obstetric care. We pre-tested the survey with a panel of 3 obstetricians and then piloted it among 29 obstetricians from different regions of the country. The survey began with an introductory bulleted paragraph describing the media reports related to the reduced effectiveness of influenza vaccine, the severity of the influenza season, and the VSD study showing a possible association with miscarriage in the first trimester of pregnancy following repeated vaccination with pandemic influenza A/H1N1-virus containing vaccines (hereafter referred to as the "VSD study"). These descriptions were then followed by the statement: "In this survey, we would like to understand, from your perspective, the impact of these media reports on pregnant women's acceptance of influenza vaccine." Questions regarding awareness were asked in the same way for the three issues, with response options of "very aware," "somewhat aware," and "not at all aware." Those responding "not at all

aware” were skipped out of further questions regarding each issue. Attitudes and experiences regarding these issues were assessed using 4-point Likert scales with response options of “strongly agree,” “somewhat agree,” “somewhat disagree,” and “strongly disagree.” Questions regarding alterations in practice for each issue were asked as yes/no questions. Those responding “yes” were then asked to select from a menu of items to describe how they altered their practice. The survey instrument is available as supplemental digital content.

2.3. Survey administration

We surveyed physicians via the Internet or by mail based on stated preference in initial recruitment. We used a Web-based program (Verint[®], Melville, New York, www.verint.com) to administer the Internet surveys, and sent mail surveys by the U.S. Postal Service. The Internet group was sent an initial e-mail with up to 8 email reminders, and we sent the mail group an initial mailing and up to 2 additional mailed reminders. Internet survey non-respondents were sent a mail survey in case of problems with email correspondence. Unique IDs were assigned to each survey to assure that duplicate surveys were not received from the same individual. We patterned the mail protocol on Dillman’s tailored design method [25,26].

2.4. Statistical analysis

We pooled Internet and mail surveys together for analyses because other studies have found that physician attitudes are similar when obtained by either method [27]. We compared respondents with non-respondents on all available characteristics using Wilcoxon and chi-square analyses.

3. Results

The response rate was 65% (302/468). Respondents were similar to non-respondents with respect to age, gender, practice setting, practice location, practice size, and region (Table 1). Eleven percent of respondents reported not seeing pregnant patients and were excluded from further analysis, for a total study population of n = 270.

3.1. Obstetricians’ awareness of media reports

Seventy-four percent of respondents reported being very aware of reduced vaccine effectiveness (25% somewhat aware, 1% not at all aware). Eighty-eight percent of respondents reported being very aware of the media reports that the 2017–2018 influenza season was widespread and severe (10% somewhat aware, 2% not at all aware). Twenty-five percent of respondents reported being very aware of the VSD study regarding a possible increased risk of miscarriage after influenza vaccination (28% somewhat aware, 47% not at all aware).

3.2. Obstetricians’ attitudes and experiences

Most (85%) obstetricians agreed that they knew enough about the reports of reduced vaccine effectiveness to feel comfortable discussing with their pregnant patients, but most (73%) only discussed it with them if the patients brought it up first, with about half reporting that

many of their patients brought up the issue (Fig. 1). While knowledge of these reports did not negatively impact obstetricians' enthusiasm for recommending influenza vaccine, more than half (56%) reported that this information had impacted their patients' acceptance of influenza vaccine.

Similar to reports regarding reduced vaccine effectiveness, most (86%) obstetricians reported that their patients had heard that influenza was widespread and severe in the 2017–2018 season (Fig. 2). However, in contrast to influenza vaccine effectiveness, the majority (76%) reported proactively discussing this issue with their pregnant patients. The majority (83%) also reported that the reports of increased severity had increased their own enthusiasm for recommending influenza vaccine.

Only respondents who reported some level of awareness of the VSD study (n = 136) answered questions regarding it (Fig. 3). Among those, the vast majority agreed that most of their patients had not heard about the study (88%) and that the study had methodologic limitations (94%). The majority (76%) also reported that they did not bring the topic up with patients unless prompted. However, about one-third (35%) agreed that the study had increased their own concerns about the safety of influenza vaccine for pregnant women.

Twenty-two percent of respondents reported that a higher proportion of their pregnant patients received influenza vaccine in the 2017–2018 season compared to the 2016–2017 season, 69% that the proportion was the same, 8% that it was lower, and 1% didn't know. Among those who reported uptake was higher (n = 60), 22% reported that the publicity regarding the severe season had a major effect and 47% that it had a moderate effect. Among those who reported uptake was lower (n = 21), 71% said the reports of reduced effectiveness had a major or moderate effect (19% and 52%, respectively) compared to 24% for the VSD study (14% and 10%, respectively).

3.3. Reported alterations in practice

Eighty-two percent of obstetricians (n = 270) reported that the media reports regarding decreased effectiveness and the VSD study did not lead them to change the way they recommended influenza vaccine to pregnant women; the majority (86%) were already recommending influenza vaccination at any point in pregnancy. Among those who said they did change (n = 48), 16 (5.9% of total study population) said they did not recommend influenza vaccine to women in the first trimester of pregnancy and 25 (9.3% of total study population) said they still recommended it but were more willing to delay it until the second trimester if the patient requested it. None reported that they stopped recommending influenza vaccine to pregnant patients.

4. Discussion

In this nationally representative survey of obstetricians, we examined obstetricians' awareness and perceived impact of media reports about influenza vaccine on maternal influenza vaccine delivery. Obstetricians were very aware of the media reports regarding reduced influenza vaccine effectiveness and the severe season but almost half reported having no knowledge of the VSD study suggesting a potential increased risk of miscarriage

after influenza vaccination in the first trimester. Similarly, obstetricians reported hearing a great deal about the vaccine effectiveness and influenza severity issues from their pregnant patients but little about the VSD study. Their impressions were that these issues overall had minimal impact on uptake of influenza vaccine within their practices. Few altered their practice as a result of these issues, and most agreed with the statement that the VSD study had methodologic limitations. Importantly, none stopped recommending influenza vaccine to their pregnant patients, although a small proportion reported delaying vaccination until after the first trimester of pregnancy.

We previously reported that obstetricians have a great deal of confidence in the safety of influenza vaccine, and essentially all strongly recommend the vaccine to their pregnant patients [23]. While this study's findings are generally consistent with that prior finding, there is one potential cause for concern: among those obstetricians who were aware of the VSD study, over one-third reported strongly or somewhat agreeing that the VSD study increased their own concerns about influenza vaccine safety. Most obstetricians have routinely been administering vaccines for less than a decade, and data from the era prior to routine influenza vaccine administration show that their confidence in influenza vaccine was significantly lower than previously reported in recent years[28]. Thus, the foundation for obstetricians' vaccine attitudes and beliefs may be less stable than, for example, pediatricians and family physicians who have been administering vaccines for many decades. Therefore, obstetricians' confidence in influenza vaccine safety should be monitored closely. It is helpful that this finding was later shown to be likely spurious in a larger follow up study[29].

To our knowledge, this is the first study to examine the impact of media reports on obstetricians' experiences, attitudes, and practices related to maternal vaccination. It is reassuring that, from the perspective of practicing obstetricians, the reports that could have potentially had a negative impact on vaccination uptake influenced only a minority of those aware of them. Historically, some negative media reports about vaccines have had profound impacts on vaccination uptake. Perhaps the best known was the media coverage of the now retracted Lancet paper purporting an association between measles-mumps-rubella vaccination and autism [30-32]. As a result of media coverage of that fraudulent study [33], measles vaccination rates fell dramatically, particularly in the United Kingdom and Europe [34] but in the US as well [35], leading to outbreaks of measles and numerous deaths [36]. Measles outbreaks continue 20 years on as a direct result of that study because of parents refusing vaccines for fear of autism [37]. There are other examples of media reports, particularly those regarding vaccine safety, having devastating consequences on immunization programs, such as occurred with HPV vaccination rates in Colombia [38] and Japan [39] although observed syndromes in both instances were determined not to be vaccine-related. Thus, because there were significant limitations with the VSD study, it is reassuring that it didn't have a similar impact on maternal influenza vaccination in the US, possibly because few pregnant women were aware of the study, and that there were extensive educational efforts around the release of the manuscript describing its limitations. Why some vaccine-related studies or findings but not others achieve high public awareness is an area for future research. Some have posited that major news outlets have in recent years

adopted journalistic approaches that respect science over controversy, at least in part because of the negative fallout from the MMR-autism coverage [40,41].

Media reports can also encourage vaccination uptake. For example, media coverage of the 2015 Disneyland measles outbreak led to more favorable beliefs in the importance of measles vaccination [42], increased vaccine confidence [43], and even a change in California's vaccine exemption policy. In this study, we showed that the reports related to the severe 2017–2018 influenza season seemed to outweigh the potentially negative reports, as more obstetricians reported perceiving an increase in influenza vaccination than those reporting a decrease. It is important to note, though, that the majority of obstetricians in this study reported that uptake was about the same as prior seasons. This is consistent with CDC influenza vaccination coverage estimates among pregnant women, which showed that influenza vaccination before or during pregnancy in 2017–2018 was 49.1% [44], similar to the five prior seasons [9]. The obstetricians themselves, at least, also seemed to “react” more to the positive report than the negative reports.

This study had several limitations. Although the response rate was high, respondents may have differed from non-respondents. Also, this study is based on reported experiences and practices during the 2017–2018 influenza season; actual experiences and practices were not observed. We also report obstetricians' impressions of pregnant women's attitudes. Future work should explore the impact of similar media reports among pregnant women. Finally, survey respondents may have been influenced by more than just media reports (for example, direct communiques from CDC), and it is difficult to discern from a survey the influence of various information sources.

During a season in which media reports could have impacted influenza vaccination in different directions, our data suggest that increased importance of influenza vaccination because of a severe season appeared to have more of an impact on the way obstetricians recommended the vaccine than the negative reports regarding reduced effectiveness or potential safety concerns. To the extent they changed at all, obstetricians' influenza vaccination practices seemed more responsive to positive than negative media reports on the vaccine. This is consistent with prior work showing positive vaccination attitudes among obstetricians. However, the proportion reporting increased vaccine safety concerns due to the VSD study emphasizes a need to continue monitoring vaccine confidence among obstetricians. Given that rates of vaccination uptake in pregnancy remain low, monitoring the impact of future media reports on maternal vaccination will also be important.

Acknowledgements

The authors would like to thank leaders of the ACOG for collaborating in the establishment of the sentinel network in obstetricians and gynecologists. We would also like to thank all obstetricians and gynecologists in the network for participating and responding to this survey. This work was funded by the Centers for Disease Control and Prevention, Grant Number 5U01IP001072-02.

Abbreviations:

ACIP Advisory Committee on Immunization Practices

Tdap	tetanus, diphtheria and acellular pertussis vaccine
ACOG	American College of Obstetricians and Gynecologists
CDC	Centers for Disease Control and Prevention

References

- [1]. Hartert TV, Neuzil KM, Shintani AK, Mitchel EF Jr, Snowden MS, Wood LB, et al. Maternal morbidity and perinatal outcomes among pregnant women with respiratory hospitalizations during influenza season. *Am J Obstet Gynecol* 2003;189:1705–12. [PubMed: 14710102]
- [2]. Mertz D, Geraci J, Winkup J, Gessner BD, Ortiz JR, Loeb M. Pregnancy as a risk factor for severe outcomes from influenza virus infection: a systematic review and meta-analysis of observational studies. *Vaccine* 2017;35:521–8. [PubMed: 28024955]
- [3]. Poehling KA, Edwards KM, Weinberg GA, Szilagyi P, Staat MA, Iwane MK, et al. The underrecognized burden of influenza in young children. *N Engl J Med* 2006;355:31–40. [PubMed: 16822994]
- [4]. Harper SA, Fukuda K, Uyeki TM, Cox NJ, Bridges CB. Prevention and control of influenza: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep* 2004;53:1–40.
- [5]. Zaman K, Roy E, Arifeen SE, Rahman M, Raqib R, Wilson E, et al. Effectiveness of maternal influenza immunization in mothers and infants. *N Engl J Med* 2008;359:1555–64. [PubMed: 18799552]
- [6]. Poehling KA, Szilagyi PG, Staat MA, Snively BM, Payne DC, Bridges CB, et al. Impact of maternal immunization on influenza hospitalizations in infants. *Am J Obstet Gynecol* 2011;204:S141–8. [PubMed: 21492825]
- [7]. Munoz FM, Greisinger AJ, Wehmanen OA, Mouzoon ME, Hoyle JC, Smith FA, et al. Safety of influenza vaccination during pregnancy. *Am J Obstet Gynecol* 2005;192:1098–106. [PubMed: 15846187]
- [8]. Nordin JD, Kharbanda EO, Benitez GV, Nichol K, Lipkind H, Naleway A, et al. Maternal safety of trivalent inactivated influenza vaccine in pregnant women. *Obstet Gynecol* 2013;121:519–25. [PubMed: 23635613]
- [9]. Ding H, Black CL, Ball S, Fink RV, Williams WW, Fiebelkorn AP, et al. Influenza vaccination coverage among pregnant women - United States, 2016–17 influenza season. *MMWR Morb Mortal Wkly Rep* 2017;66:1016–22. [PubMed: 28957044]
- [10]. O'Leary ST, Pyrzanowski J, Brewer SE, Barnard J, Beaty B, Donnelly M, et al. Influenza and pertussis vaccination among pregnant women and their infants' close contacts: reported practices and attitudes. *Pediatr Infect Dis J* 2015;34:1244–9. [PubMed: 26322660]
- [11]. Ding H, Black CL, Ball S, Donahue S, Fink RV, Williams WW, et al. Influenza vaccination coverage among pregnant women-United States, 2014–15 influenza season. *MMWR Morb Mortal Wkly Rep* 2015;64:1000–5. [PubMed: 26390253]
- [12]. Donahue JG, Kieke BA, King JP, DeStefano F, Mascola MA, Irving SA, et al. Association of spontaneous abortion with receipt of inactivated influenza vaccine containing H1N1pdm09 in 2010–11 and 2011–12. *Vaccine* 2017;35:5314–22. [PubMed: 28917295]
- [13]. Fox M, Study linking early miscarriage to flu vaccine puzzles doctors. *NBC News*; 2017.
- [14]. Rossman S, Experts: pregnant women should get a flu shot, despite miscarriage study. *USA Today* 2017.
- [15]. Paules CI, Sullivan SG, Subbarao K, Fauci AS. Chasing seasonal influenza - the need for a universal influenza vaccine. *N Engl J Med* 2018;378:7–9. [PubMed: 29185857]
- [16]. Welch A, This year's flu vaccine may only be 10% effective, experts warn. *CBS NEWS* 2017.
- [17]. Scutti S, Flu vaccine just 36% effective this season, CDC reports. *CNN*; 2018.
- [18]. Belluz J, The flu shot offers lousy protection against this year's worst strain. Blame eggs. *Vox*; 2018.

- [19]. Howard J, Deadly flu season hits California particularly hard. CNN; 2018.
- [20]. Woods B, Get ready, some medical experts are predicting the worst flu season in history. CNBC; 2018.
- [21]. Steenhuisen J, Flu still widespread in U.S., worst season since 2014/2015: CDC. Reuters; 2018.
- [22]. Crane LA, Daley MF, Barrow J, Babbel C, Stokley S, Dickinson LM, et al. Sentinel physician networks as a technique for rapid immunization policy surveys. *Eval Health Prof* 2008;31:43–64. [PubMed: 18184632]
- [23]. O'Leary ST, Riley LE, Lindley MC, Allison MA, Crane LA, Hurley LP, et al. Immunization practices of U.S. obstetrician/gynecologists for pregnant patients. *Am J Prev Med* 2018;54:205–13. [PubMed: 29246674]
- [24]. O'Leary ST, Riley LE, Lindley MC, Allison MA, Albert AP, Fisher A, et al. Obstetrician-gynecologists' strategies to address vaccine refusal among pregnant women. *Obstet Gynecol* 2019;133:40–7. [PubMed: 30531564]
- [25]. Dillman DA, Smyth J, Christian LM. *Internet, mail and mixed-mode surveys: the tailored design Method*. 3rd ed. New York, NY: John Wiley Co.; 2009.
- [26]. Brtnikova M, Crane LA, Allison MA, Hurley LP, Beaty BL, Kempe A. A method for achieving high response rates in national surveys of U.S. primary care physicians. *PLoS ONE* 2018;13:e0202755. [PubMed: 30138406]
- [27]. McMahon SR, Iwamoto M, Massoudi MS, Yusuf HR, Stevenson JM, David F, et al. Comparison of e-mail, fax, and postal surveys of pediatricians. *Pediatrics* 2003;111:e299–303. [PubMed: 12671142]
- [28]. Power ML, Leddy MA, Anderson BL, Gall SA, Gonik B, Schulkin J. Obstetrician-gynecologists' practices and perceived knowledge regarding immunization. *Am J Prev Med* 2009;37:231–4. [PubMed: 19596538]
- [29]. Donahue J, Case-Control Study of Inactivated Influenza Vaccine and Spontaneous Abortion in the Vaccine Safety Datalink, 2012–13, 2013-14, and 2014-15. Presented at: 2019 Advisory Committee on Immunization Practices; February 27, 2019; Atlanta, Georgia.
- [30]. Retraction—ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *Lancet*. 2010;375:445. [PubMed: 20137807]
- [31]. Holton A, Weberling B, Clarke CE, Smith MJ. The blame frame: media attribution of culpability about the MMR-autism vaccination scare. *Health Commun* 2012;27:690–701. [PubMed: 22236220]
- [32]. Speers T, Lewis J. Journalists and jabs: media coverage of the MMR vaccine. *Commun Med* 2004;1:171–81. [PubMed: 16808699]
- [33]. Deer B, Secrets of the MMR scare. How the vaccine crisis was meant to make money. *BMJ* 2011;342:c5258. [PubMed: 21224310]
- [34]. Owens SR. Injection of confidence. The recent controversy in the UK has led to falling MMR vaccination rates. *EMBO Rep* 2002;3:406–9. [PubMed: 11991943]
- [35]. Smith MJ, Ellenberg SS, Bell LM, Rubin DM. Media coverage of the measles- mumps-rubella vaccine and autism controversy and its relationship to MMR immunization rates in the United States. *Pediatrics* 2008;121:e836–43. [PubMed: 18381512]
- [36]. Maggie F, Measles cases hit record high in Europe. NBC News 2018.
- [37]. Leslie TF, Delamater PL, Yang YT. It could have been much worse: The Minnesota measles outbreak of 2017. *Vaccine* 2018;36:1808–10. [PubMed: 29496348]
- [38]. Simas C, Munoz N, Arregoces L, Larson HJ. HPV vaccine confidence and cases of mass psychogenic illness following immunization in Carmen de Bolivar, Colombia. *Hum Vaccin Immunother* 2018;1–4. [PubMed: 29324170]
- [39]. Hanley SJ, Yoshioka E, Ito Y, Kishi R. HPV vaccination crisis in Japan. *Lancet* 2015;385:2571. [PubMed: 26122153]
- [40]. Dobson R, Media misled the public over the MMR vaccine, study says. *BMJ* 2003;326:1107.
- [41]. Goodman NW. MMR scare stories: Some things are just too attractive to the media. *BMJ* 2007;335:222.

- [42]. Cataldi JR, Dempsey AF, O'Leary ST. Measles, the media, and MMR: impact of the 2014–15 measles outbreak. *Vaccine* 2016;34:6375–80. [PubMed: 27817962]
- [43]. Cacciatore MA, Nowak G, Evans NJ. Exploring the impact of the US measles outbreak on parental awareness of and support for vaccination. *Health Aff (Millwood)* 2016;35:334–40. [PubMed: 26858389]
- [44]. Kahn KE, Black CL, Ding H, Williams WW, Lu PJ, Fiebelkorn AP, et al. Influenza and Tdap vaccination coverage among pregnant women - United States, April 2018. *MMWR Morb Mortal Wkly Rep* 2018;67:1055–9. [PubMed: 30260946]

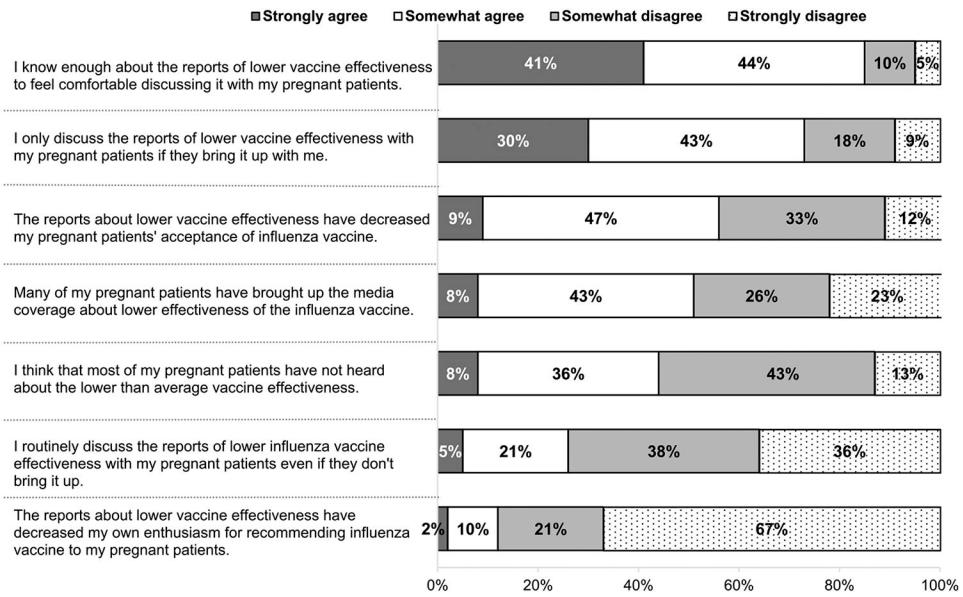


Fig. 1. Attitudes and Experiences Regarding Media Reports of Decreased Effectiveness of Influenza Vaccine in the 2017–2018 Season (n = 267). Some percentages do not add up to 100% due to rounding.

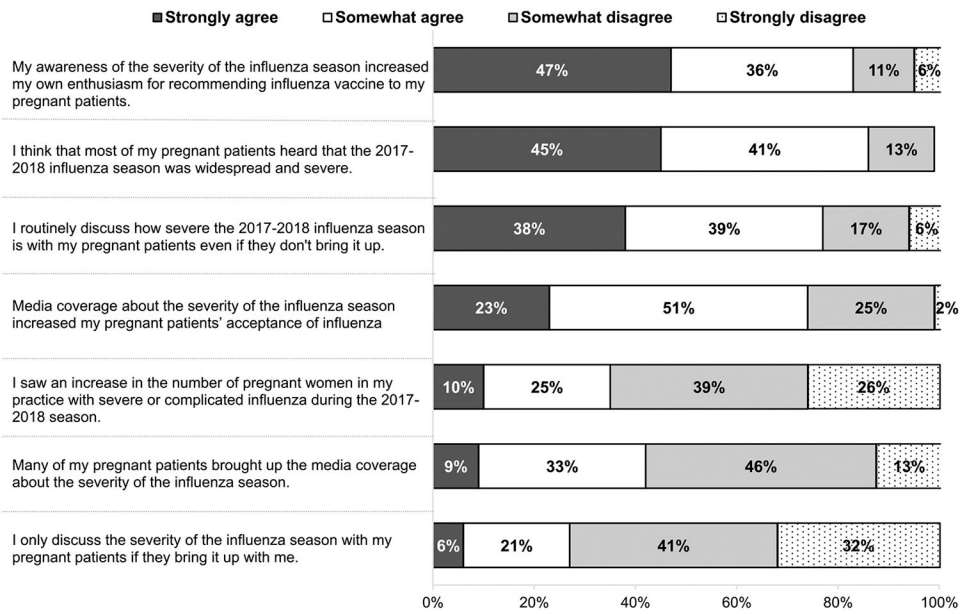


Fig. 2. Attitudes and Experiences Regarding Media Reports of Increased Severity of Influenza in the 2017–2018 Season (n = 264). Some percentages do not add up to 100% due to rounding.

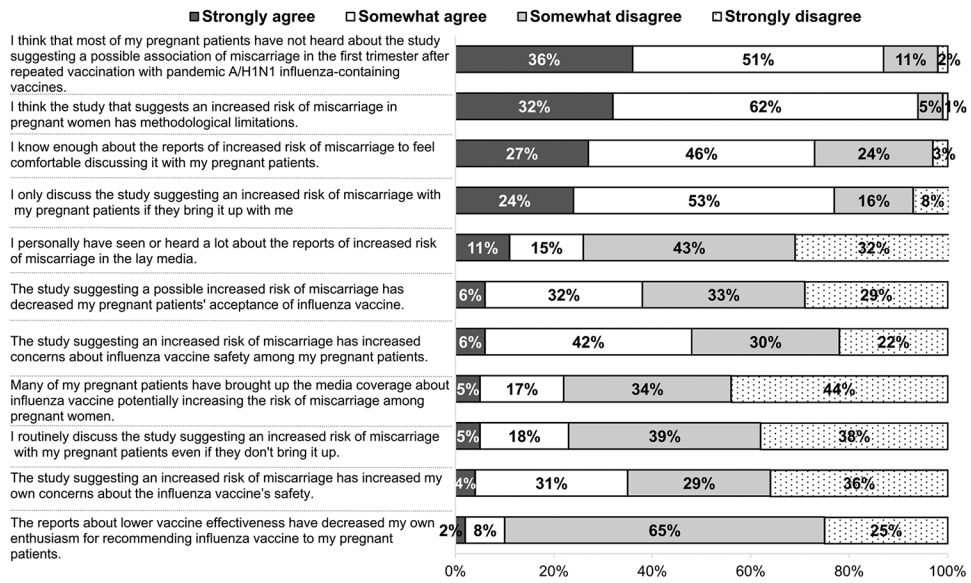


Fig. 3. Attitudes and Experiences Regarding Media Reports of a Possible Increased Risk of Miscarriage after Influenza Vaccine in the 2017–2018 Season (n = 136). Some percentages do not add up to 100% due to rounding.

Table 1

Comparison of Responders and Non-responders (n = 468).

Variable	Non-Responder Col % (n) n = 166	Responder Col % (n) n = 302	p value
Gender			
Male	34 (57)	32 (96)	
Female	66 (109)	68 (203)	0.62
Setting			
Private practice	69 (113)	65 (194)	
Hospital or clinic	24 (40)	27 (82)	
HMO	7 (11)	8 (23)	0.68
Census Location			
Urban	60 (99)	60 (180)	
Suburban	40 (66)	40 (120)	
Rural	1 (1)	1 (2)	0.99*
Region			
Midwest	16 (27)	23 (68)	
Northeast	27 (45)	18 (55)	
South	34 (57)	38 (114)	
West	22 (37)	22 (65)	0.09
Decision-making			
Independent	58 (95)	58 (172)	
Larger system level	42 (69)	42 (127)	0.93
Mean (sd)/Median age in years	51.2 (11.0)/50.0	52.1 (10.6)/52.0	0.35
Mean (sd)/Median number of providers	14.2 (33.9)/6.0	14.0 (28.6)/7.0	0.42**

* Fisher's exact test.

** Wilcoxon test.