ORIGINAL RESEARCH

Association of Vaccination in Pregnancy With Newborn Hepatitis B Vaccine Receipt

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Abstract

INTRODUCTION: The authors evaluated factors associated with neonatal hepatitis B vaccination (HepB), including prenatal vaccinations, race, ethnicity, neonatal disposition, parity, and maternal age to identify potential areas of engagement to improve maternal and child health.

METHODS: The authors conducted a retrospective cohort study of patients who received prenatal care and delivered at an academic tertiary care hospital in central Pennsylvania from 2015–2020. A multiple logistic regression model was used to assess factors associated with newborn receipt of HepB.

RESULTS: Prenatal vaccination was significantly ($P < .0001$) associated with subsequent neonatal HepB vaccination in the hospital following birth. Race, Hispanic ethnicity, age at delivery, neonatal disposition, and parity were not shown to be associated with HepB vaccine uptake.

CONCLUSION: Prenatal vaccination was significantly associated with neonatal in-hospital HepB vaccine uptake.

Introduction

Multiple large studies have demonstrated the safety and efficacy of tetanus, diphtheria, and pertussis (Tdap) and influenza vaccines during pregnancy.[1–3] Since 1990, the hepatitis B (HepB) vaccine has been included in the schedule for routine vaccinations for children by the US Centers for Disease Control and Prevention (CDC), resulting in a 90% decrease in rates of reported acute HepB virus (HBV) infections. The initial dose is recommended within 24 hours of birth and is effective in decreasing HBV infection in young infants who may develop chronic disease if they acquire HBV early in life. Increasing the rate of HepB vaccination at birth is an important strategy in preventing HBV infection.[4]

The birth dose of HepB vaccine is an important predictor of completion of the HepB vaccine series and vaccination rates for other recommended childhood vaccines.[5,6] Factors affecting HepB vaccination are

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varied. Prior studies have found that parental concern over the safety of infant vaccines, as well as personal and religious beliefs, contribute to resistance to childhood vaccination.[7] However, several studies have indicated patient desire for information and the potential influence of health care interactions to increase knowledge and trust of vaccines in pregnancy.[8–10] Although studies have investigated some of the factors influencing vaccine decisions during the prenatal period and childhood,[11,12] studies exploring correlations between maternal vaccination during gestation and neonatal HepB vaccination are few.

Two recent studies suggest a predictive correlation between receipt of either Tdap or influenza vaccine during gestation and newborn receipt of the HepB vaccine. Wales et al found an association between Tdap and influenza vaccines during pregnancy as well as an association between maternal receipt of Tdap and infant receipt of HepB vaccine at a medical center in Albany, New York.[13] Fuchs et al found an association between a gestational dose of Tdap vaccine and infant receipt of HepB vaccine at a university hospital in Texas.[14]

This study investigated the relationship between maternal vaccination during gestation to neonatal HepB vaccination at a central Pennsylvania academic medical center, which serves a population of largely White, non-Hispanic patients in a semirural area. The 2021 Community Health Needs Assessment for this service area identified a total population of 1,707,543, which was 83.9% White (1,433,036) and 16.1% non-White (274,507). Twenty-seven percent of households in the service area fail to earn above the cost of living, and 7.2% of families earn below the poverty line. The authors evaluated the association of receipt of recommended vaccines during gestation with newborn receipt of HepB before hospital discharge. Additionally, the authors sought to identify potential confounders that may be related to uptake of HepB vaccine for newborns, including maternal racial and ethnic identity, primiparity, maternal age, and/or Neonatal Intensive Care Unit (NICU) admission. Because the electronic medical records used did not distinguish between sex and gender identity, more specific language to describe the patient population studied cannot be used. This study is using the terms "maternal" and "mother" to refer to childbearing individuals.

Methods

STUDY SAMPLE

The Pennsylvania State University institutional review board approved this study as exempt (approval # STUDY00015245). Data were collected from past medical records of individuals who received prenatal care and subsequently delivered at an academic tertiary care hospital in central Pennsylvania between January 2015 and January 2020 during the months of January, April, July, and October. These months were chosen from different seasons to evaluate if seasonality impacted influenza vaccine uptake. Excluded patients were those who delivered prior to 28 weeks' gestation, given that recommendation for Tdap vaccine administration begins at 27 to 28 weeks. If a patient had 2 deliveries during the study period, the second birth was excluded. Multiple gestations were also excluded. Deliveries with no recorded receipt or decline of the HepB vaccine for the newborn were excluded. A total of 2947 maternal–infant dyads were included in the analysis.

MEASURES

Patient data including maternal age, race, ethnicity, parity, and prior obstetric history were abstracted from discharge summaries and scanned inpatient charts. Vaccination status for influenza and Tdap vaccination during pregnancy was abstracted from patient prenatal charts, documented as either administered, declined, or absent for charts that did not document either administration or declination. Prenatal care with obstetrics practitioners or family medicine practitioners was also recorded.

Delivery date, initial newborn disposition (NICU vs newborn nursery), and newborn HepB vaccine receipt prior to discharge were abstracted from corresponding newborn inpatient charts.

STATISTICAL ANALYSIS

The following predictors of newborn HepB vaccination receipt prior to discharge were examined univariably via logistic regression models: mother's influenza and Tdap vaccination status, first birth (yes or no), ethnicity, race, NICU initial disposition, and age. Results were quantified via unadjusted odds ratios and 95% confidence intervals (CI) as well as adjusted odds ratios (AOR) (ie, odds ratios adjusted for other factors in the model) with 95% CIs. Additionally, the aforementioned predictors were included in a single multiple logistic regression model. With respect to missing data, no imputation

was performed. Missing data were either excluded (ie, race and ethnicity) or included as a separate category (ie, mother's vaccination status). This resulted in the exclusion of n = 76 participants from the multiple logistic regression model for records that were missing race and/or ethnicity. All analyses were conducted using SAS software, version 9.4 (SAS Institute Inc).

Results

A total of 2947 patients were included in this study. Maternal age ranged from 15 to 53 years with a mean age of 29 years at delivery (standard deviation [SD] = 5.5). The average gestational age was 38.8 weeks (SD = 1.9). The majority of the cohort was non-Hispanic (87.3%) and White (69.9%). Patients also identified their race as "Other" (14.7%), Black (8.8%), and Asian, Native Hawaiian, or other Pacific Islander (5.2%). It was the first birth for 1177 patients (39.9%) in the study. In this cohort, 2645 mothers (89.8%) received at least 1 of the 2 recommended vaccinations (influenza or Tdap) during pregnancy, and 2843 neonates (96.5%) received the HepB vaccine in the hospital before discharge. Table 1 shows the crude HepB vaccination rates for the variables of interest.

Per the logistic regression models (Table 2), vaccine receipt during pregnancy was the strongest predictor of HepB vaccine uptake. After adjusting for the other factors of interest, participants who had at least one of the vaccinations during pregnancy had odds of vaccinating their neonate against HBV that are 8 times those who declined both pregnancy vaccinations (AOR = 8.37; 95% CI = 5.33, 13.15; $P < .001$). Although first birth was associated with HepB vaccine receipt in the unadjusted model, after adjusting for the other factors in the model, it was no longer statistically significant (AOR = 1.49; 95% CI = 0.94, 2.35; $P = .09$). Race, ethnicity, age, and NICU disposition were not associated with HepB vaccine receipt in either the unadjusted or adjusted models.

Given that the influenza vaccine is offered seasonally, an association exists between month of delivery and influenza vaccination rates. The authors investigated whether delivery month impacted the relationship between influenza vaccination and HepB vaccination by adjusting for delivery month. The authors found the relationship between influenza vaccine and HepB vaccine uptake was unchanged; therefore, delivery month was not included in the final adjusted model. Specialty of prenatal practitioner was also not associated with HepB vaccine receipt.

Variable	HepB received	HepB not received
Age, y	29.0 ± 5.5	29.6 ± 5.2
Prenatal influenza vaccination		
Yes	1811 (98.3)	31 (1.7)
No	665 (91.5)	62 (8.5)
Absent	367 (97.1)	11 (2.9)
Prenatal Tdap vaccination		
Yes	2487 (97.5)	63 (2.5)
No	220 (85.6)	37 (14.4)
Absent	136 (97.1)	4 (2.9)
At least 1 prenatal vaccination (flu or Tdap)		
Yes	2580 (97.5)	65 (2.5)
No	158 (82.3)	34 (17.7)
Absent	105 (95.4)	5 (4.6)
First birth		
Yes	1146 (97.4)	31 (2.6)
No	1697 (95.9)	73 (4.1)
Ethnicity		
Hispanic	311 (97.5)	8 (2.5)
Non-Hispanic	2478 (96.3)	96 (3.7)
Unknown[a]	54 (100.0)	0 (0.0)
Race		
White	1976 (95.9)	85 (4.1)
Black	252 (96.9)	8 (3.1)
Asian/NHPI	154 (100.0)	0 (0.0)
Other/multiracial/unknown[a]	461 (97.7)	11 (2.3)
NICU (initial disposition)		
Yes	269 (94.7)	15 (5.3)
No	2574 (96.7)	89 (3.3)

Table 1: Predictors of hepatitis B virus vaccination

Note: Data reported as mean ± SD or n (row %).

[a] Factors have missing data (n = 54 missing ethnicity, n = 27 missing race)

Flu = influenza; HepB = hepatitis B vaccine; NHPI = Native Hawaiian or other Pacific Islander; NICU = neonatal intensive care unit; Tdap = tetanus, diphtheria, and pertussis.

Discussion

This study provides additional evidence of a significant relationship between vaccination during pregnancy and neonatal receipt of HepB vaccine in the hospital before discharge. The authors did not find statistically significant racial differences in HepB vaccination rates, with more than 95% of patients

Variable	Pairwise comparison	Unadjusted odds ratio (95% CI)	*P* value	Adjusted odds ratio (95% CI)[a]	*P* value
Flu/Tdap vaccination	Yes vs no	8.58 (5.50, 13.36)	**< .001**	8.18 (5.25, 12.75)	**< .001**
	Yes vs absent	2.05 (0.84, 5.03)	.12	1.86 (0.77, 4.53)	.17
	No vs absent	0.24 (0.09, 0.61)	**.003**	0.23 (0.09, 0.58)	**.002**
First birth	Yes vs no	1.58 (1.03, 2.41)	**.04**	1.45 (0.93, 2.27)	.10
Ethnicity	Hispanic vs non-Hispanic	1.43 (0.70, 2.91)	.33	1.32 (0.53, 3.27)	.55
	Hispanic vs unknown	0.34 (0.02, 6.06)	.46	0.30 (0.02, 5.37)	.41
	Non-Hispanic vs unknown	0.24 (0.01, 3.94)	.31	0.22 (0.01, 3.98)	.31
Race	White vs Black	0.78 (0.38, 1.60)	.49	0.72 (0.35, 1.49)	.37
	White vs Asian/NHPI	0.07 (0.00, 1.22)	.07	0.08 (0.00, 1.25)	.07
	White vs other/multiracial/unknown	0.58 (0.31, 1.08)	.08	0.72 (0.33, 1.58)	.41
	Black vs Asian/NHPI	0.10 (0.01, 1.69)	.11	0.11 (0.01, 1.87)	.13
	Black vs other/multiracial/unknown	0.74 (0.30, 1.82)	.51	1.00 (0.36, 2.80)	1.00
	Asian/NHPI vs other/multiracial/unknown	7.70 (0.45, 132.6)	.16	9.38 (0.52, 168.1)	.13
NICU (initial disposition)	Yes vs no	0.60 (0.35, 1.05)	.08	0.65 (0.37, 1.15)	.14
Age (per 1 y increase)		0.98 (0.95, 1.02)	.29	0.99 (0.95, 1.03)	.53

Table 2: Logistic regression modeling probability of hepatitis B virus vaccination

Note: Boldface indicates statistical significance (*P* < .05).

[a] Odds ratio adjusted for the other factors in the multiple logistic regression model.

CI = confidence interval; Flu = influenza; HBV = hepatitis B virus; NHPI = Native Hawaiian or other Pacific Islander; NICU = neonatal intensive care unit; Tdap = tetanus, diphtheria, and pertussis.

in each racial category included in the study receiving this vaccine. Given high overall vaccination rates in the study population, these results may lack the statistical power to detect statistically significant differences between groups; however, the crude vaccination rates were lowest for White patients compared to Black, Asian, and other racial groups. Prior studies have demonstrated varying racial differences in HepB vaccination, which may reflect regional differences or factors affecting this semirural patient population as compared to the largely urban populations in prior studies.[15–20]

The authors did not find an association with Hispanic ethnicity and HepB vaccine receipt. However, the sample size of Hispanic patients was small; this study lacked the statistical power to detect a difference in such a small cohort. Another study with a higher proportion of Hispanic patients found that Hispanic White patients were more likely to receive prenatal vaccination and more likely to consent to the newborn HepB vaccine than other racial and ethnic groups.[12] Future studies could further explore ethnic and racial disparities and differences in vaccination rates in various populations.

The COVID-19 pandemic and vaccine rollout has changed the landscape for vaccine hesitancy. Vaccination rates for COVID-19 during pregnancy remain low, even though the benefits to mother and baby appear to be strong and the risks minimal.[21–23] This study preceded the pandemic, so future studies would be valuable to evaluate trends over time.

The correlation of HepB vaccination with prenatal vaccination presents an opportunity for clinicians to engage pregnant patients in early conversations about the benefits of prenatal and neonatal vaccines. Addressing vaccination early in pregnancy may provide doctors and patients alike the opportunity to explore concerns over the course of the pregnancy. Future studies should evaluate the impact of prenatal interventions on vaccination rates for neonates.

This study has several limitations. The primary outcome studied was HepB vaccine administered in the hospital; as a result, these findings do not capture those infants who ultimately received the HepB vaccine in outpatient settings or subsequently during childhood. The study also could not account for pregnant patients who received vaccines in another setting, such as a pharmacy. The study did not differentiate preterm infants born after 28 weeks from those born at term. The study was performed at a single academic

institution in one geographical location. Most of the patients identify as non-Hispanic White and live in a suburban or rural area with low rates of poverty, limiting the generalizability of the study.

Conclusions

Receipt of the Tdap or seasonal influenza vaccine during pregnancy was associated with newborn receipt of the HepB vaccine in-hospital. Prenatal care presents an opportunity for productive patient engagement to increase HepB vaccination rates for infants.

Data-Sharing Statement

Data are available upon request. Readers may contact the corresponding author to request underlying data.

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