ELSEVIER

Immunization Coverage among Predominantly Hispanic Children, Aged 2–3 years, in Central Los Angeles

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PURPOSE: To assess the immunization status of young children in a predominantly Hispanic region in and around downtown Los Angeles, and factors associated with complete immunization by age 24 months.
METHODS: The information was gathered in a two-stage cluster survey with probability proportionate to estimated size (PPS) sampling of 30 clusters at the first stage, and simple random sampling of a constant number of children at the second stage. Vaccination coverage was determined by a review of the home immunization (HI) card, or of clinic records.
RESULTS: Of the 270 sampled children, 91.5% were Hispanic and 6.7% were Black. Home telephone numbers were not available in 24.8% of the homes, and 34.1% reported having no health insurance. Vaccination coverage was over 90% for the first three doses of Diphtheria, tetanus toxoids and pertussis/diphtheria, tetanus toxoids and acellular pertussis vaccine (DTP/DTaP)/Diphtheria and tetanus toxoids vaccine (DT), first two doses of poliovirus (Polio) vaccine, first dose of measles, mumps and rubella (MMR) vaccine, and first two doses of hepatitis B (Hep B) vaccine. Yet, by age 24 months, only 72.2% of the children had received the combined series of 4:3:1 (i.e., four DTP/DTaP/DT, three Polio, one MMR). This was further reduced to 64.4% for the combined series of 4:3:1:3:3 (i.e., four DTP/DTaP/DT, three Polio, one MMR, three *Haemophilus influenzae* type b (Hib), three Hep B). Factors associated with completed on-time vaccination were having an HI card available during the interview and being enrolled in Supplemental Nutrition Program for Women, Infants and Children (WIC).
CONCLUSIONS: While vaccination levels for individual antigens were found to be high, more emphasis needs to be placed on getting preschool children vaccinated on-time according to the Recommended Childhood Immunization Schedule.
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KEY WORDS: Immunization Coverage, Children, Los Angeles County, Hispanic, Inner City, Population Survey, Two-Stage Cluster Survey, Minority Populations.

BACKGROUND AND SIGNIFICANCE

Vaccination is the most effective means for preventing the occurrence of common childhood diseases. Yet, immunization coverage may lag in urban regions where immigrants comprise a high percentage of the population, and possibly they are not aware of the Recommended Childhood Immunization Schedule, updated and widely publicized in the United States (1).

Children classified as either Hispanic or non-Hispanic black were found in a large national survey to have lower vaccination levels than non-Hispanic white children, with differences being most evident with the 4:3:1:3 combined series (i.e., four or more doses of diphtheria, tetanus toxoids, and pertussis (DTP/DTaP), or diphtheria and tetanus toxoids (DT) vaccine; three or more doses of poliovirus vaccine (Polio); one of more doses of measles containing vaccine (MCV); and three or more doses of *Haemophilus influenzae* type b vaccine (Hib)) (2).

In the same national survey, the immunization coverage deficiencies were equally pronounced when comparing children from homes above and below the poverty level. While many reasons have been cited for parents falling behind on childhood immunizations (3), a recent experiment in Los Angeles suggests that innovative strategies can raise vaccination levels among inner city children, but the effort may be expensive (4). Before allocating scarce public health resources, however, the magnitude of the coverage problem should first be assessed in preschool populations. Here, we present the results of a community-based survey conducted by volunteers, University of California, Los Angeles (UCLA) students, and the staff of the Los Angeles County Department of Health Services, to determine the immuniza-

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Selected Abbreviations and Acronyms

PPS = probability proportionate to estimated size
HI = home immunization
WIC = Supplemental Nutrition Program for Women, Infants and Children
YCIS = Young Child Immunization Survey
ACIP = Advisory Committee on Immunization Practice
NIS = National Immunization Survey

tion levels of children, aged 24–47 months in a central city region of Los Angeles.

METHODS

Study Population

All children, 24–47 months at the time of enumeration, living in zip codes 90007, 90011, and 90015 in and around downtown Los Angeles were eligible to participate in the Young Child Immunization Survey (YCIS). The area is predominantly populated by low income families, many whom have immigrated from Mexico or Central America. For the first stage of sampling, the area was divided into 236 clusters (groups of blocks), each with at least 20 estimated children aged 24–47 months using 1990 United States Census data.

Thirty clusters were randomly selected with probability proportionate to the estimated size (PPS) of the eligible child population. We next enumerated, with house-to-house visits, and found 718 children, aged 2–3 years, in the 30 chosen clusters. At the second sampling stage, we randomly selected 10 targeted and five alternate children per cluster and were able to interview the parents of 270 of the targeted 300 children. Participation was 63.1% of the sampled children who were previously enumerated, and 81.3% of the sampled children whose parent or guardian was at home at the time of the interview.

Interview

A signed consent form was obtained from the parent or guardian before conducting the interview or abstracting the information from the home immunization (HI) card. The data collection form included demographic questions about the child's age, sex, and race. It also had questions about parent's or guardian's perception about the immunization status of the child and barriers to immunization, the type of immunization provider used, enrollment in the Supplemental Nutrition Program for Women, Infants and Children (WIC), and insurance coverage. The vaccine doses and date of immunization were abstracted from the HI card. If the HI card was absent at the time of the interview, information on vaccinations was obtained through a follow-up telephone call or revisit. When the information could not be obtained from the HI card by the previous methods, Immunization Program staff from the Los Angeles County Health Department contacted and requested immunization histories from the health care provider who supplied the vaccinations. This information was obtained either by facsimile, mail, or clinic visit.

In 81% of the sampled homes, immunization information was obtained directly from the HI card at the time of the interview. Information about child's immunization history was obtained from 19 parents (7.0%) over the telephone or by revisit after the interview was completed. These parents did not have the HI card available at the time of interview. Finally, clinics were contacted to get the immunization records for 27 surveyed children (10.0%) for whom parents did not have the HI card at home during or after the interview when again contacted by telephone or revisit. In about 2% of the sample (i.e., five children), there was no information about the immunization history of the children; that is, there was no available HI card or clinic record. To avoid bias, immunizations that occurred after the date of enumeration but before the time of interview were not accepted in the survey.

The date of birth for the child was recorded from either the immunization record, clinic record, birth certificate provided by the parents, or reporting of the parents. Five children were included as two-year olds who were within four days of their second birthday.

Data Analysis

Data were analyzed using the *Csample* module of *Epi Info* program (Epi Info: Version 6.04. Centers for Disease Control and Prevention, Atlanta, Georgia, 1997) and the *Survey* module of *STATA* (Stata: Release 5.0. StataCorp. College Station, Texas, 1997) statistical program. Both programs account for the expansion of variance which is typical of cluster surveys. The recommended childhood immunization schedule (United States, January-December, 1997) of the Advisory Committee on Immunization Practice (ACIP) was used for analyzing the immunization coverage levels (1). We calculated the immunization coverage as a percentage of the sampled children who received the specified vaccine dose, along with the 95% confidence intervals (CI).

To determine the relationship between immunization status (as an outcome) and factors expected to be associated with the outcome, we used the logistic regression module (i.e., *svylogit*) of *Stata* to derive odds ratios (ORs) and 95% CI.

RESULTS

Among the 270 sampled children, more than half were two-year olds, half were male, and nine of ten were Hispanic

TABLE 1. Characteristics of participants in Young Child Immunization Survey ($n = 270$)

	Number	Percent
Child variables		
Age at last birthday		
two years[a]	159	58.9
three years	111	41.1
Gender		
Male	134	49.6
Female	136	50.4
Race/ethnicity		
Hispanic	247	91.5
Black	18	6.7
Other[b]	5	1.8
Parent variables		
Have telephone at home		
Yes	203	75.2
No	67	24.8
Family has health insurance coverage		
Yes	178	65.9
No	92	34.1
Immunization card available at home during interview		
Yes	219	81.1
No	51	18.9
Enrolled child in WIC[c]		
Yes	230	86.5
No	36	13.5
Missing	4	—
Where child usually taken for immunization shots[d]		
Pediatrician	175	64.8
Family practicioner	48	17.8
Neighborhood clinic	130	48.2
Health department	68	25.2
Hospital	5	1.9
Emergency room	3	1.1
Schools	3	1.1
Mobile van	1	0.4
Number of cited immunization providers		
None	4	1.5
1	129	47.8
2	113	41.9
3 or more	24	8.9

[a] Includes five children nearly aged two years (minus one day = 1, minus four days = 4).
[b] Two whites, two American Indians, and one missing information.
[c] Special Supplemental Nutrition Program for Women, Infants and Children.
[d] Multiple responses are permitted.

(see Table 1). While we did not ask about financial status, many appeared to be in lower income families. Nearly one fourth of the homes did not report a home telephone number. Over a third of the children had no family health insurance coverage, and almost 87% of those who responded were enrolled in the United States Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (see Table 1). Immunizations tended to be given at the health department or by pediatricians and family practitioners, usually at neighborhood clinics. Nearly half of the parents (47.8%) reported only one category of provider for immunizations, while all but four cited at least one provider (see Table 1).

Immunization Coverage

More than nine of ten children had received at least three doses of DTP/DTaP/DT vaccine, two doses of Polio vaccine, one dose of measles, mumps and rubella (MMR) vaccine, two doses of Hib, and two doses of hepatitis B (Hep B) vaccine. The lowest coverage was for the fourth dose of Hib, not always required, and the single dose of varicella (Var) vaccine, only recently introduced in Los Angeles (see Table 2).

When combined as a series of vaccinations, eight of ten children received the minimal 4:3:1 series (i.e., 4 DTP/DTaP/DT, 3 Polio, 1 MMR), nearly 76% received the more complete 4:3:1:3 series (i.e., 4 DTP/DTaP/DT, 3 Polio, 1 MMR, 3 Hib), and approximately 72% obtained the most complete 4:3:1:3:3 series (i.e., 4 DTP/DTaP/DT, 3 Polio, 1 MMR, 3 Hib, 3 Hep B). The varicella vaccine is not yet included in these combined series since few in Los Angeles or elsewhere have had the opportunity to be immunized with this vaccine (5).

To reduce the risk of vaccine preventable diseases, the various immunization series should have been completed by 18 months of age (1), although 24 months of age is usually mentioned as the cutoff for community surveys. As shown in Table 2, only 72.2% of the children had received the minimal 4:3:1 series by their second birthday, reduced to about 69% for the more complete 4:3:1:3 series. Approximately 64% of the children had received the most complete 4:3:1:3:3 series by age 24 months.

As part of the national health objectives for the year 2000, Centers of Disease Control and Prevention (CDC) has published interim goals for 1996 and 1998 for childhood immunization coverage by age 24 months (5). The children in our survey area were above the 1998 interim national goal of 90% coverage for three doses of DTP/DTaP/DT, slightly below for three doses of Polio, one dose of MMR, and three doses of Hib, respectively, and well below for three doses of Hep B (see Figure 1). Yet, with the exception of Hep B, the confidence intervals bracket 90%, suggesting that the differences could be due to sampling variation. For three doses of Hep B, however, the coverage does exceed the 1996 interim goal of 70%.

The findings in the YCIS, as shown in Figure 2, are very similar to immunization levels reported for the United States in the National Immunization Survey (NIS) (5). Children in our survey area were slightly higher in DTP/DTaP/DT coverage, slightly lower in Hib coverage, lower in varicella coverage, and nearly identical in Polio, MMR, and Hep B coverage. The ages of the children prevent direct comparisons, however, since the NIS included children aged 19–35

TABLE 2. Vaccination coverage levels in Young Child Immunization Survey obtained from home immunization cards or medical records ($n = 270$)

Vaccine/dose	Immunized at any age			Immunized by 24 months of age		
	Number	Percent	95% CI[a]	Number	Percent	95% CI[a]
Diphtheria, tetanus toxoid and pertussis vaccine (DTP/DTaP) or diphtheria and tetanus toxoid (DT)						
⩾1 dose	260	96.3	±2.5	256	94.8	±2.6
⩾2 doses	254	94.1	±2.9	252	93.3	±3.0
⩾3 doses	248	91.9	±3.8	245	90.7	±3.2
⩾4 doses	226	83.7	±4.2	209	77.4	±5.2
Poliovirus (Polio)						
⩾1 dose	259	95.9	±2.5	256	94.8	±2.6
⩾2 doses	254	94.1	±2.9	251	93.0	±2.9
⩾3 doses	242	89.6	±4.2	233	86.3	±4.8
Measles, mumps and rubells (MMR)						
⩾1 dose	244	90.4	±3.5	233	86.3	±4.1
Haemophilus influenzae type b (Hib)						
⩾1 dose	258	95.6	±2.6	253	93.7	±3.5
⩾2 doses	247	91.5	±4.0	245	90.7	±4.0
⩾3 doses	236	87.4	±4.4	230	85.2	±5.0
⩾4 doses[b]	173	64.1	±6.1	160	59.3	±6.2
Hepatitis B (Heb B)						
⩾1 dose	255	94.4	±2.8	251	93.0	±3.1
⩾2 doses	248	91.9	±3.4	239	88.5	±3.9
⩾3 doses	228	84.4	±4.0	212	78.5	±5.1
Varicella (Var)						
⩾1 dose	35	13.0	±4.4	18	7.0	±3.1
Combined series: 4 DTP/DTaP/DT, 3 Polio, 1 MMR (4:3:1)[c]						
8 doses	215	79.6	±4.5	195	72.2	±5.9
Combined series: 4 DTP/DTaP/DT, 3 Polio, 1 MMR, 3 Hib (4:3:1:3)[d]						
11 doses	205	75.9	±5.0	187	69.3	±6.2
Combined series: 4 DTP/DTaP/DT, 3 Polio, 1 MMR, 3 Hib, 3 Hep B (4:3:1:3:3)[e]						
14 doses	195	72.2	±4.9	174	64.4	±5.8

[a] 95% confidence interval.
[b] May not be required, depending on vaccine type and starting time of series.
[c] Four or more doses of DTP/DTaP/DT, three or more doses of poliovirus, and one or more doses of MMR vaccines.
[d] Four or more doses of DTP/DTaP/DT, three or more doses of poliovirus, one or more dose of MMR, and three or more doses of *H. influenzae* type b vaccines.
[e] Four or more doses of DTP/DTaP/DT, three or more doses of poliovirus, one or more dose of MMR, three or more doses of *H. influenzae* type b, and three or more doses of hepatitis B vaccines.

months compared to aged 24–47 months in our study. To address this issue, we reanalyzed our data in a retrospective manner for 212 children, aged 19–35 months, and found no appreciable differences in four vaccines (i.e., Polio3, Hib3, MMR ,and Hep B3), a decrease in one vaccine (Dtp/DTaP/DT4: 81.6% vs. 83.7%) and an increase in another (Var: 15.1% vs. 13.0%). The recalculated values remain comparable to the NIS for most of the vaccines, but remain lower for Hib and Var.

Parent's Knowledge

Independent of the recommended age at vaccination, only about 72% of the children received the 4:3:1:3:3 combined series (see Table 2). Yet, when asked if their child had obtained all the necessary shots, 248 (91.9%) of all parents responded, "yes." Among the 75 children who had not received the entire 4:3:1:3:3 series, 85.3% of the parents thought that their child had been fully immunized. In contrast, among the 195 who had received the 4:3:1:3:3 series, only 4.1% of the parents stated the children were not fully immunized or were unsure of their status. Another three parents (1.5%) did not respond. Thus, in our sample the parents of fully immunized children seemed to know that they were completely immunized, but most parents of children not fully immunized did not recognize the need for more shots.

Among the handful of parents of the 75 not fully immunized children who were aware of the need for more shots, the reasons given for the lack of vaccination varied. Most commonly mentioned by the 11 parents with an opinion was confusion with the immunization schedule (5 or 45.5%), followed with two parents each for "did not know where to

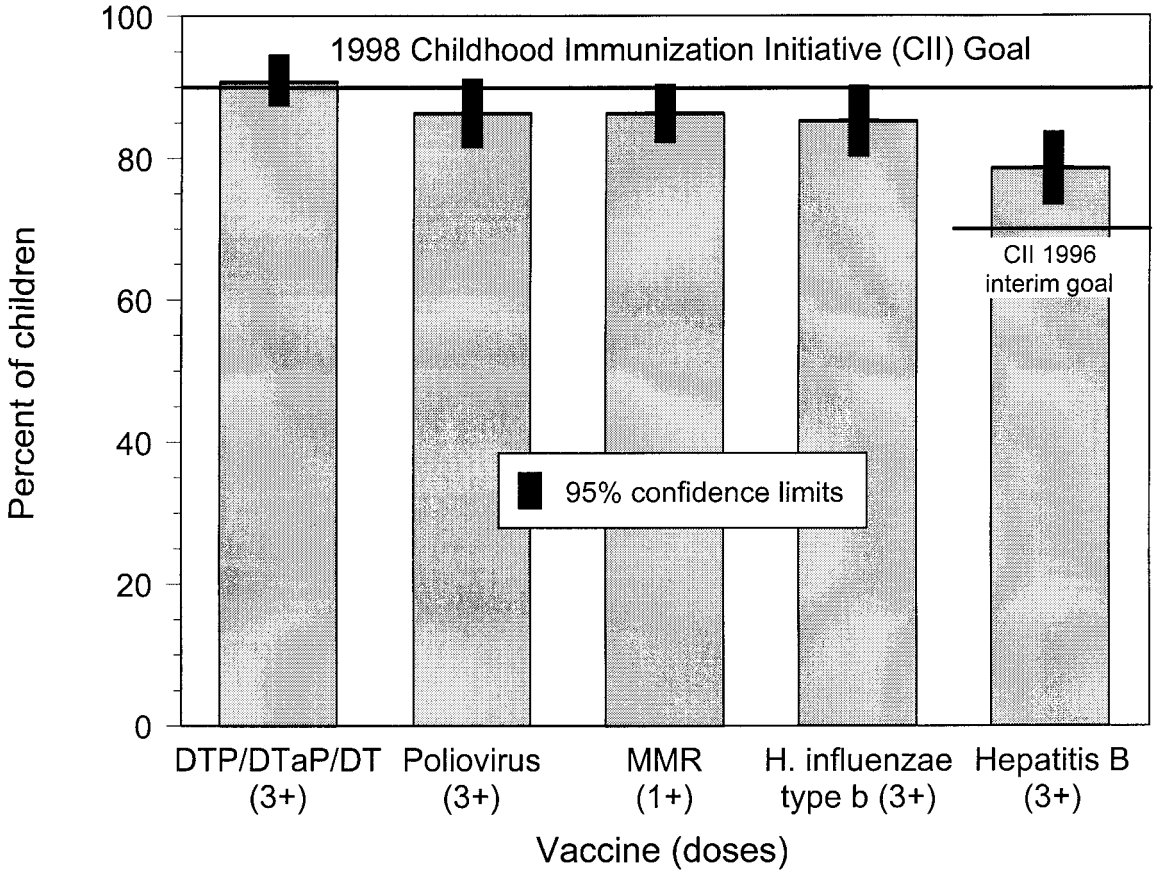

FIGURE 1. Vaccination coverage levels by aged 24 months in Young Child Immunization Survey (YCIS) compared to national CII goals for 1996 and 1998.

go for immunization," "concerned with the cost of immunization," and "did not have time to take the child for the immunization" (18.2% each), and one parent each for "did not know about immunization," "were afraid the shot would hurt or make their child sick," and "doubted that the immunization is really helpful" (9.1% each). In summary, lack of knowledge rather than parental fears or anxieties is what likely contributed to most parents not having their children fully immunized.

Risk of Inadequate Coverage

To view the relation between the 4:3:1:3 series and 4:3:1:3:3 series by aged 24 months as outcome variables and various characteristics as risk factors, we derived ORs adjusted for the potential confounding effects of age. Two-year olds were more likely than those past their third birthday to have received both the 4:3:1:3 series (OR = 1.75 ; 95% CI = 1.04–2.95) and 4:3:1:3:3 series (OR = 1.88; 95% CI = 1.16–3.06). Age may also be associated with the variables under consideration, thereby confounding the apparent association. To account for this, we present the age-adjusted ORs in Table 3. Having a telephone at home had no measured effect on either the 4:3:1:3 series or the 4:3:1:3:3 series by aged 24 months.

A more substantial effect was observed among those having the HI card to remind parents of the scheduled doses. While 73.1% of children whose parents had an HI card received the 4:3:1:3 series by aged 24 months, only about half of those who did not have a HI card (i.e., 52.9%) received the same series. The age-adjusted OR for this association was 2.49, with a 95% CI that did not bracket 1.0 (the null value of no association). The association of HI card and vaccination coverage was also apparent for the 4:3:1:3:3 series, with an OR of 2.07. Enrollment in the WIC program was also positively associated with both the 4:3:1:3 and 4:3:1:3:3 series, although not statistically significant (see Table 3).

Another factor associated with completing the 4:3:1:3 and 4:3:1:3:3 series by aged 24 months is receiving the first vaccine dose at the age cited in the Recommended Childhood Immunization Schedule. In Table 3 we present results for receiving from one to four vaccines on time in the first months of life. While the CIs are wide and bracket 1.0 (the null value

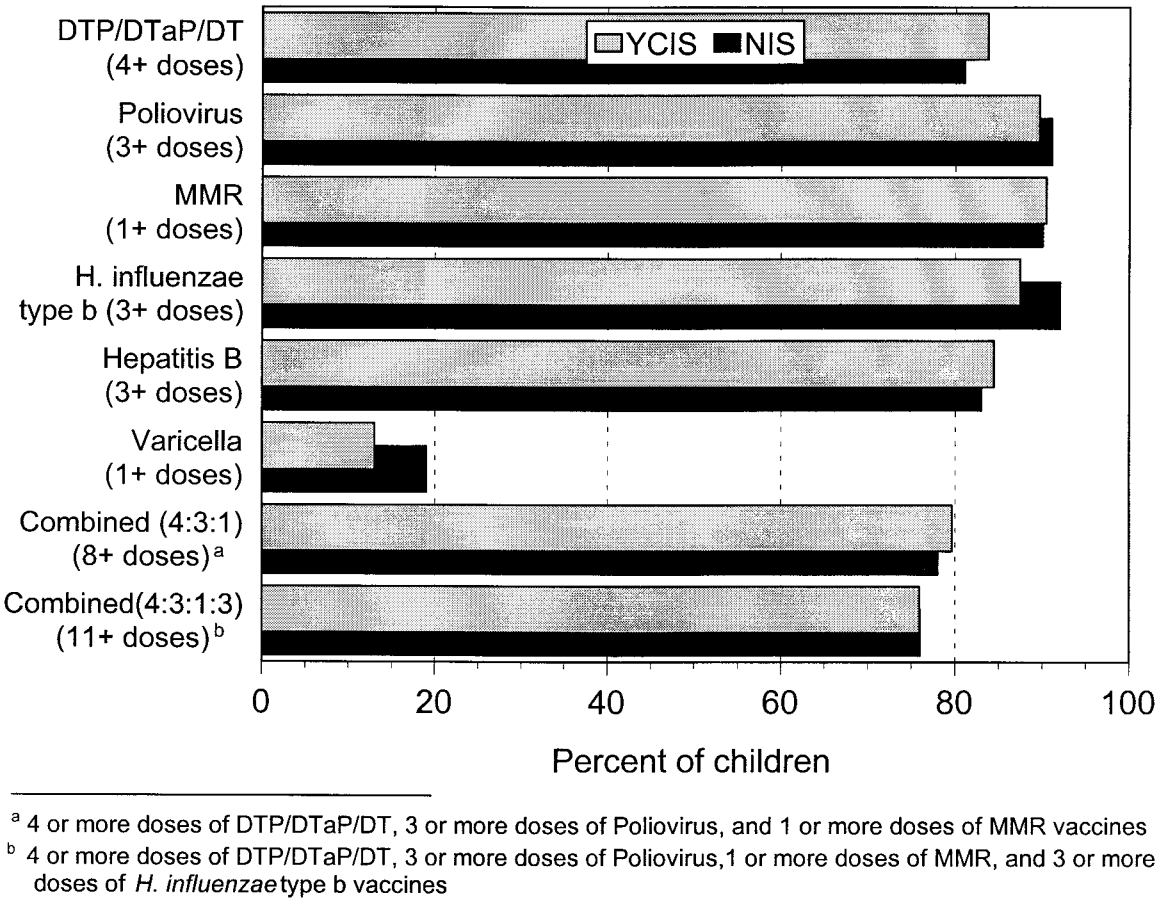

FIGURE 2. Comparison of children aged 24–47 months in the Young Child Immunization Survey (YCIS) to children aged 19–35 months in the National Immunization Survey (NIS).

indicating no association) for all but one of the comparisons, the trend is clearly evident: as more initial vaccines are received on time, children are more likely to have completed the full immunization series on time.

We decided to further explore the relationship between coverage and having an immunization card at home and participation in WIC, although we recognized that small numbers of subjects compromise the power of our statistical tests. We reasoned that both WIC and HI card would have little effect on the timeliness of initial doses of vaccine, but might have an effect on the timeliness of subsequent doses, or on completion of the vaccine series. To address this point, we first divided the surveyed children into those who did and did not receive their first doses of DTP/DTaP/DT, Polio, and Hib at ages 61–91 days, the age recommended in the childhood immunization schedule (1). As expected, neither having an HI card nor participation in WIC were related to being in the on-time group (HI card = 38.4%, no HI card = 35.3%, $p = 0.69$; WIC = 38.3%, no WIC = 38.9% , $p = 0.94$). Yet, when we compared the impact of having an HI card and WIC participation on completion of the 4:3:1:3 series by aged 24 months, we observed in Figure 3 that the on-time and not-on-time groups showed different patterns. Among those who followed the recommended schedule for the first doses of three vaccines (i.e., DTP/DTaP/DT, Polio, and Hib), having an HI card or participating in WIC had no additional effect on subsequent completion of the vaccine series. However, among those who were not initially vaccinated at the recommended time, both HI card and WIC appear to have a positive effect on completion of the 4:3:1:3 series.

The numbers for this analysis, however, are very small, and only the comparison between the reference group (i.e., no HI card and no WIC) and "HI card and WIC" was statistically significant (OR = 10.27; 95% CI = 1.47–71.51).

Finally, we considered the relationship between the provider of immunization coverage and completion of the 4:3:1:3 and 4:3:1:3:3 series by aged 24 months. We asked the question "where does the child usually go for immunization shots?" The responses were included as eight categories (see Table 1). For our analysis, the responses were recoded into three categories: only one provider was mentioned, the one

TABLE 3. Age-adjusted odds ratios for complete immunization coverage (4:3:1:3)[a] and (4:3:1:3:3)[b] by aged 24 months, Young Child Immunization Survey, 1997 (n = 270)

Characteristics	No.	4:3:1:3 series[a] OR[c]	4:3:1:3 series[a] 95% CI[d]	4:3:1:3:3 series[b] OR	4:3:1:3:3 series[b] 95% CI
Have telephone at home					
Yes	203	0.79	0.41, 1.55	0.71	0.40, 1.25
No	67	1.00	Reference	1.00	Reference
Is immunizaiton card available at home at interview?					
Yes	219	2.49	1.17, 5.30	2.07	1.02, 4.21
No	51	1.00	Reference	1.00	Reference
Is the child enrolled in the WIC program?					
Yes	230	1.89	0.75, 4.78	1.67	0.69, 3.99
No	36	1.00	Reference	1.00	Reference
Followed recommended schedule for first vaccine dose[e]					
DTP/DTaP/DT	115	1.19	0.77, 1.85	1.16	0.69, 1.95
DTP/DTaP/DT and Polio	110	1.34	0.87, 2.06	1.27	0.75, 2.14
DTP/DTaP/DT, Polio and Hib	102	1.68	0.99, 2.86	1.52	0.83, 2.78
DTP/DTaP/DT, Polio, Hib and Hep B	91	1.73	0.94, 3.19	2.23	1.19, 4.17
Where child usually goes for immunizations					
Pediatrician					
Only mentioned	61	1.38	0.59, 3.28	1.35	0.59, 3.04
Mentioned but not only	114	1.17	0.65, 2.10	1.00	0.57, 1.71
Not mentioned	95	1.00	Reference	1.00	Reference
Family practitioner					
Only mentioned	16	1.09	0.40, 2.94	1.00	0.40, 2.54
Mentioned but not only	32	0.53	0.28, 0.99	0.68	0.36, 1.31
Not mentioned	222	1.00	Reference	1.00	Reference
Neighborhood clinic					
Only mentioned	32	1.57	0.50, 4.89	1.24	0.47, 3.27
Mentioned but not only	98	0.85	0.49, 1.47	0.66	0.40, 1.10
Not mentioned	140	1.00	Reference	1.00	Reference
Health department					
Only mentioned	20	0.98	0.26, 3.73	1.31	0.35, 4.91
Mentioned but not only	48	0.68	0.42, 1.10	0.85	0.51, 1.40
Not mentioned	202	1.00	Reference	1.00	Reference

[a] Four or more doses of DTP/DTaP/DT, three or more doses of poliovirus, one or more dose of MMR, and three or more doses of *H. influenzae* type b vaccines.
[b] Four or more doses of DTP/DTaP/DT, three or more doses of poliovirus, one or more dose of MMR, three or more doses of *H. influenzae* type b, and three or more doses of hepatitis B vaccines.
[c] Age-adjusted odds of complete coverage among those with the characteristic divided by age-adjusted odds of complete coverage among those without the characteristic.
[d] 95% confidence interval.
[e] Received first dose of DTP/DTaP/DT at 61–91 days, poliovirus vaccine at 61–91 days, H. influenzae type b vaccine at 61–91 days or hepatitis B vaccine at 0–91 days; reference group for each line is "not received".

provider plus others was mentioned, and the one provider was not mentioned. We then derived ORs for each provider category comparing both the "only mentioned" and "mentioned but not only" groups to the reference group of "not mentioned." The findings are presented in Table 3. While none of the ORs are statistically significant, in general the associations were more definite for the "only mentioned" category than the more diluted "mentioned but not only" category.

Pediatricians, family practitioners and neighborhood clinics were mildly associated with completion of the 4:3:1:3 series by aged 24 months, while the health department as a source of immunizations was not associated with completing the 4:3:1:3 series. The association with the 4:3:1:3:3 series remained positive among pediatricians and neighborhood clinics (but not statistically significant), became positive for the health department as source, but was 1.0 for family practitioners.

DISCUSSION

Our participation rate varied between 63.1% for those who were identified by enumerators weeks earlier and 81.3% for those who were at home at the time of interview. The former participation rate of 63.1% is equivalent to 66% experienced in a similar style of face-to-face interview survey done years earlier in Los Angeles (14), while the latter participated rate of 81.3% is greater than the 67% response reported for the at- home telephone survey of the United States population done by the National Immunization Sur-

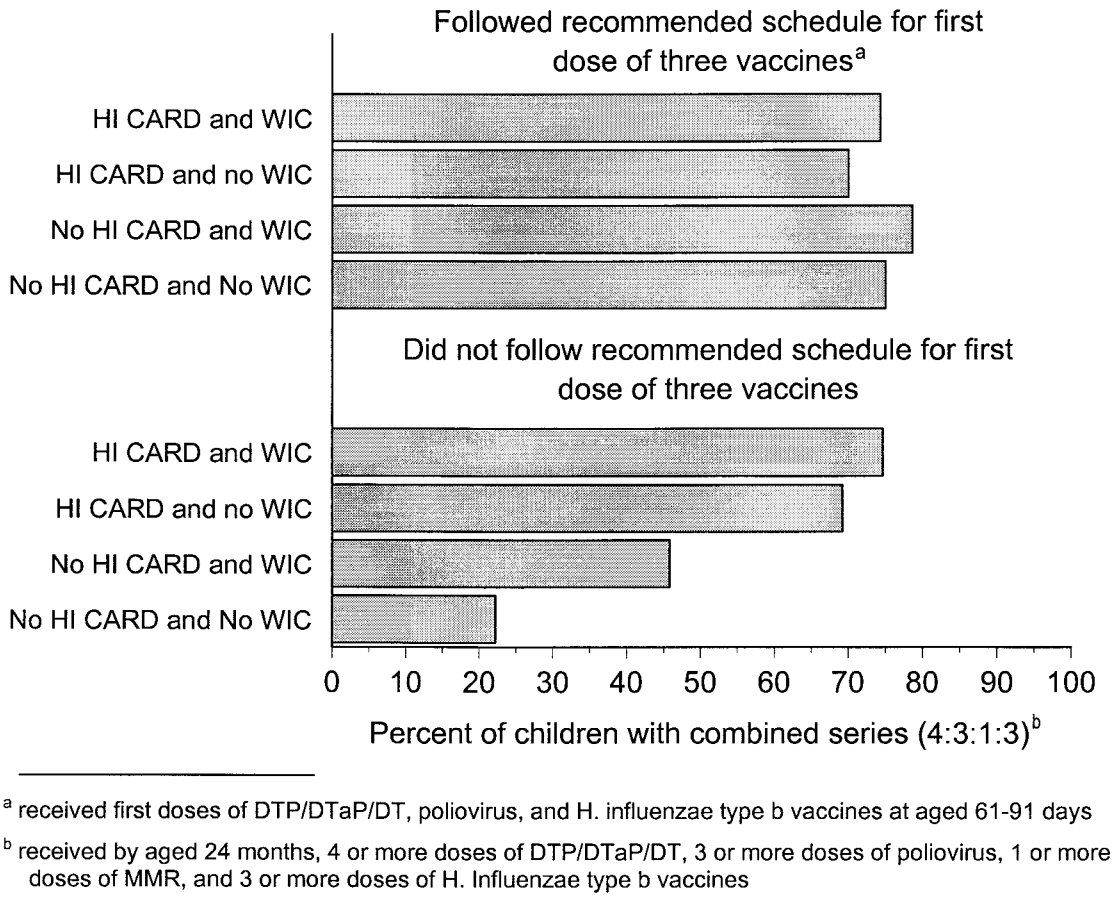

FIGURE 3. Association of home immunization card and WIC enrollment by on-time first vaccination, with completion of combined series (4:3:1:3) by aged 24 months.

vey (NIS) (5). Our participation value of 81.3%, however, was within the range of 55–83% reported for the 78 individual survey areas of the NIS (5). We have no additional information on non-participants.

Children in the Los Angeles study population were expected before aged 24 months to have received 15 to 16 doses divided among six vaccines, as advised in the Recommended Childhood Immunization Schedule (1). Although many of our surveyed parents appeared to be of low-income and likely were less acculturated than families in higher-income regions of Los Angeles, over 90% of their children partially complied with this requirement, at least with five of the six vaccines. The NIS has shown that poverty status is not a major determinant of immunization levels in the United States, although levels among children below poverty level tended to be lower by several percentage points than those at or above poverty level (2).

Our findings seem to agree that given existing support programs, poverty *per se* has a negligible effect on being vaccinated, although in our study we have no direct information on family income. Since community volunteers accompanied many of the interviewers, we were reluctant to ask personal questions about factors such as family income, or even mother's education and marital status. Nevertheless, our impression based on the interview preference for Spanish, absence of telephones and presence of WIC enrollment is that families in our predominantly Hispanic study area were less acculturated and likely poorer than families elsewhere in Los Angeles. In an earlier study also in Los Angeles, Anderson and associates (6) reported that less-acculturated mothers were actually more likely to have adequately immunized children. In their study, factors associated with lower immunization levels were inadequate prenatal care, absence of close family members, being other than firstborn, and having more than one family relocation during the child's lifetime.

While coverage for individual vaccines met the interim goal for the Childhood Immunization Initiative, coverage was lower when considering timely vaccination. By aged 24 months, more than a third of the study subjects had not received the combined 4:3:1:3:3 series, placing them at risk of vaccine-preventable childhood diseases.

Our finding that 85% of parents of not-fully-immunized children thought them fully immunized suggests that many

did not understand the recommended immunization schedule. Our supposition is supported by the findings of Miller and coworkers (7) who noted that incorrect information about the recommended age at immunization for MMR significantly elevated the odds for delayed immunization, and Lieu and colleagues (8) who reported that more than one-third of the parents in a cohort study of young children did not know when the next immunization was due.

Having an HI card at home and enrollment in a structured program such as WIC should help remind parents of the need for complete vaccination. Enrollment in WIC provides important nutritional supplementation for young children (9) but also support for timely and complete immunization coverage (10, 11). In Los Angeles County, five of the eight local WIC agencies provide individualized immunization assessments and referrals at some designated WIC clinic sites. HI card availability is likely a surrogate measure for factors related to parents' sense of responsibility and attitude towards child health. Our survey findings agreed with Simpson and his colleagues (12) who found that having an immunization record accounted for differences in vaccine coverage. While our study was too small to adequately explore the relative importance of WIC enrollment versus having an immunization card at home, our findings suggest that both have an effect, but mainly among those who were not able to initially follow the Recommended Childhood Immunization Schedule.

The findings that children who are late in beginning their vaccination tend not to complete the recommended immunizations on time, is similar to what was reported by Dietz and coworkers (13). Children who start immunization late are in need of more extensive follow-up in order to help them catch-up. As demonstrated by Wood and coworkers (4), early follow-up and case management can improve on-time immunization coverage, although the undertaking may be expensive.

In conclusion, the results of rapid surveys as presented here can be used to describe what exists, and to provide baseline data for intervention programs and for evaluation activities. Besides presenting data on existing and timely immunization coverage, we have tried to identify possible determinants of vaccination levels, while recognizing the limitations of small sample size. Finally, we expect that the results will continue to be used in Los Angeles for planning programs to improve immunization coverage in the downtown region of the city, and thereby help safeguard the local pediatric population.

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