



Maternal Attitudes and Other Factors Associated with Infant Vaccination Status in the United States, 2011-2014

Cicely W. Fadel, MD, PhD^{1,*}, Eve R. Colson, MD, MHPE², Michael J. Corwin, MD³, Denis Rybin, PhD⁴, Timothy C. Heeren, PhD⁵, Colin Wang³, and Rachel Y. Moon, MD⁶, on behalf of the Study of Attitudes and Factors Effecting Infant Care (SAFE) study[†]

Objective To assess the role of maternal attitudes and other factors associated with infant vaccination status. **Study design** Data on reported vaccination status were analyzed from a nationally representative prospective survey of mothers of 2- to 6-month-old infants. Weighted univariate and multiple logistic regression analyses were conducted. Latent profile analysis of mothers reporting nonimmunized infants identified distinct groups. **Results** Of 3268 mothers, 2820 (weighted 86.2%), 311 (9.1%), and 137 (4.7%), respectively, reported their infant had received all, some, or no recommended vaccinations for age. Younger infants and infants with younger mothers were more likely to have received no vaccinations. Mothers with neutral and negative attitudes toward vaccination were >3 (aOR 3.66, 95% CI 1.80-7.46) and 43 times (aOR 43.23, 95% CI 20.28-92.16), respectively, more likely than mothers with positive attitudes to report their infants had received no vaccinations. Two subgroups of mothers reporting that their infants had received no vaccinations were identified: group A (52.5%) had less than positive attitudes and less than positive subjective norms about vaccination (ie, perceived social pressure from others); group B (47.5%) had positive attitudes and positive subjective norms. Group A mothers were more likely to be white (76.1% vs 48.3%, $P = .002$), more educated (43.5% vs 35.4% college or higher, $P = .02$), and to exclusively breastfeed (74.9% vs. 27.3%, $P < .001$). **Conclusions** Although access barriers can result in nonvaccination, less than positive maternal attitude toward vaccination was the strongest predictor. Strategies to improve vaccination rates must focus on both improved access and better understanding of factors underlying maternal attitudes. (*J Pediatr* 2017;185:136-42).

Childhood vaccination is one of the most successful public health interventions of the 20th century.¹ Ironically, by eliminating diseases, vaccines may have shifted some toward a decision not to vaccinate. Previous studies have reported factors impacting the decision to vaccinate²⁻⁴ and parenting behaviors correlated with the decision not to vaccinate.^{4,5} The Theory of Planned Behavior (TPB) posits that one's attitudes toward a behavior, perceived social pressure from valued others (subjective norms), and perceptions about one's own control over the behavior impact on intention and ultimately the behavior.⁶ However, not all children who lack vaccines have parents who intended to not vaccinate them. These families may have access difficulties; urban, low-income, and minority children are at greatest risk for undervaccination.⁷ Although there is a perception that there are these 2 categories of children who have not received recommended vaccinations, no study has documented the relative size and characteristics of these 2 distinct scenarios.

We analyzed data on vaccination status from the Study of Attitudes and Factors Effecting Infant Care (SAFE), a nationally representative study of mothers' infant care practice choices. The objective of this analysis was to, in this sample of mothers of 2- to 6-month-old infants, assess the role of maternal attitudes and other factors associated with infant vaccination status.

Methods

The SAFE study, conducted in 2011-2014, used a stratified, 2-stage, cluster design, with oversampling of black and Hispanic mothers, to obtain a nationally representative sample of mothers of 2- to 6-month-old infants. Sampling procedures have been previously described.^{8,9} Briefly, a probability sample of 32 US birth hospitals with >100 births/year, based on the 2010 American Hospital Association annual survey, was selected. Each hospital was assigned enrollment targets so that ~1000 surveys, including >250 each from Hispanic and black mothers, were obtained annually for 3 years. Mothers were eligible if they spoke English or Spanish, lived

From the ¹Division of General Pediatrics and Community Health, Children's National Health System, Washington, DC; ²Department of Pediatrics, Yale University, New Haven, CT; ³Slone Epidemiology Center, Boston University, Boston, MA; ⁴Data Coordinating Center, Boston University School of Public Health, Boston, MA; ⁵Department of Biostatistics, Boston University School of Public Health, Boston, MA; and ⁶Department of Pediatrics, University of Virginia School of Medicine, Charlottesville, VA

*Current affiliation is Harvard Neonatal-Perinatal Fellowship Program, Boston Children's Hospital, Boston, MA.

[†]List of participating institutions of the SAFE study is available at www.jpeds.com (Appendix).

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SAFE Study of Attitudes and Factors Effecting Infant Care
TPB Theory of Planned Behavior

in the US, and would be caring for their infant by 2-4 months after delivery. Sampling weights were calculated to account for the probability of selection and differential response patterns.

After signing written informed consent, mothers completed an initial interview to collect demographic data and contact information. Once their infants were >60 days old, mothers were asked to complete an online or telephone follow-up survey. This survey, informed by the TPB,⁶ included questions regarding current infant care practices (including vaccination status, feeding, sleep position, sleep location) and, for each infant care practice, subjective norms, perceived control, and attitudes. Mothers who reported that their infant received no vaccinations were queried about reasons. Definitions of study measures are shown in [Table I](#) (available at www.jpeds.com). All survey questions were piloted and validated with mothers in the target population. Institutional Review Board approval was obtained at all participating hospitals.

Statistical Analyses

All analyses accounted for the 2-stage cluster sample design for both variable estimates and 95% CI using SAS (SAS Institute, Cary, North Carolina)¹⁰ methods for complex survey design. Demographic and behavioral characteristics, with weighted percentages, were calculated to obtain prevalence estimates with 95% CI. Weighted univariate and multiple logistic regression analyses, with vaccination status (none vs fully vaccinated, none vs any vaccinations) as the primary outcome, were conducted. Multiple logistic regression analyses first controlled for demographic factors only; a second model included demographic and infant care practice variables, and a third model included all variables (demographic, infant care practices, and TPB domains). A second latent profile analysis, accounting for sampling weights and design, was conducted among the 137 mothers who reported that their infants had received no vaccinations to identify distinct groups, based on maternal race, education, attitudes, subjective norms, and breastfeeding status. Finally, we conducted a systematic coding of all responses regarding reasons for receiving no vaccines.

Results

A total of 3268 mothers (82.0% of those enrolled) responded to the questions required for study analyses. The weighted distribution of maternal and infant characteristics was largely comparable with that of all mothers who gave birth in the US from 2012 to 2013 ([Table II](#)).¹¹ Maternal education was comparable with national data for high school graduates and women with some college but in our sample, women with less than high school education were underrepresented (12.7% vs 17.8% national) and women with college or more were overrepresented (33.0% vs 28.0% national). Most (63.1%) infants were 8-11 weeks old, and 89.4% were <20 weeks of age at the follow-up survey. Feeding and sleep location practices in this population have been previously reported¹²; 30.3% were exclusively breastfeeding, 77.1% were being placed supine for sleep, and 65.6% were roomsharing without bedsharing ([Table III](#)).

Prevalence of Vaccination Status and Demographic Characteristics

Of 3268 infants, 2820 (86.3%) were fully vaccinated for age, 311 (9.1%) were partially vaccinated, and 137 (4.7%) were reported as having received no vaccines. In a model that controlled for demographic factors only, younger mothers and mothers living in the Northeast or West were more likely to report that their infants had received no vaccinations, and older infants were less likely to be reported as having received no vaccinations ([Table II](#)).

Association between Vaccination Status and Infant Care Practices, Maternal Attitudes, and Subjective Norms

In a model that controlled for demographics and infant care practices, infants who were exclusively breastfed or who bedshared for part or all of the night were more likely to be reported as receiving no vaccinations ([Table III](#)). Infant sleep position was not associated with vaccination status. In this model, compared with the one that controlled for demographic factors only, mothers <20 years of age and with lower educational status were more likely to report that their infants had received no vaccinations.

When the model was adjusted to include demographics, infant care practices, and TPB domains, young mothers and those with lower educational status continued to be more likely to report their infants had received no vaccinations ([Table II](#)). However, feeding mode and sleep location were no longer associated with vaccination status. In this model, mothers who perceived subjective norms to be not positive toward vaccination were >3 times as likely to report their infants as receiving no vaccinations. Compared with mothers with positive attitudes about vaccination, those with neutral attitudes were >3 times more likely, and those with negative attitudes were 43 times more likely, to report that their infant had received no vaccinations ([Table III](#)).

Characteristics of 2 Groups of Mothers of Infants Who Received No Vaccinations

Latent Profile Analysis identified 2 distinct subgroups of mothers who reported their infants as having received no vaccinations (entropy 0.86, Vuong-Lo-Mendell-Rubin test of 2 vs 1 group; $P = .054$): group A (weighted 52.5%), who generally (74.5%) had negative attitudes toward vaccination, and group B (weighted 47.5%), who generally (87.2%) had positive attitudes toward vaccination ([Table IV](#)). Group A mothers were more likely to be white ($P = .002$), better educated ($P = .02$), and to exclusively breastfeed ($P < .001$). The 2 subgroups also had very different perceptions about subjective norms regarding vaccination. Although 98.4% of group B mothers perceived subjective norms about vaccination to be positive, 86% of group A mothers perceived these subjective norms to be not positive toward vaccination.

Reasons for receiving no vaccinations also were identified. More than one-half (55.7%) of group A mothers did not provide a response, 31% identified maternal choice, and 13% cited scheduling. Scheduling (63%) was the most commonly

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