DO BELIEFS OF INNER-CITY PARENTS ABOUT DISEASE AND VACCINE RISKS AFFECT IMMUNIZATION?

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Objective: The objective of this study was to understand how low income, inner-city parents of preschool children think about childhood diseases and prevention and the impact that this has on late receipt of vaccines.

Methods: Parents of all children born between January 1, 1991, and May 31, 1995, whose child received medical assistance and health care at one of four inner-city, primary care clinics in Pittsburgh, PA, completed a telephone interview and gave consent for a vaccine record review. The main outcome measures were lateness for first and third diphtheria and tetanus toxoids and pertussis vaccines (DTP) and not receiving at least four DTP, three polio virus containing and one measles, mumps and rubella (MMR) doses by 19 months.

Results: A total of 483 parents participated. Fifteen percent of children were late for the first DTP, 52% for the third DTP, and 40% had not received at least four DTP, three polio and one MMR by 19 months of age. Statistically significant factors associated with lateness at 19 months included: having three or more children, having two children, beliefs regarding the severity of immunization side effects, and being African American.

Conclusions: The results of this study indicate that a combination of life circumstances, as well as cognitive factors were associated with late immunization. (*J Natl Med Assoc.* 2002;94:820–832.)

Key words: immunization behavior ♦ parental beliefs ♦ health communication ♦ health behavior ♦ health disparities

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INTRODUCTION

The increase in childhood vaccination rates in the United States during the past decade has been a major success. Among children aged 19 to 35 months, 78% had completed 4 or more doses of diphtheria and tetanus toxoids and pertussis vaccine (DTP), 3 or more doses of poliovirus vaccine, and 1 or more doses of measles containing vaccine (MMR)—4:3:1 series in 1996[1]. However, at the critical time of *19 months* of age, when children should have received all of the vaccines on the Recommended Child Immunization Schedule, only 59% of children nationally had completed the 4:3:1 series.[1] And, among poor, urban children,

studies have shown that the percentages of children completing the 4:3:1 recommended primary childhood immunization series by 19 months of age is extremely low and by 24 months of age, only 54% of the children in these studies had completed the 4:3:1 series.[2-3] In order to improve the delivery of preventive health care, especially in poor, urban communities, it is first necessary to understand the cultural and social norms and beliefs of these communities.[4] In addition, there is a need to understand more about how the quality of communication between a provider and patient contributes to health disparities.[5]

A number of studies have addressed or reviewed parental beliefs about vaccination.[6-14] However, relatively few of these studies specifically address the beliefs of disadvantaged, inner-city parents [9-11] and few compare beliefs with immunization status.[11,12,15] Yet, understanding the beliefs of poor, urban parents, and how they affect immunization behavior, is a prerequisite to the design and implementation of effective communication programs for this audience.[16]

This article summarizes the results of a study of parents of urban, low-income preschool children regarding their conceptualization of childhood diseases and prevention and factors associated with late receipt of vaccines.

METHODS

This study was conducted in four inner-city, primary care centers in Pittsburgh, PA, that were representative of settings where children of low-income households in urban areas receive their primary care: the Primary Care Clinic at Children's Hospital of Pittsburgh—a medical center affiliated with the University of Pittsburgh, which offers primary health care to a large Medicaid-insured population; the East Liberty Family Health Care Center, an inner-city, neighborhood health center serving any who need care in the community regardless of income or insurance status; the Matilda H. Theiss Health Center, located in a large, public housing project adjacent to the University of Pittsburgh, which serves a predominately Medicaid-insured population; and the Allegheny County Health Department's Northside Child Health Clinic. These four clinics were chosen because they were known to serve predominately children with Medicaid insurance.

Subjects

Medicaid billing records at three of the four clinics were used to identify children who were born between January 1, 1991, and May 31, 1995, and who were currently receiving primary care at the clinic. The age range of the children was 12 months to 5.5 years (mean age was 3.5 years; median age 3.6 years) and was chosen in order to capture the parents' (or guardians') knowledge, attitudes, beliefs and immunization behavior with regard to their preschool children. In instances where two or more age-eligible children had the same address and telephone number, the youngest child was selected for inclusion in the study. At the fourth site, clinic personnel had concerns about confidentiality and preferred to identify the sample (utilizing the same criteria) and mail the introductory letters themselves. Approval for this study was received from the Institutional Review Board for the Health Sciences, University of Pittsburgh.

Introductory letters, including an endorsement from the respective clinic director, were sent to parents of all eligible children. Parents were asked if they would participate in a 30-minute telephone survey and provide permission for researchers to review their youngest child's immunization record by signing and returning an enclosed consent form. Parents were offered a payment of $25 for participation. The letters were mailed in a series of eight waves of 100 to 200 each, over the course of the survey period from June to October 1996. Follow-up calls to non-responding parents were initiated two weeks after the mailings. Telephone interviews were not conducted until a signed consent form was returned. Interviews were conducted by trained staff using a com-

puter-assisted telephone interviewing (CATI) system.

After the telephone survey was completed with the parent, a medical record review was completed for each child to determine dates of immunization for 4:(DTP)3:(polio)1(MMR) vaccine doses. Records were abstracted from each immunization provider reported by the parent and synthesized to produce the most complete immunization record possible. Chart review data was collected between October of 1996 and January 1997.

Questionnaire

In order to understand parents' conceptualization of childhood disease and prevention, the following process was followed. First, a panel of eight experts in several disciplines, including pediatric infectious disease, public health, and decision theory was consulted regarding what they believed parents needed to know in order to make an informed decision regarding completing a core set of immunizations for their preschool children. Based on the responses from the expert panel, the major determinants of decision-making behavior were identified. Next, a set of open-ended, face-to-face interviews were conducted with 25 African American parents of children less than two years of age who were late for one or more of the basic series of childhood immunizations. The purpose of the open-ended interviews was to develop the structured, closed-ended telephone survey instrument that addressed the major determinants of decision-making behavior, and develop the response categories for the survey items from the perspective of the target population of parents.

The second step of this process involved the pilot testing and administration of the telephone survey instrument. Variables chosen for inclusion in the survey included items generated by the expert panel, as well as key constructs from the Precaution Adoption Process Model -a stage-based, theoretical model of health behavior adoption.[17] This model provided the theoretical framework for the instrument design because it allows one to examine both cognitive and non-cognitive aspects of immunization behavior. The model assumes a linear approach to health behavior adoption and postulates that before one adopts a new health behavior, they progress through a series of stages. They must first have an awareness of childhood diseases followed by an acknowledgment of their susceptibility to the disease. Next, they must decide to take a precaution to avoid or lessen the consequences of the disease. And, finally, the person takes the preventive action -i.e., gets the vaccine for their child.

The telephone survey instrument consisted of 51 questions—12 of which had subparts—for a total of 138 data points. The instrument contained questions based on the following constructs: childhood disease recognition, parental experience with childhood diseases, parental beliefs regarding the likelihood of children getting whooping cough (the term whooping cough is used interchangeably in this manuscript with pertussis) and measles, parental beliefs about their child's susceptibility, as well as childhood disease transmission and prevention, judgments about the severity and consequences of getting childhood diseases, knowledge of and beliefs about immunization effectiveness, judgments regarding likelihood of side effects, beliefs about barriers to immunizations, and demographics—age, race, education, income, employment status, and number of children. Information regarding the sex of the respondent was not collected in this study because this information was not available to the investigators at the time that recruitment letters were mailed. Once parents mailed in a consent form agreeing to be interviewed by telephone, it was felt that it would be awkward to ask the parent during the telephone interview if they were male or female. Therefore, this information was not collected.

Statistical Methods

The dependent variable in this study was late receipt of DTP1, DTP3 and the combination of four DTP, three polio, and one MMR vaccines

at three points in time: three months, seven months and 19 months of age, respectively. A child was considered late if they received DTP1 at three months (>/= 91 days) and/or if they received DTP3 at seven months (>/= 213 days) and/or if they had not received four DTP, three polio, and one MMR vaccines by 19 months of age. When vaccination dates couldn't be determined, they were left as missing data. In addition, in some cases children were classified as late for a vaccination by "default". For example, if the date of immunization for DTP3 was missing and DTP2 was received very late (when DTP3 should have been given), then DTP3 was entered as being late.

The authors used a 30-day grace period in determining lateness for DTP1, DTP3, and completion of the 4:3:1 series at 19 months, based on typical clinic practice. At the time of this study, the Recommended Childhood Immunization Schedule, which is approved by the Advisory Committee on Immunization Practices, American Academy of Pediatrics and the American Academy of Family Physicians, recommended that the first doses of DTP and polio be given at two months, the third doses of DTP and polio be given at six months and by 18 months, a child should have received all four DTP, three polio and one MMR vaccines.

The rationale for the choice of vaccine components included as dependent variables in this study was as follows. The choice of DTP and MMR was influenced by the fact that there was a measles outbreak in the early 1990s and the fact that the incidence and consequences of pertussis is highest among children <6 months old. Pertussis and measles are two childhood diseases that children were dying from in the 1990s. Polio was chosen as a dependent variable because it is part of the 4:3:1 series. The varicella and pneumococcal vaccines were not included in this study because the varicella vaccine was only recommended but not mandatory at the time the study was conducted and the pneumococcal vaccine was not yet licensed.

The survey and immunization record data were joined together to create a combined data set for analysis. The analysis of the data included the following. First, in order to identify the underlying dimensions of parental beliefs about immunization and to reduce the number of predictive variables, a series of factor analyses (principal component extraction with varimax orthogonal rotation) was carried out in each of the question content domains. Factor analysis is a statistical technique used to identify a relatively small number of underlying factors that can be used to represent the associations among a larger set of interrelated variables. In this case, meaningful factors were found for questions focusing on the domains of parental beliefs regarding disease transmission, disease prevention, immunization effectiveness and the side effects of immunizations. Scales for these factors were constructed as the mean of the questions in a domain having a factor score of 0.50 or higher (the factor score measures the strength of the relationship of each variable with the underlying dimension). These scales were then utilized in the bivariate and multivariate analyses.

Second, the bivariate relationships between the independent variables and the three dependent variables were examined. In some cases, a new independent variable was created to summarize parental answers to a question when multiple responses were possible. For example, participants were asked two questions which measured their correct knowledge of symptoms of whooping cough and measles. Based on their responses, two, new yes/no variables were created called: "correct knowledge of symptoms of whooping cough" and "correct knowledge of symptoms of measles." If a respondent was able to name at least three out of five correct symptoms for whooping cough, and three out of four correct symptoms for measles, they were coded as having correct knowledge of whooping cough and measles, respectively. These two, new, independent variables were then used in the bivariate analyses for each of the three dependent variables—late

for DTP1, late for DTP3 and late for 4:3:1 at 19 months.

Finally, logistic regression was used to examine the independent effects of each variable on the immunization outcome measures. In order to address the possibility of racial differences, interaction terms were included in the three logistic regression models for the significant variables in each model. None of these interaction terms were statistically significant, suggesting that there are no interaction effects by race in immunization behavior. However this result must be viewed with some caution because of the small sample size and should be examined in subsequent studies.

Tables summarizing the results of the bivariate analyses were not included in this manuscript because of the volume of data involved. The survey instrument consisted of 51 questions-12 of which, had subparts for a total of 138 data points. Each of these 138 independent variables was included in bivariate analyses by the three dependent variables (i.e., late for DTP1, late for DTP3, and late for 4:3:1 at 19 months). It was not practical to display all of the significant and non-significant bivariate findings in table format.

RESULTS

Response Rate

According to clinic records, 1316 households had children in the selected age range. See Figure 1 for a disposition of the sample. Twenty-five households were excluded because the respondent was ineligible due to one of the following reasons: either the respondent was not the parent or legal guardian of the child in question or the respondent was unable to complete the survey due to illness, hearing impairment, or language /comprehension barriers.

An examination of the immunization data for all 507 participants indicates that there was no statistically significant difference between those who completed the telephone survey (n = 483) and those who did not (n = 24) in terms of lateness for immunization.

Sampling Step	Total Sample Number	Percent
Total households in sample	1316	
↓		
Households w/ wrong number, disconnected and/or not working telephone	428	33%
↓		
Households able to be contacted	888	
↓		
Households w/ ineligible respondent	25	3%
↓		
Total eligible households	863	
↓		
Telephone never answered after 7-10 calls	293	34%
↓		
Refused participation	63	7%
↓		
Never completed the interview	24	3%
↓		
Parents completed the interview	483	56%

Figure 1. Disposition of the Sample

Demographics of Respondents

The majority of those surveyed were African American, had 12 or fewer years of education, and had an annual household income of less than $10,000. See Table 1 for a summary of the demographic characteristics of the total population. The demographic characteristics of the study participants reflect the characteristics of the population who receive care at the four study sites rather than the population of the region. The four study sites are representative of the typical settings where children of low-income households in urban areas receive their primary care.

Immunization Status

Using the definitions of lateness described above, only 15% of children were late for the first DTP immunization at three months of age. However, at seven months, a little over half of the children (52%) were late for the third DTP vaccination. By 19 months of age, 40% of chil-

Table 1. Demographic Description of Sample

	Number	Percent
Total	483	100
Race		
African American	365	75.9
White/Other	116	24.1
Missing	2	–
Number of Children		
One	142	29.4
Two	167	34.6
Three or more	174	36.0
Age		
16 to 21	51	10.6
22 to 30	225	46.6
31 and over	207	42.9
Education		
12 or Fewer Years of School	338	70.0
Some Post Secondary Education	145	30.0
Income below $10,000		
No	141	29.4
Yes	338	70.6
Missing	4	–
Employed		
No	334	69.2
Yes	149	30.8
Enrolled in School		
No	377	78.1
Yes	106	21.9
Clinic		
Children's Hospital Primary Care Clinic	347	71.8
East Liberty Family Health Care Center	53	11.0
Matilda H. Theiss Health Center	54	11.2
Allegheny County Northside Child Clinic	29	6.0

dren had not received at least four DTP, three polio and one MMR.

Parental Awareness and Experience with Childhood Diseases

Parents were asked about their awareness of and experience with measles and whooping cough. Fifty-seven percent (n = 275) of parents said that they had heard of whooping cough. When they were read a list of symptoms (see Table 2) and asked which ones a child with the disease would have, the vast majority of parents who had heard of whooping cough knew one or more of the correct symptoms. For instance, 96% (n = 264) said a painful cough, 95% (n = 261) said difficulty breathing, and 91% (n = 250) said a fever were symptoms of whooping cough. Twenty-one percent (n = 101) of respondents said that they knew someone who has had whooping cough. Seventy-two percent (n = 347) of parents had heard of measles. Among those who had heard of measles, almost everyone knew the obvious symptoms of red rash all over the body and high fever. Twenty-seven percent (n = 130) of respondents reported knowing someone who has had measles.

Table 2. Parental Beliefs Regarding Symptoms of Whooping Cough and Measles

Whooping Cough Symptoms
1. Mucous in the lungs
2. Swelling in arms and legs
3. Painful Cough
4. Infection
5. Nose bleeds
6. Red rash all over the body
7. Difficulty breathing
8. Fever
Measles Symptoms
1. Red rash all over body
2. Mucous in the lungs
3. Red eyes
4. A virus
5. Nose bleeds
6. High fever
7. Swelling in arms and legs
8. Cough

Based on the results of the bivariate analysis, parental awareness regarding the symptoms of these two diseases had no significant impact on the timing of their child's immunization at three, seven, or 19 months.

Parental Beliefs Regarding Susceptibility

Parents were asked whether they thought their child could get whooping cough. The majority of parents (65%) said yes. Among parents who believed that their child is susceptible to whooping cough, 43% were late at 19 months for completing four DTP, three polio and one MMR vaccines. Regardless of whether the parent was on time or late at 19 months, parents gave three main reasons for why they considered their child to be susceptible. The most frequently mentioned reasons for both

Table 3. Parental Beliefs Regarding Reasons for their Child's Susceptibility to Whooping Cough & Measles

Reason for Child's Susceptibility to Whooping Cough and Measles
1. Being around a lot of kids
2. Being exposed to the disease
3. Not getting shots
4. Weaker immune system
5. Born with the disease/heredity
6. Not healthy
7. Parental neglect (no check-up, not dressing child properly)
8. Child's age (young children are more vulnerable)
9. Shots are not effective for some children
10. Having a bad cold
11. Anyone can get whooping cough/measles
12. Other reason
13. No Answer
14. Don't know

groups were that "anyone can get whooping cough," followed by "being exposed to the disease," and "being around a lot of kids." Only four parents said, "not getting shots" was a reason why their child could be susceptible to whooping cough. (See Table 3 for a complete list of reasons cited by parents.)

Among the 35% of parents who said their child was *not susceptible* to whooping cough, 35% were late at 19-months for completing four DTP, three polio and one MMR vaccines. The main reason that both on-time and late parents gave for why their children were *not susceptible* was that: they were "up-to-date with their shots."

Parental Beliefs Regarding Disease Transmission

Parents were asked how they thought whooping cough and measles are transmitted. Two underlying dimensions of parental beliefs regarding transmission were identified from the factor analyses (Table 4). The first factor was labeled the "*poor parenting factor*" based on participants' wording, and included the following reasons why children got whooping cough: "not dressing child properly in cold weather," "child is sickly," "child is not kept clean," and "child has a poor diet." Parents who gave one of these responses were very likely to give all of these responses. The second underlying dimension of parental beliefs regarding disease transmission was labeled the "*contagion factor.*" This belief is characterized by parents who state that the reasons children get whooping cough are that they: "do not have shots," "have a weak immune system," "are in contact with a person who has whooping cough," and "are exposed to germs or viruses in the air."

Table 4. Parental Beliefs Regarding Disease Transmission and Prevention: Factor Analysis Results*

Factor	Factor Loading
A. Parental Beliefs Regarding Disease Transmission (Whooping cough only)	
"Poor Parenting' Factor	
Not dressing child properly in cold weather	0.706
Being sickly	0.694
Not keeping child clean	0.659
Poor diet	0.626
"Contagion' Factor	
Not having shots	0.675
Weak immune system	0.663
Being close to a person w/ whooping cough	0.603
Exposure to germs or viruses in air	0.569
B. Parental Beliefs Regarding Disease Prevention (Whooping cough only)	
"Good Parenting' Factor	
Get regular checkups	0.724
Dress child warmly in cold weather	0.653
Make sure child has a healthy diet	0.522
"General Prevention' Factor	
Don't allow child around a lot of children	0.831
Prevent colds	0.586
"Specific Prevention' Factor	
Keep child away from someone w/ whooping cough	0.758
Get shots for child	0.751

Note: Only items with factor loadings ≥.500 (a common convention) are included.
*Factor analysis is a technique that is used to identify the underlying dimensions of responses to survey items by examining their inter-correlations. Factor loadings are coefficients which represent the strength of the association of each item with the underlying dimension. The higher the factor loading the more closely related the item is to the underlying dimension.

Parental Beliefs Regarding Disease Prevention

Parents were asked what they might do to protect their children from getting whooping cough. Three underlying dimensions of parental beliefs regarding prevention of childhood diseases were identified (Table 4). One set of responses was labeled as the *"good parenting factor"* and included, "getting regular checkups," "dressing a child warmly in cold weather," and/or making sure a child "has a healthy diet." A second factor was labeled as, *"general prevention"* and included, such things as "not allowing your child to be around a lot of other children" and "preventing colds." The third factor was labeled *"specific prevention"* and included such strategies as "keeping a child away from people who have whooping cough," and "getting shots for a child." Parents who gave one of the responses under each factor were very likely to give all of the responses.

Parental Beliefs Regarding Immunization Effectiveness

Parents were asked if they agreed or disagreed with a series of statements regarding their understanding of how shots work and their effectiveness. Three factors were identified which describe how parents think about shots for childhood diseases (Table 5). The first factor was labeled *"shots as treatment"* and summarizes the following parental responses: "shots contain medicine to treat diseases," "shots can cure diseases" such as whooping cough and measles, "it doesn't matter at what age a child gets shots" and, "shots wear off after several months." The second factor was labeled *"shots as prevention"* and included: "shots prevent children from getting diseases" and "children who have shots won't get whooping cough and measles." A final factor was designated as *"shot maintenance"* and this factor summarized the following two parental responses: "a series of several shots is needed for full protection" and "shots build up a child's immune system."

Table 5. Parental Beliefs Regarding Immunization Effectiveness and Side Effects: Factor Analysis Results

Factor	Factor Loading
A. Parental Beliefs Regarding Immunization Effectiveness	
"Shots as Treatment' Factor	
Shots contain medicine to treat disease	0.696
Whooping cough & measles can be cured by shots	0.694
It doesn't matter at what age child gets shots	0.522
Shots wear off after several months	0.509
"Shots as Prevention' Factor	
Shots prevent children from getting disease	0.779
Children with shots won't get whooping cough & measles	0.722
"Shot Maintenance' Factor	
A series of several shots is needed for full protection	0.798
Shots build up child's immune system	0.606
B. Parental Beliefs Regarding Side Effects of Immunizations	
"Severe Side Effects' Factor	
Brain damage	0.769
Severe allergic reactions	0.739
High fever	0.688
Getting the disease from the shot	0.673
"Minor Side Effects' Factor	
Fussy and crabby	0.818
Low grade fever	0.725
Soreness where shot was given	0.691

Note: Only items with factor loadings ≥.500 (a common convention) are included.
*Factor analysis is a technique that is used to identify the underlying dimensions of responses to survey items by examining their inter-correlations. Factor loadings are coefficients which represent the strength of the association of each item with the underlying dimension. The higher the factor loading the more closely related the item is to the underlying dimension.

Parental Beliefs Regarding Adverse Effects

Parents were also asked about the likelihood of certain problems occurring as a result of their child getting shots for measles and whooping cough. They were asked to rate seven possible outcomes as: very likely, somewhat likely, or not at all likely to occur. Two factors were identified which describe how parents think about the possible side effects of immunizations for childhood diseases (Table

Table 6. Logistic Regression Results Predicting Lateness (Cell Entries are Odds Ratios and 95% Confidence Intervals)

	Dependent Variable-Late for:					
	DTP1 OR	(n = 417) 95% CI	DTP3 OR	(n = 420) 95% CI	4DTP, 3Polio, 1 MMR At 19 Months (n = 368) OR	95% CI
African American	1.58	(0.75, 3.30)	1.42	(0.85, 2.39)	2.03*	(1.11, 3.73)
Two children: (Ref group 1 child)	2.11†	(0.94, 4.73)	1.77*	(1.06, 2.97)	2.38**	(1.30, 4.36)
Three children or more (Ref group 1 child)	3.05**	(1.40, 6.64)	3.39***	(2.00, 5.72)	4.29***	(2.36, 7.81)
Education: more than high school	1.05	(0.57, 1.96)	0.76	(0.47, 1.22)	0.66	(0.38, 1.14)
Income less than $10,000	1.37	(0.72, 2.59)	1.24	(0.77, 1.98)	0.70	(0.41, 1.18)
Knows someone with whooping cough	1.47	(0.75, 2.86)	1.57†	(0.94, 2.63)	1.26	(0.71, 2.26)
Thinks own child is susceptible to whooping cough	1.28	(0.71, 2.31)	1.33	(0.86, 2.06)	1.39	(0.83, 2.31)
Knows someone with measles	–		–		1.35	(0.80, 2.27)
Thinks own child is susceptible to measles	–		–		1.14	(0.67, 1.94)
Received information from MD	1.13	(0.31, 4.11)	0.27*	(0.10, 0.74)	0.87	(0.33, 2.28)
"Poor Parenting" factor scale	0.74	(0.46, 1.19)	1.12	(0.77, 1.62)	0.87	(0.58, 1.31)
"Contagion" factor scale	0.68	(0.32, 1.46)	0.50*	(0.26, 0.97)	1.25	(0.59, 2.65)
"Shots as treatment" factor scale	0.23*	(0.07, 0.78)	0.86	(0.36, 2.09)	1.27	(0.47, 3.45)
"Shots as prevention" factor scale	1.28	(0.59, 2.78)	0.99	(0.56, 1.76)	1.96†	(1.00, 3.87)
"Shot maintenance" factor scale	1.65	(0.47, 5.78)	0.82	(0.34, 1.99)	1.09	(0.42, 2.88)
"Severe side effects" factor scale	1.15	(0.63, 2.12)	1.15	(0.72, 1.84)	1.84*	(1.08, 3.16)
"Minor side effects" factor scale	0.74	(0.39, 1.40)	1.48	(0.90, 2.44)	1.23	(0.70, 2.17)

***p <= .001; **p <= .01; *p <= .05; †p <= .10

5). The first factor, "*severe side effects*" included the following responses regarding possible outcomes: "brain damage," "severe allergic reactions," "high fever," and "getting the disease from the shot." The second factor was labeled, "*minor side effects*" and included: "fussiness and crabbiness," "low-grade fever," and "soreness where the shot was given" as possible outcomes after receipt of childhood immunizations.

Factors Associated with Late Immunization

The significant relationships identified in the bivariate analyses were used in the logistic regression analysis in order to assess the independent effects of each variable on lateness at three time points (see Table 6). The main factor associated with lateness for DTP1 at three months, is having three or more children (OR = 3.05). In addition, parents who hold the belief that immunizations are effective because "shots are a treatment" for childhood diseases, are far less likely to be late than those who do not hold this belief (OR = .23).

The factors associated with lateness for DTP3 at seven months, again, are the number of children in the household. Those who have two children are approximately two times as likely to be late (OR = 1.77) and those having three or more children, are more than three times as likely to be late as those who have only one child (OR = 3.39). In addition, parents who reported having received childhood immunization information from their provider or office staff, were *less likely to be late* as those who did not report receiving information (OR = .27). Finally, parents who believe that whooping cough is a contagious disease and is transmitted as a result of "being in close contact with a person who has the disease" and/or "not having shots," are *half as likely to be late* than those who do not share this belief (OR = .50).

At 19 months, the factors that are associated with lateness for completing four DTP, three polio, and one MMR vaccines again include the number of children, parental beliefs regarding the likelihood of severe side effects occurring as a result of getting childhood immunizations and, race. Having three or more children is associated with lateness at 19 months (OR = 4.29). Believing that "brain damage" and/or "severe allergic reactions," are sequella to childhood immunizations is also associated with lateness (OR = 1.84). And, being African American was also associated with lateness at 19 months (OR = 2.03).

DISCUSSION

Immunization series completion coverage among two-year-old children in the United States has improved greatly over the past decade. In this study, 60% of poor, inner-city preschool children received four DTP, three polio and one MMR vaccines by 19 months of age, leaving 40% who were late. The desired outcome of childhood immunization interventions has been to increase immunization series completion levels among two-year-old children. Although it is important to understand the factors affecting lateness during the first year of a child's life (e.g. are parents initiating and maintaining well-baby care- as measured by timing of DTP1 and DTP3- at a time when the incidence of childhood diseases such as pertussis and the health consequences are most serious), ultimately, public health practitioners want to understand and intervene on the factors affecting vaccine series completion. For this reason, the discussion here focuses primarily on understanding the determinants of late immunization at 19 months of age for the completion of the four DTP, three polio and one MMR vaccines. The Precaution Adoption Process model provides a useful framework for thinking about and interpreting the study's findings in terms of parents' mental frameworks and their behavioral stage of readiness to vaccinate their child.

Stage 1: Parental Awareness and Experience with Childhood Diseases

Parents in this study had a general awareness of and some experience with childhood diseases. When given a list of symptoms for whooping cough and measles, most parents could give one or more correct symptoms—perhaps by chance (see Table 2). However, general awareness of symptoms did not have a significant impact on parental behavior in terms of the timing of their child's immunization. Perhaps this is because, as the model suggests, knowing about childhood diseases either from personal experience or from information provided by a healthcare professional is but a first step in the process of protecting one's child from the hazard. It is a necessary but not a sufficient condition for ensuring that a parent gets immunizations in a timely manner for their children.

Parents who had a fairly accurate conceptualization of disease transmission, as captured by the factor analysis and labeled the "contagion factor" (see Table 4), were half as likely to be late for DTP3 at seven months as those who did not share this view. This suggests that a parent's mental framework– that is, how she/he thinks about disease transmission, is related to timing of immunization– especially when the conceptualization tends to be accurate.

Stage 2: Acknowledgment of Personal Susceptibility

The model states that beliefs about personal susceptibility *facilitate* taking a precaution rather than not taking an action. Among those who said their child was susceptible and were late, the logic appeared to be that "anyone can get the disease," and if they're "around a lot of kids" this increases the likelihood of exposure. These parents did not link susceptibility to "not getting shots." Previous studies have shown that perceived susceptibility to illness was inversely related to up-to-date immunization status.[15,18] Bates et al., (1994) offered a possible explanation for this phenomenon. Mothers who per-

ceived that their children were less susceptible to illness more frequently utilized preventive services- suggesting that mothers who believe that prevention works, and therefore obtain regular preventive care, also believe that they can keep their children from becoming ill. The findings from the current study would support this explanation– the primary reason parents said their child wasn't susceptible to whooping cough, was because they were up-to-date with their shots.

Stage 3: Decides to Immunize Child

The Precaution Adoption Model states that parental beliefs regarding immunization play an important role in the decision to get immunization. One set of beliefs examined in this study were those regarding the effectiveness of immunizations. We found that these beliefs cover a range of accurate and inaccurate information– both of which could motivate parents to get shots. For instance, parents who believe that shots are effective because they "treat" a disease, are less likely to be late at DTP1 as those who do not share this belief. If a parent believes that shots "contain medicine" and/or shots can "cure" childhood diseases, then she/he may be more inclined to get her/his child immunized. This finding suggests a need for health education regarding the importance of getting a child immunized to protect him/her from serious diseases even though the immunization itself may cause some discomfort.

Likewise, parental beliefs regarding the side effects of immunizations can also affect their immunization decision. We found that these beliefs are grouped into two categories. Parents are able to distinguish severe from minor side effects (see Table 3). Parents who believe that severe side effects are likely to occur after an immunization, are more likely to be late for receiving the four DTP, three polio and one MMR vaccines at 19 months. If parents believe that severe adverse consequences are likely to occur, this presents a major barrier to getting the child immunized. At this stage, a parent's beliefs about barriers to getting immunizations is a determinant of their decision to get their child immunized.

Stage 4: Gets Immunization

The results of the logistic regression overwhelmingly indicate that having three or more children was the strongest predictor of lateness at all three points in time: three months, seven months, and 19 months of age. This finding is in keeping with the Precaution Adoption Process Model which states that one of the major determinants of a person actually taking a precautionary action is the "time, effort and resources available considering competing life demands."[17] Previous studies have shown that birth order and the number of children that a parent has increases the likelihood of being late for immunization.[19,20,21] This study produced similar results. The simplest explanation is that, the greater the number of children, the greater the number of demands on the parent's time and that is the reason they are more likely to be late.

Finally, the Model suggests that reminders to take a preventive action also play a key role in whether the person actually follows through with her/his intention. The results of this study showed that parents who reported receiving immunization information from a physician were significantly less likely to be late at seven months for DTP3. At 19 months the direction of the odds ratio is the same (i.e., less than 1) however the results are not significant.

Strengths and Limitations

There are several important features of this study. First, this study is one of only a few which addresses the beliefs of disadvantaged, inner-city parents and compares their beliefs with their child's immunization status. Second, understanding parents' mental frameworks for thinking about childhood diseases, is a unique approach and one that is necessary to the design and implementation of effective communications programs targeting this audience. This study is one of only a few studies to do so in the immunization area. Finally, the use of

computer-assisted telephone interviewing (CATI) is both a strength and a weakness. CATI systems facilitate accuracy in the management of the sample and reduce the number of interviewer errors -for instance, missing a skip pattern. However, using telephone interviews as a means of collecting data from a low-income population is also problematic. As Figure 1 illustrates, 33% of the total sample had a telephone that was either disconnected, not working, or was a wrong number. Making contact with individuals who may not be able to afford telephone service on a consistent basis or who may be highly mobile is very difficult. Although telephone surveys have these obvious limitations, the alternatives- mail surveys or face-to-face interviews at an individual's home also have significant drawbacks.

Potential limitations of this study are as follows. The first limitation of this study is the age of the data. The telephone survey was completed in late 1996 and the medical record review was completed in 1997. However, given that there have been so few studies that have addressed the beliefs of disadvantaged, inner-city parents, and fewer still that compare parental beliefs with immunization status, the authors believe the findings are still relevant. A second limitation is the response rate, which was modest and raises the issue of non-response bias. It is impossible to know to what extent, if any, the non-respondents differ with regard to their knowledge, attitudes, beliefs and immunization status. Generalizations from our study are obviously limited to the survey's target population: low income, inner-city parents of preschool children. A third limitation was that the interview was conducted with the parent after the child had already received the vaccinations that were evaluated. However, it seems reasonable to assume that parental knowledge about and attitudes toward immunization would become more informed and realistic with experience over time, and, perhaps, less likely to stand out as predictors of lateness. Therefore, the factors that were associated with late immunization in this study are probably good predictors of lateness in this population. Finally, the odds ratios for some significant factors were large due to small sample size so the results should be viewed with some caution.

CONCLUSIONS AND RECOMMENDATIONS

The present study attempted to understand how disadvantaged parents living in the inner-city, think about childhood diseases and prevention and determine if this is related to the late receipt of vaccines for their preschool children. The results of this study indicate that a combination of life circumstances, as well as cognitive factors were associated with late immunization.

The major life circumstance associated with late immunization was having three or more children in the household, suggesting busy schedules and competing priorities. Thus, it is imperative to take advantage of the opportunity to vaccinate anytime parents bring their preschool child to visit a health care provider, so as not to impose burdensome requirements on already overburdened parents. In addition, one of the implications of this study could be to increase opportunities for immunizations by making them available throughout the community, not just in health care settings.

The cognitive factors that were associated with timing of immunization have to do with parental beliefs about immunization effectiveness and adverse effects of immunizations. Primary care providers need to reinforce the accurate beliefs that parents hold regarding immunizations that may motivate them to get their children vaccinated. Likewise, they must also correct inaccurate beliefs especially about side effects. This will help to establish a partnership for more informed decision-making based on the principles of risk communication.[16]

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