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Original Article

Determinants of immunization status of children aged 1-5 years attending a tertiary health care facility: A cross-sectional study

Sridevi A Naaraayan[1], S Sundari[2], C Subbulakshmi[1], S Geethalakshmi[3], R Geetha[4], A Vengatesan[5]

From [1]Department of Pediatrics, Institute of Child Health & Hospital for Children, [2]Department of Pediatrics, Sri Balaji Medical College and Hospital, Chromepet, Chennai, [3]Department of Pediatrics, The Tamil Nadu Dr. MGR Medical University, Guindy, [4]Department of Pathology, Madras Medical College, [5]Directorate of Medical Education, Kilpauk, Chennai, Tamil Nadu, India

Correspondence to: Dr. Sridevi A Naaraayan, A-5, Sriniketan Apartments, 12/13, Gengu Reddy Road, Egmore - 600 008, Chennai, Tamil Nadu, India. Phone: +91-9884279417. E-mail: childdoctorsri@yahoo.co.in

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ABSTRACT

Background: Childhood immunization is one of the key health interventions, which is useful in decreasing the under-five mortality. There has been a recent decline in immunization coverage rates in India as shown by the National Family Health Survey 4. **Objective:** This study was undertaken with the objective of determining the socio-economic and demographic risk factors associated with partial immunization of children aged 1-5 years attending a tertiary care center in South India. **Materials and Methods:** This cross-sectional study was done at the outpatient department of Institute of Child Health and Hospital for Children, Chennai, from May 2015 to October 2015. Children aged 1-5 years attending the outpatient department were included by convenient sampling. A sample size of 1100 was calculated based on a pilot study. After obtaining parental informed consent, data were collected on immunization and socio-demographic factors, namely, gender, place of residence, parental education and occupation, family income, number of children, birth order, place of delivery, and awareness of the type of vaccines to be given. The WHO definitions were used to classify immunization status as full, partial, and delayed immunization. Univariate and multivariate logistic regression analyses were performed to determine independent risk factors for partial immunization. **Results:** Totally, 1104 children were included in the study. 1056 (95.7% [95% confidence interval 94.5-96.9]) were fully immunized, whereas 41 (3.7% [2.59-4.81]) were partially immunized and 7 (0.6% [0.14-1.06]) had delayed immunization. None of the children were totally unimmunized. Univariate analysis identified rural residence, home delivery, having more than 2 children, birth order more than 2, lack of maternal and paternal education beyond primary school level, and lack of awareness on immunization as significant risk factors for partial immunization. After multivariate logistic regression, rural residence, having more than 2 children, and lack of awareness on immunization emerged as independent risk factors for partial immunization. **Conclusion:** Residing in rural areas, having more than 2 children, and lack of awareness on immunization are significant independent risk factors for a child not being fully immunized.

Key words: *Delayed immunization, Demographic factors, Fully immunized, Partial immunization, Socio-demographic determinants, Socio-economic factors*

Improving child survival by reduction of under-five mortality is one of the millennium development goals (MDG). Among the four main strategies suggested by WHO for achieving this MDG target, immunization is of utmost importance [1]. Globally, under-five mortality has fallen steadily over the past decades because of increased use of key health interventions such as immunization [2]. According to guidelines developed by the WHO, children are considered fully immunized if they have received vaccination against tuberculosis (Bacillus Calmette-Guerin [BCG]), 3 doses of diphtheria, whooping cough (pertussis) and tetanus (diphtheria, tetanus, and pertussis [DPT]) vaccine, 3 doses of oral poliomyelitis vaccine (OPV), and 1 dose of measles vaccine by the age of 12 months [3].

According to UNICEF immunization coverage evaluation survey 2009, 61% of Indian children were completely immunized, while the corresponding figure for the state of Tamil Nadu was 77.3% [4]. National Family Health Survey 3 (NFHS-3) conducted, in 2005, documented an immunization coverage rate of 80.9% in the state [5]. The recent NFHS-4 conducted, in 2015, shows a decline in the rate from 80.9% to 69.7% [6]. There are a number of reasons why India lags behind its many less developed neighbors in vaccination rates [7]. Identification of factors determining immunization coverage is the crucial and first step to improve the immunization coverage rates and to decrease the under-five mortality.

This study was undertaken with the objective of determining the socio-economic and demographic factors associated with partial immunization in children aged 1-5 years attending a tertiary care center in south India for various illnesses.

MATERIALS AND METHODS

This cross-sectional study was done in the outpatient department of the institute of child health and hospital for children, which is an 834 bedded government hospital exclusively for children. Everyday around 1500 children attend general pediatric and various specialty OPDs, and the average bed occupancy is 102%. It is an apex tertiary care center run by the state government, receiving cases referred from all over the state and neighboring states too. Outpatient, as well as inpatient services, is provided free of cost to all patients.

Children aged 1-5 years attending the medical OPD for various ailments from May 2015 to October 2015 were the study participants. There were no specific exclusion criteria. Convenient sampling was done recruiting 10 participants per day at a particular time of the day every day at the OPD. The study was first piloted on 100 participants, which showed 8% were partially immunized. To study 9 demographic and socio-economic factors of interest, at least 90 partially immunized children were needed in the sample which necessitated a sample size of around 1100, considering 8% prevalence of partial immunization in the study population.

Operational Definitions

The universal immunization program being followed in the country consists of administering BCG and 0 dose of polio at birth, 3 doses of DPT, Hepatitis B and OPV at 6, 10, and 14 weeks, and measles after 9 completed months. Being a good performing state, Tamil Nadu was selected by the Government of India to implement immunization with the pentavalent vaccine consisting of DPT, hepatitis B, and hemophilus influenza B at 6, 10, and 14 weeks from December 2011 [8]. Hence, children vaccinated before December 2011 (aged 4-5 years) received 3 doses of DPT and hepatitis B at 6, 10, and 14 weeks while those vaccinated after that, i.e., children aged 1-3 years received 3 doses of pentavalent vaccine.

Fully immunized

Children who received BCG, 3 doses of pentavalent vaccine/DPT and hepatitis B virus (HBV), 3 doses of OPV, and 1 dose of measles vaccine within 1 month of the stipulated time were considered as fully immunized [3].

Delayed immunization

Children who received all the above vaccines before their first birthday but later than 1 month of the stipulated time were said to have delayed immunization [3].

Partially immunized

Children who had not received all of the above said vaccines before their first birthday were considered as partially immunized [3].

Children found to have delayed, and partial immunizations were analyzed as a single group, (Partial immunization) and compared with those who were fully immunized.

Major illness and minor illness

While probing for the reasons for partial immunization, any illness which warranted hospital admission in the child was termed as major illness. Minor illnesses were the ones for which the child was treated as outpatient.

The study was commenced with the approval from the Institutional Ethical Committee. After obtaining informed consent from either parent, detailed immunization history of the child was elicited including the name of the vaccines, timing, mode and site of administration and the health-care facility where it was administered and adverse reactions if any. Whenever feasible, the history was counterchecked with the immunization records. An evidence of scar over the site of insertion of deltoid muscle on the left upper arm was used as confirmation of receipt of BCG at times of dilemma in the history and immunization records. If they found to be partially immunized; the reasons for the same were probed and noted.

The following demographic and socio-economic factors were the variables of interest, and these were recorded in a structured pro forma: Gender, area of residence, parental education and occupation, family income, number of children, birth order, and place of delivery and awareness of type of vaccines to be given. Variables, such as parental education and occupation and family income, were categorized as per latest modification of Kuppuswamy scale [9].

Statistical analysis was performed using SPSS version 16. Qualitative parameters were expressed as proportions, and quantitative parameters were converted into qualitative parameters and expressed as proportions. The prevalence of partial and delayed immunization was expressed as percentage with 95% confidence interval (CI). Each variable of interest was compared with the outcome (immunization status) using univariate analysis, and factors found to be significantly associated and were subjected to multivariate logistic regression analysis [10]. Any $p<0.05$ was considered significant. Odd's ratio, both crude and adjusted, with 95% CI was used to express the strength of association between statistically significant risk factors and outcome.

RESULTS

Totally 1104 children and their caregivers participated in the study. All the 1104 data including those from the pilot study

were included for analysis. The age and sex distribution of the children is shown in Table 1.

Immunization Status

Out of 1104 children, 1056 (95.7% [95% CI 94.5-96.9]) were fully immunized. 41 (3.7% [95% CI 2.59-4.81]) were partially immunized and 7 (0.6% [95% CI 0.14-1.06]) had delayed immunization. There were no children who had not been immunized at all. 3 (43%) children with delayed immunization had received measles alone late, whereas another 2 (28.5%) had received BCG late and the remaining 2 (28.5%) had received both BCG and measles later than scheduled.

The coverage rates for various vaccines are given in Figure 1. It can be observed that measles was the most often missed vaccine (3.1%) followed by DPT and HBV/pentavalent and BCG (0.6%). OPV was the least commonly missed vaccine (0.4%) with the highest coverage rate. Around a third (34.1%) of participants cited minor illness as a reason for missing the vaccination, whereas another third (36.5%) said they missed it because they perceived it as unimportant. Other reasons such as lack of time (12.1%), lack of money (7.3%), and major illness in child (7.3%) accounted for a small fraction. Only 1 patient (2.4%) cited local reaction to previous vaccination as a reason for missing the next dose.

Socio-demographic Determinants

Univariate analysis identified rural residence, home delivery, having more than 2 children, birth order more than 2, lack of maternal and paternal education beyond primary school level, and lack of awareness about immunization as risk factors for partial immunization (Table 2). These factors were subjected to multivariate logistic regression, and the results are depicted in Table 3. Rural residence, having more than 2 children, and lack of awareness about vaccines emerged as independent risk factors for partial immunization.

Table 1: Age and sex distribution

Age in completed months	n (%)		
	Male	Female	Total
12-23 months	265 (55.8)	210 (44.2)	475 (43)
24-35 months	136 (54.8)	112 (45.2)	248 (22.5)
36-47 months	118 (56.5)	91 (43.5)	209 (19)
48-59 months	96 (55.8)	76 (44.2)	172 (15.5)
Total	615 (55.7)	489 (44.3)	1104 (100)

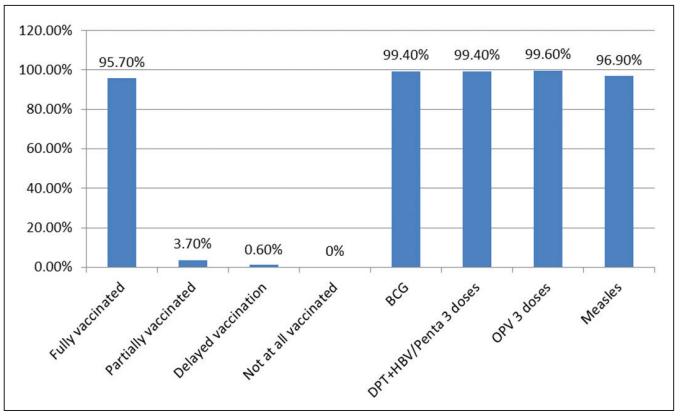

Figure 1: Immunization coverage rates

DISCUSSION

This study brings out the fact that, in spite of relatively high immunization coverage in this region, residing in rural areas, having more than two children, and lack of awareness on immunization were independent risk factors for partial immunization. The immunization coverage of patients attending this tertiary care hospital was 95.8%. This is higher than the Tamil Nadu state immunization coverage rate of 77.3% reported by UNICEF Coverage evaluation survey 2009 and 69.7% reported by NFHS-4 (2015-16) [4,6]. This is due to the obvious fact that this is a hospital based study; it reflects the status of people with good health seeking behavior rather than the general public.

Our study showed that OPV was the vaccine with maximum coverage. 99.6% of patients had received all 3 doses while there were none who did not receive OPV at all and all children had received at least 1 dose. This is due to additional National Immunization Days when OPV is administered to all under five children as a mass campaign. The coverage rate of DPT and HBV/pentavalent vaccine and BCG were similar (99.4%). Measles was the vaccine with a minimum coverage of 96.9%. This is in agreement with NFHS-3 data, which show that measles was the commonly missed vaccine (coverage rate-92.5%) [5]. However, this is in contrast with NFHS-4 data, which show that HBV was the most commonly missed vaccine (coverage rate 70.9%) followed by OPV (82.3%) and DPT (84.5%) [6]. The relatively lower coverage of OPV reported in NFHS-4 is because only OPV doses of routine immunization schedule were considered while calculating coverage rates, ignoring the additional doses administered on national immunization days.

Residing in rural areas was one of the risk factors for partial immunization identified in our study. This is in concurrence with UNICEF Coverage Evaluation Survey 2009, NFHS-3 (2005-2006) and NFHS-4 (2015-16) [4-6]. This can be explained by the fact that people who live in urban areas have easier access to better maternal and child care services.

Lack of maternal education beyond primary school level is another important risk factor reported by various studies. NFHS-3 reported that only 26% of children of mothers with no education were fully vaccinated, whereas 75% of children of mothers who had completed 12 years or more of education were fully vaccinated [5]. Further, the percentage of vaccinated children rose steadily with increasing levels of education.

Table 2: Socio-demographic variables and immunization status – univariate analysis

Variable	Category	Immunization status n (%)		χ^2	p value	Odd's ratio (95% CI)
		Partially immunized	Fully immunized			
Gender	Female	16 (3.3)	473 (96.7)	2.443	0.118	
	Male	32 (5.2)	583 (94.5)			
Residence	Rural	24 (8.4)	259 (91.6)	15.629	<0.001	3.1 (1.7-5.5)
	Urban	24 (2.9)	797 (97.1)		HS	
Number of children	>2	13 (16.9)	64 (93.1)	31.275	<0.001HS	5.8 (2.9-11.4)
	Up to 2	35 (3.4)	992 (96.6)			
Birth order	>2	8 (17)	39 (83)	18.959	<0.001	5.2 (2.3-11.9)
	Up to 2	40 (3.8)	1017 (96.2)		HS	
Place of delivery	Home	3 (37.5)	5 (62.5)	21.296	0.004 HS	14 (3.2-60.4)
	Hospital	45 (4.1)	1051 (95.9)			
Maternal education	Up to primary	16 (9.7)	148 (90.3)	13.547	<0.001	3 (1.6-5.7)
	Above primary	32 (3.4)	908 (96.6)		HS	
Paternal education	Up to primary	13 (10.8)	107 (89.2)	13.590	<0.001	3.3 (1.7-6.4)
	Above primary	35 (3.5)	948 (96.5)		HS	
Maternal occupation	Unemployed	42 (4.4)	895 (95.6)	0.270	0.604	
	Employed	6 (3.5)	161 (96.5)			
Paternal occupation	Unemployed	0	7 (100)	0.314	0.575	
	Employed	47 (4.3)	1047 (95.7)			
Monthly family income	Up to Rs. 5546	5 (5.7)	82 (94.3)	0.445	0.505	
	>Rs. 5546	43 (4.2)	974 (95.8)			
Awareness on vaccines	Lacking	12 (70.6)	5 (29.4)	182.166	<0.001	70.1 (23.4-209.4)
	Present	36 (3.3)	1051 (96.7)		HS	

HS: High significant

Table 3: Socio-demographic variables and immunization – multivariate logistic regression analysis

Variable	Odd's ratio		95% confidence interval	p value
	Crude	Adjusted		
Residence				
Rural versus Urban	3.1	2.175	1.120-4.222	0.022
Number of children				
>2 versus up to 2	5.8	3.910	1.435-10.655	0.008
Birth order				
>2 versus up to 2	5.2	0.737	0.189-2.877	0.660
Place of delivery				
Home versus Hospital	14	1.644	0.138-19.585	0.694
Maternal education				
Up to primary versus above primary	3	1.901	0.855-4.228	0.115
Paternal education				
Up to primary versus above primary	3.3	1.191	0.468-3.030	0.714
Awareness of vaccination				
Lack versus presence	70	43.591	12.941-146.839	<0.001

Similar finding is reported by various other studies [11-14]. In our study, though univariate analysis identified the lack of maternal education beyond primary school level as a risk factor, regression analysis failed to establish its role. This is probably due to higher female literacy rate prevailing in our state as evidenced by 85.2% of women having studied beyond primary school level [6].

Having more than 2 children was a risk factor for partial immunization identified in our study. A similar finding was

reported by NFHS-3 and various other studies [5,12-14]. In households with many children, the resources (time and money) available have to be shared among all the children and hence the children receive only suboptimal care.

Lack of awareness on immunization was an important risk factor identified. This is similar to that reported by Ahmad et al. [15]. Thus, improving the awareness of immunization services starting with adolescents, moving on to pregnant women during their antenatal visits, at the time of delivery and each and every time young mothers come into contact with a health service provider for any minor ailment will go a long way in improving the immunization coverage.

The strength of the study is that it was done on a large sample in a systematic manner using a robust questionnaire by trained personnel. Limitations of this study include a high chance of selection bias being a hospital-based study done in a government hospital, as the participants are people with good health seeking behavior and are mainly from lower socio-economic status. Hence, the prevalence rates may not be reflecting that in the community. Further, since immunization card was not checked in all cases and immunization status was classified based on mother's recall even in children as old as 5 years, misclassification could have been a possibility due to errors in recall. Even in that case, it would have been a non-differential misclassification and would have resulted in underestimation of the association. However, the focus of the study is to determine the predictors of incomplete immunization, which was done using robust statistical methods and is hence valid. Further the identified risk factors are consistent with that reported in other studies and are plausible.

In a nutshell, improving health-care services in rural areas, family planning services, and awareness about vaccines will go a long way in improving immunization coverage rates, which will facilitate to reduce under-five mortality and reach MDG. Further, a community-based study using cluster sampling method with verification of vaccination cards will yield a more precise and comprehensive picture of the prevailing situation.

CONCLUSION

We conclude that residing in rural areas, having more than 2 children, and lack of awareness of vaccination are risk factors for partial vaccination.

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