

Maternal Characteristics Associated With Vaccination of Young Children

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ABSTRACT. *Objective.* Mothers can be instrumental in gaining access to vaccination services for their children. This study examines maternal characteristics associated with vaccination in US preschool children.

Methods. We analyzed data from 21 212 children aged 19 to 35 months in the National Immunization Survey. Bivariate and multivariate analyses were used to identify maternal characteristics associated with completion of all recommended vaccinations in these children.

Results. Factors most strongly associated with under-vaccination included having mothers who were black; had less than a high school education; were divorced, separated, or widowed; had multiple children; were eligible for the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) but not participating; or had incomes below 50% of the federal poverty level.

Conclusion. Because most mothers play an important role in their children's vaccination, it is important to address maternal concerns and barriers when developing public health interventions for promoting childhood vaccinations. Encouraging eligible women and their children to participate in the WIC program and providing support and encouragement for immunization to mothers with multiple children may improve early childhood vaccination coverage. *Pediatrics* 2003;111:1215–1218; *vaccination, immunization, children, mother, maternal characteristics.*

ABBREVIATIONS. NIS, National Immunization Survey; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children; OR, odds ratio.

Vaccinations are one of the simplest and most effective ways that we can protect the health of our children.^{1,2} Physicians,³ family and friends,⁴ communities, and public health programs^{5–7} all influence young children's receipt of vaccinations. However, it is most often the mother who assumes direct responsibility for ensuring that her children receive proper preventive health services, including vaccinations.^{8–12} This study examines maternal characteristics that influence immunization in a nationally representative sample of US preschool children.

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METHODS

The National Immunization Survey (NIS) has been conducted by the Centers for Disease Control and Prevention since 1994 to estimate vaccination coverage rates for US children aged 19 to 35 months. The NIS uses random-digit dialing to survey households with age-eligible children followed by a mail survey to the eligible children's vaccination providers to validate immunization information. Analyses of NIS data are based on children with a completed interview, parental consent to contact vaccination providers, and adequate vaccination history. The estimation methodology of the NIS includes adjustments for household unit nonresponse, households with multiple telephone lines or without telephones, and vaccination provider nonresponse. Details of the NIS sample design and estimation methodology appear elsewhere.^{13–15} The current study was based on NIS data collected in July 2000 to June 2001, the last full year in which information was collected on participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). In total, we analyzed data for 21 212 children aged 19 to 35 months.

Vaccination doses recommended by the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, and the American Academy of Family Physicians during the period that children in this survey were younger than 19 months (1996–2001) include 4 doses of diphtheria and tetanus toxoids and pertussis vaccine, 3 doses of poliovirus vaccine, 1 dose of measles-mumps-rubella vaccine, 3 or 4 doses of *Haemophilus influenzae* type b vaccine, and 3 doses of hepatitis B vaccine (the 4:3:1:3:3 series).^{16,17} One dose of varicella vaccine is also recommended, but because varicella vaccine is relatively new, is not needed for children who have had chicken pox, and more than one quarter of the children in this analysis (27%) did not receive it, we analyzed maternal characteristics associated with its receipt separately. In addition to completion of vaccinations by 19 to 35 months, we evaluated maternal characteristics associated with timely vaccination, defined as administration of all vaccinations during the recommended time periods.^{16–18}

We evaluated information provided by the survey respondent (89% of respondents were the mother) in the household portion of the survey regarding maternal characteristics: race/ethnicity, age, marital status, education, number of children, poverty status, and WIC participation. Poverty status of the family was based on household size, composition, and income, as defined by the US Bureau of the Census.¹⁹ Poverty levels were defined as "severe" for income below 50% of the poverty level, "intermediate" for income between 50% and <100%, "near" for income between 100% and <125%, and "above" for income at or above 125% of the poverty level. WIC eligibility was based on family income below 185% of the poverty level, as defined by the WIC program.²⁰

All analyses were conducted in SUDAAN version 8.0²¹ and account for the sample weights and complex sampling design of the NIS. Bivariate analysis and multiple logistic regression analysis were used to assess strength of association between maternal characteristics and vaccination status. Because vaccination completion and other factors such as WIC participation varies by age of the child between 19 and 35 months, the child's age at the time of the interview was considered as an independent variable in multiple logistic regression analyses. To account for possible collinearity between WIC eligibility and poverty status (ie, those not eligible for WIC cannot be below or near poverty), the model was also analyzed without poverty status. Interactions between maternal characteristics and both race/ethnicity and WIC participation were also evaluated.

RESULTS

Several maternal characteristics were useful predictors of vaccination status of the children (Table). In bivariate analysis, children were less likely to be fully vaccinated if their mothers were black or Hispanic, were 19 to 29 years of age, were unmarried, had less than a college education, had multiple children, or were living near or below the federal poverty level. Mothers who were eligible to participate in WIC were less likely to have fully vaccinated children than those with incomes above the eligibility level. However, among those who were eligible to participate, past participants and those who had never participated were less likely to be fully vaccinated (67% and 64%, respectively) than current participants (74%).

In multiple logistic regression, characteristics most strongly associated with undervaccination included having less than a high school education (odds ratio [OR] 0.6 when compared with college graduates), having 4 or more children (OR 0.6 when compared with having only 1 child), and being eligible for WIC

but not participating (OR 0.5 for those never participating and 0.7 for those who previously participated when compared with current participants). Characteristics associated with vaccination for varicella were similar, as were characteristics associated with timely vaccination (results not shown). Results were also similar when poverty status was removed from the model. No statistically significant interactions were found between race/ethnicity or WIC participation and the other maternal characteristics.

Because WIC participation was strongly associated with vaccination status, we also evaluated maternal characteristics associated with WIC participation among those eligible to participate. Current participants were more likely than those who had never participated to be black or Hispanic, younger than 30 years, never married, less educated, and below the federal poverty level ($P < .05$). Current participants were also more likely than those who dropped out (ie, previous participants who were eligible for WIC at the time of the interview) to be Hispanic and to have less than a high school education; however,

TABLE. Maternal Characteristics Associated With Childhood Vaccination,* US Children 19 to 35 Months, NIS, July 2000–June 2001

Maternal Factor	<i>n</i>	Bivariate Weighted % Vaccinated* (95% CI)	Multiple Logistic Regression† Odds Ratio (95% CI)
Race/ethnicity			
White, non-Hispanic	14 600	76.4 (75.3–77.4)	Ref
Black, non-Hispanic	3446	69.6 (67.0–72.3)	0.8 (0.7–0.9)
Hispanic, any race	4111	71.4 (69.2–73.6)	0.9 (0.8–1.1)
Other	1233	72.8 (68.2–77.4)	0.8 (0.6–1.0)
Age			
<19 y	746	70.3 (64.8–75.8)	1.1 (0.8–1.5)
19–29 y	10 279	71.9 (70.5–73.2)	0.9 (0.8–1.0)
30+ y	12 365	76.5 (75.3–77.7)	Ref
Marital status			
Married	16 815	75.7 (74.7–76.7)	Ref
Never married	4626	71.2 (69.1–73.3)	1.0 (0.9–1.2)
Divorced, separated, or widowed	1933	68.3 (65.2–71.6)	0.8 (0.7–0.9)
Education completed			
<High school	3157	68.0 (65.5–70.5)	0.6 (0.5–0.8)
High school	7160	72.5 (70.9–74.1)	0.7 (0.6–0.8)
>High school	4375	73.9 (71.8–75.9)	0.8 (0.7–0.9)
College graduate	8698	79.5 (78.2–80.8)	Ref
No. of children in household			
1	6502	77.8 (76.3–79.4)	Ref
2 or 3	14 053	74.1 (73.0–75.3)	0.8 (0.7–0.9)
4 or more	2835	66.7 (63.9–69.5)	0.6 (0.5–0.7)
WIC participation/eligibility‡			
Current participant/eligible	5807	74.0 (72.1–75.8)	Ref§
Not participating/not eligible	10 901	78.0 (76.8–79.2)	0.8 (0.7–0.9)
Past participant/eligible	3295	66.8 (64.3–69.3)	0.7 (0.6–0.8)
Never participated/eligible	1209	64.2 (60.0–68.4)	0.5 (0.4–0.7)
Poverty status			
Above poverty¶	17 330	76.0 (75.0–77.0)	Ref
Near poverty#	1431	70.9 (66.9–74.8)	0.9 (0.7–1.2)
Intermediate poverty**	2807	70.2 (67.4–72.9)	0.9 (0.8–1.1)
Severe poverty††	1822	66.2 (62.6–69.8)	0.8 (0.7–1.0)

* Four doses of diphtheria and tetanus toxoids and pertussis vaccine, 3 doses of poliovirus vaccine, 1 dose of measles-mumps-rubella vaccine, 3 or 4 doses of *Haemophilus influenzae* type b vaccine, and 3 doses of hepatitis B vaccine (the 4:3:1:3:3 series).

† Weighted; results were similar when modeling receipt of varicella and of timely vaccinations, as well as when poverty status was removed.

‡ Eligibility based on family income below 185% of the poverty level.

§ Current WIC participants are the referent group to facilitate comparisons between this category and the others.

|| Poverty status of the family as defined by the US Bureau of the Census.

¶ Income at or above 125% of the poverty level.

Income between 100% and <125% of the poverty level.

** Income between 50% and <100% of the poverty level.

†† Income below 50% of the poverty level.

they were less likely to be younger than 30 years; to be widowed, divorced, or separated; and to be near or below the poverty level.

DISCUSSION

Mothers are often strongly influential in the vaccination of their children. It is therefore important to ensure that public health interventions for promoting childhood vaccinations address maternal concerns and barriers. Although other studies have noted the role of maternal characteristics in vaccination coverage in the United States, they have most often examined a limited group of children^{22–28} or have regarded maternal characteristics as a confounder in the context of other issues.^{6,29,30} We found that mothers with multiple children and less education are at highest risk of having undervaccinated children and thus should be given special attention and encouragement to vaccinate their children.

We found that among those eligible to participate in WIC, participation was associated with higher vaccination coverage, similar to previous findings.^{6,31} Thus, encouraging eligible women and their children to participate in the WIC program may increase vaccination rates. Those who dropped out of WIC had vaccination rates nearly as low as those who were eligible but never participated, and both groups had lower rates than current participants. Because factors associated with dropping out differ from those associated with never participating, it is important to target both groups.

One limitation of this study is that maternal characteristics, such as WIC participation, marital status, poverty status, and so forth, may have changed between the time the children were vaccinated and the interview. Also, we do not know whether the association between WIC participation and vaccination coverage is causal or whether those who participate in WIC are simply a subgroup of mothers who tend to participate in available assistance programs, including childhood vaccination programs. Intensive interventions implemented by the WIC program to improve vaccination levels, especially those involving parental incentives,³² are more effective than less intensive ones.⁶ Thus, participation in WIC may offer an opportunity to provide effective interventions that will lead to increased vaccination compliance.

Caring for multiple children can create unique barriers to vaccination. We found that mothers with 2 to 3 children were 20% less likely and those with 4 or more children were 40% less likely to have vaccinated children than those with only 1 child. Providers should be aware that mothers with multiple children may need added support and encouragement regarding immunizations. For example, providing child care for siblings in pediatrician offices and health departments may assist mothers in overcoming the difficulty of bringing a child for vaccination while supervising others.

Other barriers to vaccination not evaluated in this analysis may be related to maternal characteristics as well. For example, lack of insurance to cover the cost of well-child care and ability to gain access to health care during work hours may be related to maternal

employment status. Mothers may not know when vaccinations are due, the importance of timely vaccinations, or where to go for well-child care. Questions about insurance status and parental knowledge and experiences were added to the NIS in July 2001. When available, these data may shed additional light on maternal concerns and barriers to childhood vaccination that could improve interventions.

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