Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

COVID-19 vaccination patterns and attitudes among American pregnant individuals

OBJECTIVE: Recent investigations have provided reassuring data on the use of COVID-19 vaccines in pregnant populations,[1]. Vaccination during pregnancy has now been endorsed by key organizations, including the American College of Obstetrician Gynecologists (ACOG) and the Society of Maternal Fetal Medicine (SMFM).[2] Yet, with respect to vaccine acceptance, the United States (US) ranked near the bottom in a list of 16 countries in a recent international survey.[3] Granular information regarding the predictors of acceptance is lacking. To optimize vaccine acceptance in people during pregnancy in the United States, the data on current patterns and attitudes toward vaccination are needed. As of May 2021, just 16% of pregnant persons in a centers for disease control and prevention (CDC) database had received at least one dose of a COVID-19 vaccine.[4] In this report, we utilized a nationwide prospective study of pregnant persons, recruited before 10 weeks of gestation, to characterize the vaccination rates and acceptance during the first 6 months of vaccine roll-out.

STUDY DESIGN: Institutional Review Board approval was obtained through the University of California, San Francisco. We analyzed the survey data from the participants in the assessing the safety of pregnancy in the coronavirus pandemic (ASPIRE) study, which is a nationwide prospective cohort of pregnant individuals recruited early in the first trimester. The study was launched in April 2020, with participant recruitment accomplished through social media and web-based communications. Inclusion required pregnancy at <10 weeks' gestation and a lack of vaccination before pregnancy. The current analysis considers respondents who completed at least one vaccine-specific questionnaire between April 1, 2021, and June 30, 2021, with the most recently completed questionnaire being utilized. Unvaccinated respondents who indicated a willingness to be vaccinated in the future were defined as indicating vaccine acceptance. The Wilcoxon rank sum or Fisher's exact tests were used to test for bivariable associations with the vaccine status and acceptance. Those significant at the $P<.1$ level were included in multivariable logistic regression models.

RESULTS: A total of 2506 community ASPIRE respondents completed at least 1 vaccine questionnaire as of June 30, 2021, with 57.4% getting vaccinated during pregnancy (Table). In an adjusted model, the predictors of lower odds of vaccination were being of the Black race compared with White race and being counseled by a provider not to vaccinate compared with no counseling. The predictors of higher odds of vaccination were increasing education and income, living in a metropolitan area, and worry over COVID-19. In addition, being counseled about vaccination by a provider was a strong predictor of getting vaccinated compared with receiving no counseling (Figure, A).

Among the unvaccinated, only 35.7% reported vaccine acceptance. Being advised by a provider not to vaccinate negatively predicted vaccine acceptance. The predictors of higher odds of vaccine acceptance were the following: some or extreme COVID-19 worry compared with little or none and being counseled about vaccination (Figure, B). Over time, provider information was a consistent predictor of vaccination and vaccine acceptance (Figure, C).

CONCLUSION: Using data from an ongoing, nationwide study launched in the beginning of the COVID-19 pandemic, we found that while a slight majority of the pregnant respondents had been vaccinated as of June 2021, there remained substantial vaccine hesitancy, with most of the currently unvaccinated individuals indicating no plans to get vaccinated. Race, education, living in a metropolitan area, and income were strong predictors of vaccination status, but they did not predict vaccine acceptance among those currently unvaccinated.

The initial roll-out of the COVID-19 vaccine to pregnant persons was complicated by a lack of phase 3 trial data, and there continues to be a need for rigorous investigations on vaccine safety in pregnancy. We found that the respondents who reported having any vaccine discussion with their provider, even when no advice was given, were more likely to get vaccinated; this suggests that providers can play an important role in improving vaccination rates. Public health strategies should prioritize provider and public education regarding the adverse effects of COVID-19 in pregnancy and evolving safety data for vaccines in this group.[5] Critically, authorities including the CDC, ACOG and SMFM now recommend vaccination for all pregnant individuals. Encouragingly, we found that the decision to vaccinate evolved, with many participants reporting a shift in attitude from no acceptance to acceptance on the final survey.

Our sample size is large and distributed across diverse regions and backgrounds, but it also represents those who chose to participate in a longitudinal cohort study focused on COVID-19. Therefore, as with any observational study, the limitations include generalizability to the larger population.

Overall, our data characterize the current landscape of COVID-19 vaccination during pregnancy in the United States, highlighting opportunities for improving vaccination rates in this high-risk group.

EDITOR'S CHOICE

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TABLE
Participant characteristics by vaccination status

Characteristic or Group	Overall Mean (SD) or N (%) of cohort	Unvaccinated Mean (SD) or % of group	Vaccinated Mean (SD) or % of group	*P* value
Age at enrollment (y)	32.3 (3.9)	31.8 (4.5)	32.7 (3.7)	<.001
Race				
White	2100 (83.8)	41.8	58.2	<.001
Black	78 (3.1)	78.2	21.8	
Asian	91 (3.6)	20.9	79.1	
Native American	19 (0.8)	36.8	63.2	
Mixed/Other	127 (5.1)	47.2	52.8	
Ethnicity				
Not Hispanic	2135 (85.2)	41.9	58.1	.054
Hispanic	273 (10.9)	48.0	52.0	
Education				
Less than bachelor's degree	579 (23.1)	66.8	33.2	<.001
Bachelor's degree	903 (36.0)	42.4	57.6	
Graduate degree	985 (39.3)	29.5	70.5	
Household income				
<$50,000	391 (15.6)	68.5	31.5	<.001
$50,000–$99,000	730 (29.1)	50.7	49.3	
$100,000–$250,000	1078 (43.0)	33.6	66.4	
>$250,000	266 (10.6)	22.2	77.8	
Work status				
Unemployed	137 (5.5)	61.3	38.7	<.001
Full-time homemaker	366 (14.6)	55.5	44.5	
Part-time employment	316 (12.6)	45.6	54.4	
Full-time employment	1648 (65.8)	38.2	61.8	
Employed in a healthcare field				
No	1824 (72.8)	42.6	57.4	.476
Yes	640 (25.5)	44.2	55.8	
Region of residence				
South	718 (28.7)	47.9	52.1	.011
Midwest	596 (23.8)	43.3	56.7	
West	706 (28.2)	39.9	60.1	
Northeast	405 (16.2)	39.8	60.2	
Lives in a metropolitan area				
No	978 (39.0)	51.4	48.6	<.001
Yes	1448 (57.8)	37.4	62.6	
COVID-19 anxiety/worry (baseline)				
Anxiety about pregnancy (1–100)	50.3 (25.8)	44.8 (28.9)	54.3 (24.5)	<.001
Anxiety about giving birth (1–100)	53.4 (26.0)	50.7 (30.1)	55.4 (25.0)	.004
Worry about self/loved ones being affected				
A little/not at all	796 (31.8)	56.9	43.1	<.001
Somewhat	933 (37.2)	37.8	62.2	
Extremely/very	700 (27.9)	32.6	67.4	

(continued)

TABLE
Participant characteristics by vaccination status *(continued)*

Characteristic or Group	Overall Mean (SD) or N (%) of cohort	Unvaccinated Mean (SD) or % of group	Vaccinated Mean (SD) or % of group	*P* value
General anxiety/worry (baseline)				
GAD-7 score (0–21)	4.5 (4.2)	4.7 (4.6)	4.3 (4.1)	.246
Minimal (GAD-7 score 0–4)	1445 (57.7)	40.9	59.1	.064
Mild-Severe (GAD-7 score 5-21)	941 (37.5)	44.7	55.3	
Provider counseling/advice				
Counseled by provider				
No	1000 (39.9)	61.5	38.5	<.001
Yes	1501 (59.9)	30.6	69.4	
Advice given (if counseled)				
No given clear direction	278 (11.1)	40.3	59.7	<.001
Discussed pros and cons	603 (24.1)	33.2	66.8	
Told not to vaccinate	39 (1.6)	89.7	10.3	
Told to vaccinate	579 (23.1)	19.3	80.7	
Planning				
Planning to get vaccinated	336 (13.4)	31.2		
Reasons for not planning to get vaccinated	693 (27.7)			
May experience side effects or get sick	195 (7.8)	28.1		
Does not think it will work	80 (3.2)	11.5		
Does not need - had COVID-19 infection	94 (3.8)	13.6		
Does not need - not at risk	107 (4.3)	15.4		
Does not think it's good for them	136 (5.4)	19.6		
Not sure if vaccine is safe in pregnancy	566 (22.6)	81.7		
Allergic to the vaccine/other medical reason	22 (0.9)	3.2		
Other reason[a]	136 (5.4)	19.6		
Timing				
Gestational weeks at enrollment	6.9 (1.3)	6.9 (1.3)	6.9 (1.3)	.312
Gestational weeks at data collection	19.9 (10.4)	18.2 (12.0)	21.2 (9.5)	<.001
Weeks between data collection and analysis	5.8 (4.1)	4.7 (3.9)	6.5 (4.1)	<.001
Gestational weeks at vaccination	16.8 (8.4)		16.8 (8.4)	
Month of vaccination	1416 (56.5)			
Dec 2020	59 (2.4)		4.2	
Jan 2021	115 (4.6)		8.1	
Feb 2021	123 (4.9)		8.7	
March 2021	630 (25.1)		44.5	
April 2021	316 (12.6)		22.3	
May 2021	140 (5.6)		9.9	
June 2021	35 (1.4)		2.5	

P values by Wilcoxon rank sum (continuous), or Fisher's exact test (categorical).

Region of residence and zip code variables are based on US Census Bureau data.

GAD-7: minimal: 0–4; Mild-Severe: 5–21.

GAD-7, general anxiety disorder scale; *SD*, standard deviation.

[a] Of those reporting other reasons, 67.7% also cited at least one of the other listed reasons.

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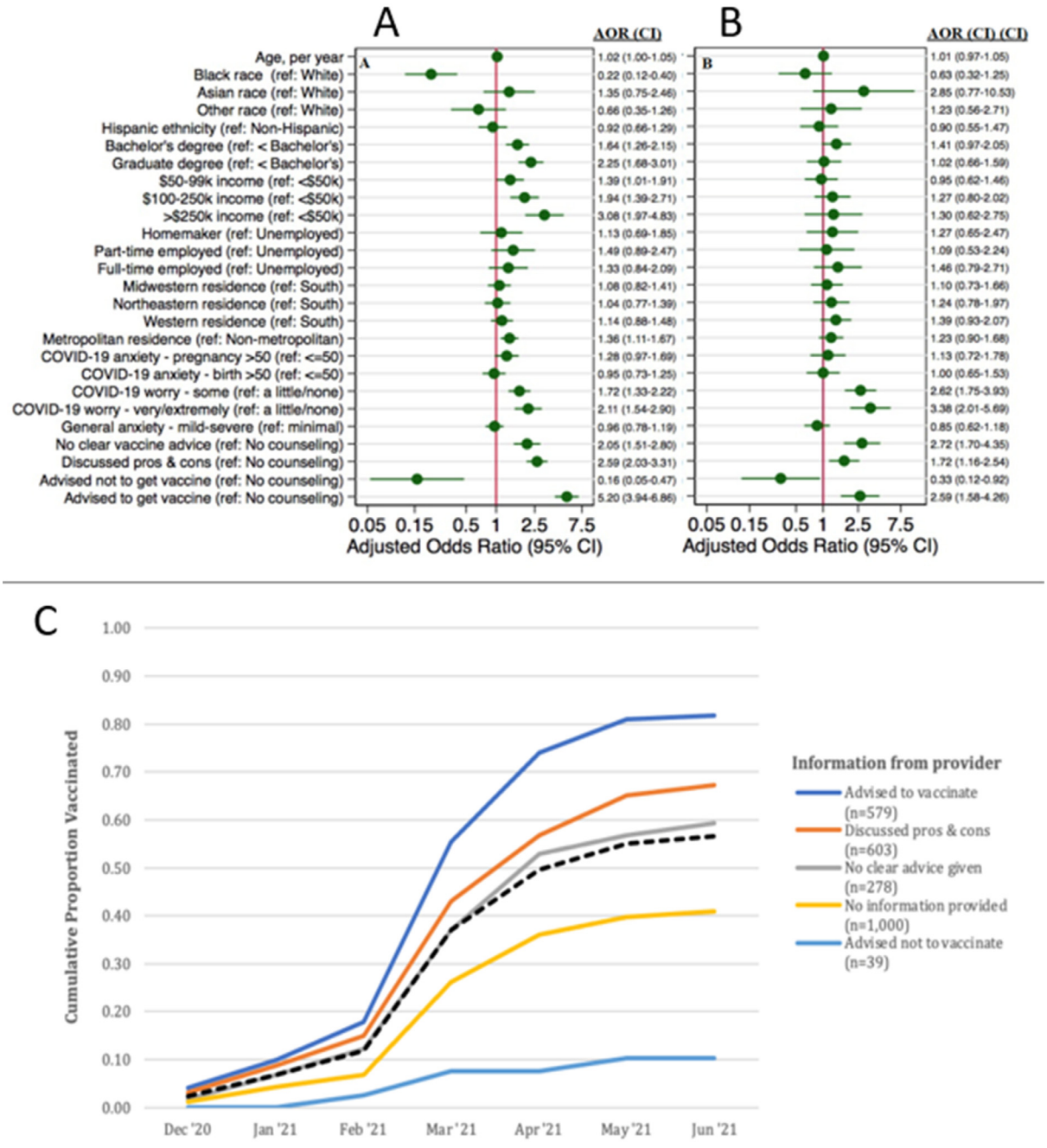
FIGURE
Factors influencing odds of vaccination and longitudinal trends in vaccination by provider advice



A, (upper left panel). Adjusted odds ratios (95% confidence interval) of vaccination among the study population, multivariable model; **B,** (upper right panel). Adjusted odds ratios (95% confidence interval) of vaccine acceptance among the unvaccinated, multivariable model; **C,** (bottom panel). Cumulative proportion of participants vaccinated by information received from provider. Number of participants in each category of information type received from the provider are shown in the legend on the right.

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Huddleston. COVID-19 vaccination patterns and attitudes among American pregnant individuals. Am J Obstet Gynecol MFM 2021.

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