Hepatitis A Vaccine Uptake in San Diego County

Hispanic Children Are Better Immunized

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Background: Few studies have examined compliance with hepatitis A vaccination recommendations or factors likely to predict vaccination against hepatitis A virus.

Objectives: To investigate hepatitis A coverage among 3- to 17.9-year-olds in San Diego County and examine predictors of child and adolescent hepatitis A immunization.

Design, Setting, and Participants: A total of 1455 participants completed a random-digit dial telephone survey that assessed hepatitis A immunization status of 3- to 17.9-year-old children from May 1 to June 24, 2003. Analysis was limited to the 983 respondents with available immunization records or verified immunization histories.

Main Outcome Measures: Receipt of at least 1 hepatitis A vaccine administered on or after the child’s second birthday and differences in the frequencies of vaccination based on vaccine availability, sex, ethnicity, type of health care provider, mother’s highest level of education, and parental knowledge of the hepatitis A vaccine recommendation.

Results: Participant response rate was 77.1%. Among all respondents aged 3 to 17.9 years, 59% received at least 1 hepatitis A vaccine and 41% completed the 2-shot regimen. The adjusted odds that a child received at least 1 hepatitis A vaccine was 3.6 times greater among Hispanic children compared with non-Hispanic children. Other predictors of hepatitis A immunization included child’s age, having a public health care provider, lower maternal education, and parental knowledge of the vaccine recommendation.

Conclusions: Results challenge historical patterns of underimmunization among Hispanic children compared with white children. Public health education and community awareness should be sustained in Hispanic communities, but interventions are needed in non-Hispanic communities.

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San Diego County infants aged 19 to 35.9 months. The Vaccines for Children (VFC) program has removed many of the economic barriers to childhood vaccination; however, there continue to be disparities in immunization delivery that result in lower age-appropriate immunization coverage among ethnic minorities. This study reports hepatitis A vaccination coverage among 3- to 17.9-year-olds for the first time in San Diego County and examines predictors of child and adolescent hepatitis A immunization, including ethnicity, based on a random-digit dial telephone survey.

**METHODS**

**STUDY POPULATION**

To be eligible, a child had to be 3 to 17.9 years of age on the date the interview was completed. A decision was made a priori to collapse the children’s ages into 3 birth cohorts based on hepatitis A vaccine availability and implementation of the 1999 ACIP recommendations (Figure). The first cohort consists of children older than 2 years at the time of 1995 vaccine licensure (11-17.9 years old at the time of the survey). The second cohort consists of children who were 2 years old at the time the vaccine was licensed or who turned 2 years old after vaccine licensure but before the 1999 ACIP recommendations (7-10.9 years old at the time of the survey). The final cohort contains children who turned 2 years old after the 1999 ACIP recommendations (3-6.9 years old at the time of the survey).

**RANDOM-DIGIT DIAL METHODOLOGY**

The methodology for the San Diego County random-digit dial telephone survey was based on the Centers for Disease Control and Prevention National Immunization Survey. Household telephone numbers were purchased from Scientific Telephone Samples, Inc (Santa Ana, Calif). Telephone numbers were prestratified by 6 San Diego County major statistical areas and were screened to limit the amount of residential fax, disconnected, and mobile numbers. According to 2000 US Census estimates, 811,038 children aged 0 to 19 years resided in San Diego County. The selection of household numbers within the 6 strata was determined using the well-established Waksberg methodology. A minimum of 5 phone attempts was made before classifying a number as no answer. Telephone interviews were completed between May 1, 2003, and June 24, 2003.

**SURVEY QUESTIONNAIRE**

Two versions of the survey instrument were created based on whether the respondent had an immunization record available. Respondents who did not have an available immunization record were asked to recall the number of hepatitis A vaccine immunization doses the child received. Both forms contained the same questions targeting child and family demographics, behaviors, and knowledge. Interviews were conducted in English or Spanish. All respondents were asked whether the child’s health care provider could be contacted to verify vaccines given and dates. Only respondents who had an available immunization record or a provider-verified immunization history were included in the final sample population. A terminated interview was defined as an interview that was initiated by a respondent of an age-eligible child, but the respondent chose to end participation before the interview was completed.

**STUDY VARIABLES**

Demographic covariates collected included the child’s sex, child’s primary type of health care provider (public vs private), child’s birthplace, mother’s highest level of education completed, and whether the questionnaire was completed in English or Spanish. Variables examined as possible predictors of hepatitis A immunization status included the child’s age, participant-identified ethnicity, and parental knowledge and source of the hepatitis A immunization recommendation. Hepatitis A vaccination was quantified by 2 different measures: receipt of at least 1 hepatitis A immunization and regimen completion, defined as receipt of 2 doses of hepatitis A vaccine administered at least 6 months apart.

**IMMUNIZATION RECORD VERIFICATION**

Verification of immunization was attempted for any respondent with no immunization record available or for records with any missing data. A record was considered up-to-date for hepatitis A vaccine if 2 doses were administered at least 6 months apart. If a parent provided dates for a complete 2-shot hepatitis A series, the immunizations were not verified with the child’s provider. Immunization records were verified using the computerized San Diego Regional Immunization Registry or by directly contacting the child’s provider.

**STATISTICAL ANALYSIS**

We used SPSS statistical software graduate version 12.0 (SPSS Inc, Chicago, Ill) to maintain and analyze data. Descriptive frequencies were determined for study variables, stratified by hepatitis A vaccination status. Logistic regression was used to individually examine the association of all study variables to the receipt of at least 1 hepatitis A vaccine immunization. The crude odds ratios and 95% confidence intervals (CIs) are reported for each association. Categories with small cell sizes were collapsed for logistic models.

Multiple logistic regressions were used to examine the relationship between child’s age, participant-identified ethnicity, and parental knowledge of the hepatitis A immunization recommendation and hepatitis A vaccination status, adjusting for any confounders. Hepatitis A vaccine was available from public providers, through the VFC program, before it was covered by many health insurance plans. Models were constructed to differen-
Ethnicity is first explored by stratifying ethnicity and hepatitis A immunization coverage by the child’s age cohort. To investigate the relationship of ethnicity and provider access to vaccine as a variable, multiple logistic regression was also performed, limiting the sample to children who received care from private providers, essentially controlling for vaccine access. To further examine the association between ethnicity and the type of provider, an additional model was constructed to examine the relationship between the mother’s education and the child’s hepatitis A immunization status among non-Hispanic children who received care in the private sector. Using the mother’s education as a surrogate measure for socioeconomic status allowed us to determine the utilization pattern among non-Hispanic children with access to VFC-purchased vaccine while still controlling for the child’s type of provider. Confounding was assessed by comparing the crude odds ratio for each factor of interest against the adjusted model, adjusting for only 1 additional covariate at a time. Any covariate that changed the magnitude of the crude estimate by more than 15% was adjusted for in the final logistic regression models. We also constructed a single, full model containing all potential predictors and their respective confounders using backward elimination to determine the association between study variables and hepatitis A vaccination status.

**RESULTS**

**SURVEY RESPONSE**

The response rate was 77.1% (1455/1888). There was no difference in ethnicity between the 433 respondents who terminated the interview and those who completed the interview. Before immunization verification, 747 (51.3%) respondents who completed the survey had an immunization record available during the interview. Following immunization verification, the sample size increased by 236 for a total of 983 participants with either available immunization records or verified immunization histories. Participants were distributed evenly across the age cohorts with 332 (33.8%) 3- to 6.9-year-old children, 329 (33.4%) 7- to 10.9-year-olds, and 322 (32.8%) 11- to 17.9-year-olds. Fewer participants self-identified as white than expected and more Hispanic families participated than expected when compared with 2000 US Census data (P < .01).

**HEPATITIS A IMMUNIZATION COVERAGE AND PREDICTORS**

Among all respondents aged 3 to 17.9 years (n = 983), 59% received at least 1 hepatitis A vaccine immunization and 41% completed the 2-dose regimen. Table 1 presents the frequencies of study variables stratified by hepatitis A vaccination status. One- or 2-dose vaccination coverage was higher among the youngest age cohort, 3- to 6.9-year-olds (67%), and lowest among the oldest age cohort, 11- to 17.9-year-olds (50%). Vaccination coverage also varied by ethnicity. Nearly 78% of Hispanic children received at least 1 hepatitis A immunization, while children of every other ethnicity had less than 60% coverage. Collapsing all non-Hispanic children into 1 group resulted in a coverage rate of 44% for at least 1 dose of vaccine. In addition, children who received care from public providers had higher coverage (77%) than children who saw private providers (50%), and 77% of children who received a recommendation from their health care providers were vaccinated.

The relationship between ethnicity and vaccination status was explored using a variety of approaches that demonstrate ethnicity is a strong predictor of immunization, regardless of a child’s age or access to VFC vaccine. Among children who receive care from private providers, 30% were Hispanic and 70% were non-Hispanic. In contrast, among children who see public providers, nearly 80% were Hispanic.

The unadjusted odds that a child received at least 1 hepatitis A immunization were 4.6 times greater among Hispanic children compared with non-Hispanic children (95% CI, 3.5-6.0). To evaluate whether Hispanic children were more likely to receive hepatitis A vaccine because they saw public providers who had better access to VFC vaccine, we performed the bivariate association between ethnicity and hepatitis A immunization status on the 529 children who self-identified an ethnicity and received health care from a private provider. In this group, the odds that a child received at least 1 hepatitis A immunization were 2.76 times greater among Hispanic children compared with non-Hispanic children (95% CI, 2.5-3.0). To further explore the effect of vaccine availability through the VFC program, we examined the association between mother’s education (surrogate for VFC eligibility) and hepatitis A vaccination status among non-Hispanic children who received care from private providers. There was no association between the mother’s highest level of education and her child’s hepatitis A vaccination status in this group (odds ratio, 1.38; 95% CI, 0.87-2.20).

Two separate multivariate models were constructed for ethnicity. The first examined the association between vaccination status and ethnicity. After adjusting for the child’s type of provider, the mother’s highest level of education, and the respondent’s knowledge of the hepatitis A immunization recommendation, the odds that a child received at least 1 hepatitis A immunization were 3.6 times greater among Hispanic children compared with non-Hispanic children (95% CI, 2.5-5.2). The second model limited the sample to children who saw private providers. This model for ethnicity produced 2.8 times greater odds of immunization among Hispanic children compared with non-Hispanic children, after adjusting for the mother’s education and the respondent’s knowledge (95% CI, 1.8-4.3).

Regardless of a child’s age, Hispanic children had significantly higher coverage than non-Hispanic children. When we adjusted for a child’s age, the magnitude of the association between ethnicity and vaccination status decreased by less than 2%, indicating that age is not a confounder. No study variables confounded the association between birth cohort and hepatitis A vaccination status.

The odds that a child received at least 1 hepatitis A immunization were 78% less if the respondent did not hear about the hepatitis A immunization recommendation (95% CI, 0.21-0.58) and 65% less if a parent heard
the recommendation from a source other than a health care provider, after adjusting for ethnicity (95% CI, 0.15-0.38). Table 2 contains results of the adjusted full multivariate model. After adjusting for all study variables, the odds of receiving at least 1 hepatitis A immunization were 1.86 times greater among Hispanic children when compared with non-Hispanic children. A child’s age and type of provider, the mother’s highest level of education, knowledge of the vaccine recommendation, and the language in which the survey was administered and completed are all factors that significantly contributed to the receipt of at least 1 hepatitis A immunization.

### COMMENT

This is one of the few published studies to establish hepatitis A vaccine coverage in a recommended high-incidence region and surprisingly demonstrates that Hispanic children are significantly better immunized compared with non-Hispanic children. The relationship between ethnicity and vaccination status is not dependent on a child’s age or type of provider seen for health care. Despite the fact that the San Diego County Immunization Branch has not implemented a specific strategy to promote hepatitis A immunization, immunization coverage in San Diego County is 16% higher than the estimated 2003 coverage in the 11 Western states in which the hepatitis A vaccine is recommended. Compared with a rural California county with a 5-year hepatitis A vaccine-targeted immunization initiative that reported 66% of eligible children received the first hepatitis A vaccination and 39% completed the regimen, baseline coverage rates in San Diego County are higher than anticipated at 60% for the first dose and 40% for series completion. According to 2000 US census estimates, the Hispanic population exceeds 25% in San Diego County and continues to increase. The county achieves 60% overall coverage in part because of the increased utilization among the Hispanic population, in which 78% of children received at least 1 hepatitis A immunization.

As expected, we observed coverage that was significantly higher for children 3 to 6.9 years old compared with children 11 to 17.9 years old. Children aged 3 to 6.9 years were eligible to receive the vaccine following...
the 1999 ACIP recommendations when the vaccine was commonly available. Results from this study are consistent with previous investigations in that children are more likely to be vaccinated if a health care provider recommends vaccination.4,8,14,15 However, data from this study do not suggest that increased Hispanic utilization is due to increased provider recommendation to receive the vaccine. In a cross-tabulation between ethnicity and respondent knowledge of the recommendation, only 13.4% of Hispanic respondents indicated they received a recommendation from their health care provider compared with 24.3% of non-Hispanic respondents.

Previous studies have demonstrated that multiple factors contribute to timely vaccination. This study demonstrates that ethnicity, parental knowledge of the vaccination recommendation, a child’s age, and type of provider are significant predictors of hepatitis A immunization. When we acknowledged and accounted for the contributions of each variable to hepatitis A immunization status, the magnitude of the association between ethnicity and vaccination status declined. Impressively, the resulting odds ratio demonstrates Hispanic children were still 86% more likely to be vaccinated against hepatitis A than non-Hispanic children (95% CI, 1.2-2.8).

Accounting for the availability and accessibility of low-cost vaccinations plays a key role in assessing predictors of immunization. Insurance coverage, co-payments, and out-of-pocket expenses for immunizations can influence vaccine coverage rates and are necessary but not sufficient predictors of childhood immunizations.16 It would have been advantageous to quantify the participants’ annual household income and insurance status. However, we have suggested a pattern of utilization among the Hispanic community from 2 surrogate measures, education and type of health care provider, which challenges conventional beliefs surrounding ethnic disparities in immunization coverage rates. These results suggest that Hispanic families had higher coverage rates independent of health care access and availability. The association is evident in the adjusted models, but 2 additional sets of analyses that eliminated the data from children with access to public services support this claim. If impoverished Hispanic children who see private providers were more likely to receive hepatitis A vaccine because they had access to vaccine through the VFC program, we would expect that non-Hispanic children of similar socioeconomic status would also be more likely to be immunized, which they were not.

In 2002, the coverage rate of 4:3:1 immunization (4 doses of diphtheria-tetanus-acellular pertussis vaccine, 3 doses of poliovirus vaccine, and 1 dose of measles-mumps-rubella vaccine) in San Diego County was also higher in the Hispanic population (89.2%) when compared with non-Hispanic children (81.6%).7 However, the difference in hepatitis A immunization coverage among Hispanic children compared with non-Hispanic children was much greater than the difference in 4:3:1 immunization rates. The published results from the 2003 National Immunization Survey17 also report that Hispanic children aged 24 to 35 months have significantly higher coverage than non-Hispanic children in all areas for which the vaccination is recommended. We believe the results from the San Diego and national surveys suggest, whether patient driven or provider driven, Hispanic children have better hepatitis A vaccine utilization than non-Hispanic children. Interestingly, Hispanic children had the highest incidence of hepatitis A infections in San Diego County.6 Disease incidence and coverage level give reason to consider a perception of disease risk and susceptibility in the Hispanic community and among providers that results in higher hepatitis A immunization rates. More studies are needed to assess provider attitudes, perceptions, and procedures for recommending and administering hepatitis A immunizations.

Among the limitations of this study was the acceptance of parental history of immunizations if a complete and up-to-date record was available. We believe it is unlikely that respondents indicated their children’s immunization records were available and then did not provide us with reliable immunization dates. This study excluded surveys completed solely by respondent recall and those in which immunization histories could not be verified. The majority of omitted children were white children in the 11- to 17.9-year-old cohort. Because older

### Table 2. Adjusted Full Model Examining the Odds of Receiving at Least 1 Hepatitis A Immunization Among 3- to 17.9-Year-Olds in San Diego County, 2003 (n = 894)†

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>Odds Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-6.9</td>
<td>297</td>
<td>1.00</td>
</tr>
<tr>
<td>7-10.9</td>
<td>304</td>
<td>0.67 (0.46-0.99)</td>
</tr>
<tr>
<td>11-17.9</td>
<td>294</td>
<td>0.42 (0.29-0.62)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>461</td>
<td>1.00</td>
</tr>
<tr>
<td>Female</td>
<td>433</td>
<td>1.15 (0.84-1.57)</td>
</tr>
<tr>
<td>Language</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>606</td>
<td>1.00</td>
</tr>
<tr>
<td>Spanish</td>
<td>288</td>
<td>3.82 (2.32-6.30)</td>
</tr>
<tr>
<td>Ethnicity</td>
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<td></td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>469</td>
<td>1.00</td>
</tr>
<tr>
<td>Hispanic</td>
<td>425</td>
<td>1.86 (1.21-2.84)</td>
</tr>
<tr>
<td>Type of provider</td>
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<td></td>
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<tr>
<td>Private</td>
<td>526</td>
<td>1.00</td>
</tr>
<tr>
<td>Public</td>
<td>224</td>
<td>1.82 (1.17-2.83)</td>
</tr>
<tr>
<td>Mixed†</td>
<td>144</td>
<td>1.97 (1.23-3.14)</td>
</tr>
<tr>
<td>Mother’s education‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>College, trade, or graduate school</td>
<td>480</td>
<td>1.00</td>
</tr>
<tr>
<td>High school or less</td>
<td>414</td>
<td>1.45 (1.02-2.06)</td>
</tr>
<tr>
<td>Child’s birthplace</td>
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<td></td>
</tr>
<tr>
<td>San Diego</td>
<td>649</td>
<td>1.00</td>
</tr>
<tr>
<td>Other</td>
<td>245</td>
<td>0.91 (0.63-1.31)</td>
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<tr>
<td>Knowledge of hepatitis A vaccine recommendation</td>
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<td></td>
</tr>
<tr>
<td>Heard from health care provider</td>
<td>179</td>
<td>1.00</td>
</tr>
<tr>
<td>Heard from other source</td>
<td>123</td>
<td>0.29 (0.17-0.50)</td>
</tr>
<tr>
<td>Did not hear about the recommendation</td>
<td>592</td>
<td>0.17 (0.11-0.26)</td>
</tr>
</tbody>
</table>

*Sample sizes vary between study variables; refusals to respond and missing responses were not included in analysis.
†Includes 22 military providers.
‡Collapsed due to sample sizes.
Study findings are unique in that hepatitis A vaccination coverage demonstrates successful implementation of a recent and novel ACIP recommendation. In addition, results challenge historical patterns of underimmunization among Hispanic children compared with white children. There is no evidence that would lead us to believe that Hispanic children in San Diego County have different utilization patterns compared with Hispanic children in the other regions and states that fall under ACIP’s hepatitis A immunization recommendation. Public health education and community awareness should be sustained in Hispanic communities, but clearly interventions are needed more in non-Hispanic communities.

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Additional Information: Dr Sawyer and Ms Owen had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
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REFERENCES