

TIMELINESS OF CHILDHOOD VACCINE UPTAKE AMONG CHILDREN ATTENDING IMMUNOPROPHYLAXIS CLINIC IN CENTRAL INDIA

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ABSTRACT

BACKGROUND

Child survival is dependent on many survival factors including immunisation. Even though, vaccines are provided free of cost at all government healthcare centers, the immunisation coverage in India is very low. Delayed vaccination not only increases the risk of vaccine preventable disease, but also increases the risk of never fully completing the vaccination course. The present study assessed the timeliness of immunisation for children below one year of age and factors influencing the timeliness of vaccination.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Immunoprophylaxis Clinic (IPC) of a tertiary care hospital. Total 300 children were selected. All mothers/caretakers were interviewed. Chi-square test was used to find the difference between two proportions. Unadjusted odds ratio was calculated for various factors studied. Stepwise logistic regression analysis was done to calculate the adjusted odds ratio.

RESULTS

The overall delayed vaccination was found in 184 (61.3%) babies while only 116 (38.7%) babies were vaccinated on time without any delay. Education below secondary, lower socioeconomic classes, less than 4 ANC visits, birth order of 1 and 2 and those babies accompanied by other than mothers were significantly higher in "delayed group" when compared to "on time" group and also showed higher odds of 6.955, 8.612, 4.199, 14.248, 4.392, respectively.

CONCLUSION

In this study, we found that mother's education, socioeconomic status, number of ANC visits, birth order and accompanied by mother or relatives affect the overall timeliness of immunisation.

KEYWORDS

Immunisation, Timeliness, ANC Visits, Birth Order.

HOW TO CITE THIS ARTICLE: Sahoo DP, Jadhao AR, Deshmukh JS, et al. Timeliness of childhood vaccine uptake among children attending immunoprophylaxis clinic in central India. *J. Evolution Med. Dent. Sci.* 2017;6(73):5232-5237, DOI: 10.14260/Jemds/2017/1136

BACKGROUND

Immunisation is one of the most cost-effective interventions preventing avoidable sickness, disability and death among under-five children. These benefits are not only restricted to improvement in health and life expectancy, but also have social and economic impact at both community as well as national level.⁽¹⁾ The world health organization estimates that vaccines annually prevent almost 6 million deaths worldwide.⁽²⁾ The aim of routine immunisation program is to deliver complete number of doses of potent vaccine in a timely, safe and effective way to all children and women.⁽³⁾

The current EPI schedule recommends BCG at birth; a total of 4 doses of primary bivalent oral polio vaccines at birth, 6 weeks, 10 weeks, 14 weeks and booster at 16-24 months of age; 3 doses of pentavalent-containing Diphtheria, Pertussis, Tetanus, Haemophilus influenza type B and Hepatitis B at 6 weeks, 10 weeks, 14 weeks of age and Hepatitis B at birth; inactivated polio vaccines at 6 weeks and 14 weeks of age; measles and vitamin A1 at 9 months of age are administered to children less than one year of age.^{(4),(5)}

Even though vaccines are provided free of cost at all government health centers, the immunisation coverage in India is as low as 62.0%, and in Maharashtra, it is 56.3% amongst children of age 12-23 months (fully immunised).^{(6),(7)} Delayed vaccination not only increases the risk of vaccine preventable disease, but also increases the risk of never fully completing the vaccination course.⁽⁸⁾

It was found that the recommended schedules for vaccination was not practiced commonly.⁽⁹⁾ There are numerous factors like higher birth order of children, being unmarried, being in the lowest wealth quintile, living area, etc. lead to delayed uptake of vaccine.^{(10),(11)} Considering this fact, the present study was undertaken in a tertiary care

Financial or Other, Competing Interest: None.

Submission 03-08-2017, Peer Review 28-08-2017,

Acceptance 02-09-2017, Published 11-09-2017.

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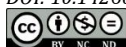
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DOI: 10.14260/jemds/2017/1136



centre’s Immunoprophylaxis Clinic (IPC) to assess the timeliness of immunisation for children below one year of age and factors influencing the timeliness of vaccination.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at the Immunoprophylaxis Clinic (IPC) of a tertiary care institute in central India. The IPC attends an average of 2500 children per year and is open from Monday to Saturday except on weekends and public holidays. IPC provides immunisation services as per Universal Immunisation Program adopted by Government of Maharashtra.

Based on 87.3% of “on time” vaccination at 95% confidence interval, 5% absolute error, design effect of 1 and an estimated population of 2500, the minimum sample size calculated using sample size calculation for single proportion was 160.^{(12),(13)}

$$\{Formula\ n = deff * Np (1-p) / [d^2 / 1.96 * (N-1) + p(1-p)]$$

n= sample size

deff = design effect = 1

N = population size = 2500

P = prevalence = 0.873

d= desired precision= 5%

Though the sample size estimated to be 160, we had recruited 300 children for the study. After taking informed consent from all the respondents and after explanation of the purpose of the study, a pretested structured questionnaire was administered to all the respondents. The study duration was 3 months from April to June 2017. Timeliness of immunisation for BCG, OPV 0, Hep B0, pentavalent 1/2/3, OPV 1/2/3, IPV 1/2, measles and vitamin A1 was studied. All the children who had received measles vaccine and vitamin A1 at 9 months and those who have received booster dose of DPT/OPV/measles were enrolled for the study till the sample size reach 300 in IPC of study institute for timeliness of immunisation. Date of immunisation was verified from the immunisation card in possession of the respondents. If respondent was not having immunisation card, then immunisation registry record was seen for verification of dates of immunisation. Ethical approval for the study was taken from institutional ethics committee.

On the date of attending IPC, selected children were identified and questionnaire was administered. Details of previous vaccination was used as a part of data collection from the immunisation card provided by study center.⁽¹⁴⁾ The data collection tool included the demographic factors, immunisation history, dates of previous immunisation, maternal information, distances to health facility, antenatal records and delivery history were collected from their mothers or relatives accompanying the child. Education was classified according to Indian Standard Classification of Education⁽¹⁵⁾ and socioeconomic status was classified using the modified B G Prasad Classification.⁽¹⁶⁾

The timeliness of vaccination was determined based on immunisation schedule adopted by Government of Maharashtra for a specific vaccine as follows.

On Time

If the child received vaccine on or within two weeks after scheduled date.

Accepted Delayed

If the child received between 2 and 4 weeks after scheduled date.

Delayed

If the child received after 4 weeks of scheduled date.

The timeliness of vaccination was calculated by subtracting the expected date of vaccination based on date of birth of the child from the date of administration of specific vaccines.

Children who all fall into acceptably delayed or in the delayed group even for a single vaccine was considered as “delayed group” while children who all received all the vaccines on time was considered as “on time” group for comparison of various factors.

Statistical Analysis

The data was analysed using SPSS version 20.0. The quantitative variables were expressed in terms of mean and standard deviation and the qualitative variables were expressed in percentages. Chi-square test was used to find the difference between two proportions. Unadjusted odds ratio was calculated for various factors studied. Stepwise logistic regression analysis was done to calculate the adjusted odds ratio.

RESULTS

Total 300 participants enrolled after informed consent of mother or relative accompanied the child at immunoprophylaxis clinic of a tertiary care center in Central India who had received measles vaccine and vitamin A1 at 9 months and those who have received booster dose of DPT/OPV/measles.

Demographic Variables		Frequency	%
Age of mother in years	Less than 30 years	230	76.7
	30 years or more	70	23.3
Gender	Female	147	49.0
	Male	153	51.0
Education	Illiterate	12	4.0
	Primary	27	9.0
	Upper primary	53	17.7
	Secondary	93	31.0
	Senior secondary	78	26.0
	Graduate	37	12.3
Socioeconomic status	I	23	7.7
	II	41	13.7
	III	81	27.0
	IV	90	30.0
	V	65	21.7
Occupation	Homemaker	266	88.7
	Working	34	11.3
Time taken to reach IPC	Less than 30 minutes	175	58.3
	More than 30 minutes	125	41.7
Mode of transport	Own vehicle/on foot	156	52.0
	Public transport	144	48.0
Accompanied by	Mother	198	66.0
	Others	102	34.0

Table 1. Demographic Characteristics of the Study Subjects

Table 1 shows socioeconomic and demographic information. There was a total of 153 (51.0%) males and 147 females (49.0%) of study subjects. The mean age of the children was 14.15 ± 3.51 months, median age of 14.0 months and range of 9 to 22 completed months. The mean age of mother was 26.20 ± 4.51 years and a range of 18 to 37 years. Majority of the mothers were less than 30 years 230 (76.7%) while 208 (69.3%) of the mothers studied secondary and above. Around half of the mothers belonged to lower class 155 (class IV and class V = 51.7%) as per modified B.G. Prasad classification. Most of the mothers were homemakers 266 (88.7%). Using own vehicle or by walking was the most commonly used mode of transports 156 (52.0%) with an average time of 24.24 ± 16.43 minutes with a median of 20 minutes. Majority of the children were accompanied by their mothers 198 (66.0%).

Obstetric Variable		Frequency	Percent
ANC visits	Yes	300	100
Number of ANC visits	Less than 4	29	9.7
	4 or more	271	90.3
Birth order	1	174	58
	2	99	33
	3 or more	27	9
Place of delivery	Hospital	300	100
Mode of delivery	Vaginal	166	55.3
	Forceps	11	3.7
	Cesarean	123	41

Table 2. Distribution of the Study Subjects as per Obstetrics Variable

Table 2 shows distribution of study subjects as per obstetrics information. All the mothers attended ANC visits during pregnancy period and 271 (90.3%) of mothers made 4 or more ANC visits. All the mothers were delivered in health

institution. Out of all the 300 babies delivered, 123 (41.0%) were delivered by caesarean section and the remainder by spontaneous or assisted vaginal delivery. Majority of the babies were of birth order one 174 (58.0%).

Vaccine	On time	Acceptably Delayed	Delayed
BCG	272 (90.7%)	21 (7.0%)	7 (2.3%)
OPV 0	272 (90.7%)		
Hep B 0	232 (77.3%)		
Pentavalent1/OPV1/IPV1	228 (76.0%)	41 (13.7%)	31 (10.3%)
Pentavalent2/OPV2	199 (66.3%)	65 (21.7%)	36 (12.0%)
Pentavalent3/OPV3/IPV2	188 (62.7%)	61 (20.3%)	51 (17.0%)
Measles/vitamin A1	219 (73.0%)	41 (13.7%)	40 (13.3%)
Overall delayed = 184 (61.3%), On time = 116 (38.7%)			

Table 3. Timeliness of Vaccine Uptake for Specific Vaccines by Study Subjects

Table 3 shows timeliness of vaccine uptake by study subjects. Majority of the babies were vaccinated for BCG and OPV 0 dose 272 (90.7%). Only 9.3% got delayed vaccination for BCG and OPV 0 as mothers/relatives informed due to sickness of the babies, low birth weight babies, mother's ill health or no reason, etc. The "on time" vaccination percentage was decreased as the immunisation schedule progressed for primary immunisation OPV/pentavalent/IPV (6 weeks >10 weeks >14 weeks). On time vaccination at completed 9 months for measles and vitamin A₁ was slightly higher 219 (73.0%). OPV 0 and Hep B 0 are not to be administered after 14 days. Hence, it was not assessed. The overall delayed vaccination was found in 184 (61.3%) babies, while only 116 (38.7%) babies were vaccinated on time without any delay.

Variables	Group		Odd's Ratio (Confidence Interval)	Chi-Square	p value
	Delayed	On Time			
Age of Mother in Years					
Less than 30 years	148 (64.4%)	82 (35.6%)	Reference value	3.777	0.052
30 years or more	36 (51.4%)	34 (48.6%)	0.587 (0.342, 1.008)		
Gender					
Female	85 (57.8%)	62 (42.2%)	Reference value	1.498	0.221
Male	99 (64.7%)	54 (35.3%)	1.337 (0.839, 2.131)		
Education					
Upto Secondary	145 (78.4%)	40 (21.4%)	7.064 (4.195, 11.895)	59.123	0.0001*
Above Secondary	39 (33.9%)	76 (66.1%)	Reference value		
Socioeconomic Status					
I, II, III	55 (37.9%)	90 (62.1%)	8.119 (4.738, 13.912)	64.810	0.0001*
IV, V	129 (83.2%)	26 (16.8%)	Reference value		
Occupation					
Homemaker	161 (60.5%)	105 (39.5%)	Reference value	0.645	0.422
Working	23 (67.6%)	11 (32.3%)	1.364 (0.638, 2.914)		
Number of ANC Visits					
Less than 4	23 (79.3%)	6 (20.7%)	2.619 (1.033, 6.642)	4.375	0.036*
4 or more	161 (59.4%)	110 (40.6%)	Reference value		
Birth Order					
1,2	178 (65.0%)	96 (35.0%)	6.181 (2.401, 15.909)	17.568	0.0001*
3 or more	6 (23.1%)	20 (76.9%)	Reference value		
Time Taken to Reach IPC					
Less than 30 minutes	105 (60.0%)	70 (40.0%)	Reference value	0.315	0.574
More than 30 minutes	79 (63.2%)	46 (36.8%)	1.145 (0.714, 1.837)		

Mode of Transport				
Own vehicle/on foot	96 (61.5%)	60 (38.5%)	Reference value	0.006
Public transport	88 (61.1%)	56 (38.9%)	0.982 (0.617, 1.564)	
Accompanied by				
Mother	110 (55.6%)	88 (44.4%)	Reference value	8.197
Other	74 (72.5%)	28 (27.5%)	2.114 (1.260, 3.547)	

Table 4. Factors Related to Timeliness of Vaccination Group

*Significant values.

Table 4 depicts education below secondary, lower socioeconomic classes, less than 4 ANC visits, birth order of 1 and 2 and those babies accompanied by other than mothers were significantly higher in “delayed group” when compared to “on time” group and also showed higher odds. However, age of mother less than 30 years, male babies, working mothers, time taken more than 30 minutes to reach IPC were more in “delayed group” when compared to “on time” group, but it was not statistically significant.

Variables	Odds Ratio	95% Confidence Interval	P value
Socioeconomic status	8.612	4.471, 16.592	0.0001*
Education	6.955	3.664, 13.203	0.0001*
Birth order	14.248	4.212, 48.194	0.0001*
Number of ANC visits	4.199	1.249, 14.109	0.02*
Accompanied by	4.392	2.150, 8.973	0.0001*

Table 5. Multivariate Analysis of the Factors Associated with Delayed Vaccination in the Study Population (Final Model)

Cox and Snell R square = 0.387, Nagelkerke R square = 0.526 *Significant.

For lower economic status, lower education, lower birth order, less number of ANC visits and babies accompanied by other than mothers, the odds ratio was higher, 8.612, 6.955, 14.248, 4.199 and 4.392, respectively for delayed vaccination. The Cox and Snell R² and Nagelkerke R² explains between 38.7% and 52.6% of the variance of all the above variables for timeliness of vaccination.

DISCUSSION

This descriptive cross-sectional study inferred that only 38.7% of the babies were vaccinated on time without any delay and 61.3% of the babies got over all delayed vaccination (delayed by more than 14 days). Proportion of “on time” vaccination for BCG and OPV 0 was 90.7%, while it was decreased as the immunisation schedule progressed.

In a study conducted by Laryea D O et al in a tertiary health services facility in Ghana, overall 87.3% of babies received vaccine on time, which was higher as compared to our study. However, the proportion of on-time vaccination for BCG and measles were 88.9% and 50.5%, which were comparatively lower as compared to our study.⁽¹²⁾ Another study conducted by Holambe VM et al at a tertiary care center of Maharashtra, 66% of the babies presented on time for vaccination, which was similar to our study.⁽¹⁷⁾

In our study, delayed vaccination was more when the age of the mothers were less than 30 years, i.e. 64.4% compared to mothers with age 30 years and above, but the difference was not significant. This finding was similar to a study conducted by Luman ET et al where mothers who all had age

more than 30 years got less severely delayed vaccination (17.9%) for babies as compared to mothers who had age of 20-30 years and less than 20 years (22.9% and 28.7%, respectively).⁽⁹⁾ Similar findings were observed by Holambe VM et al and Cotter JJ et al.^{(17),(18)}

Delayed vaccination was more in male babies (64.7%) as compared to female babies (54.8%) in our study. Similar findings were found by Holambe VM et al that females were vaccinated more (53.08%) on time as compared to males (46.92%) and this association was not significant (p value = 0.479).⁽¹⁷⁾ Another study conducted by Huggins L J on immunisation status of NICU graduates found no association between gender and immunisation.⁽¹⁹⁾

The association between education and timeliness of vaccination was highly significant. Similar findings were observed by Sadoh AE et al conducted a study on Nigerian infants and Luman ET et al where education played one important role for timeliness of vaccination.^{(20),(9)} Mothers with higher education group got more timely vaccination of babies as compared to lower education group.

Delayed vaccination was more in lower socioeconomic classes (83.2%) as compared to higher classes (37.9%) and the difference was significant. Similar findings were observed by Sadoh AE et al where on time vaccinations for class I, class II, class III and class IV were 75%, 52%, 50% and 25%, respectively and the difference was significant.⁽²⁰⁾

In this study, working mothers made more delayed vaccinations (67.6%) for their babies as compared to housemakers (60.5%). A study conducted by Rahji F R et al found that housewives got significantly less compliance in immunisation than working mothers.⁽²¹⁾

Mothers with less than 4 ANC visits had significantly more (79.3%) of delayed vaccinations for their babies as compared to mothers with more than 4 ANC visits (59.4%). A study conducted by Bisiriyu L et al in Nigeria observed similar results where women with 4 ANC visits plus got 50.8% full vaccination as compared to women with less than 4 ANC visits (12.5%).⁽²²⁾ There was a strong and significant relation observed by Meredith et al between number of ANC visits and EPI attendance.⁽²³⁾

The study showed a significant difference in delay in vaccination for children with lower birth order. This may be explained by the fact that mothers with high parity might have more experience on child rearing practices and better knowledge on immunisation. This is in contrary to studies done by Ramaswamy G et al, Fadness LT et al, Holambe VM et al where delayed vaccination was more common in higher birth order.^{(24),(11),(17)} Another study conducted by Nilanjan Patra in three states of India (Bihar, Tamil Nadu and West Bengal) found association of lower birth order with delayed vaccination, which is similar to our study findings.⁽²⁵⁾

In this study, delayed vaccination was more when time taken to reach IPC was more than 30 minutes. Similar results were found by Ndiritu M et al that immunisation rate ratio were reduced with every increasing kilometer of distance from home to vaccine clinic (HR = 0.95; CI = 0.91, 1.00).⁽²⁶⁾ Another study conducted by Xeuatvongsa A et al found that fully immunised proportion was significantly more when time taken to reach nearest health facilities was less than 30 minutes (69.52%) as compared to when it was more than 30 minutes (30.48%).⁽²⁷⁾

The proportion of delayed vaccination when used public transport (61.5%) or own vehicle/on foot (61.1%) as mode of transport was almost equal. In contrary to this, a study conducted by Vonasek BJ et al found higher odds (OR = 1.103) of full vaccination for those mothers/relatively rely on walking for transportation to vaccination facility.⁽²⁸⁾

Delayed vaccination was significantly higher when the babies were accompanied by relatives apart from mothers. This may be explained by the fact that mothers were more concerned about the health status of their own babies as compared to other relatives and the babies were more comfortable with their mothers as compared to other relatives.

Samples of the present study may not be representative of the population since we selected only one tertiary care center from Central India. Since, this was a descriptive cross-sectional study, a cause and effect relationship between timeliness of vaccination and risk factors was difficult to assess. In spite of these limitations, the study can give certain insight about the timeliness vaccination of the children of the Central India.

CONCLUSION

In this study, higher proportion of overall delayed vaccination was found in Central India. We also found that higher proportions of on-time vaccinations for BCG, OPV 0 and measles. Further, we found that mother's education, socioeconomic status, number of ANC visits, birth order and accompanied by mother or relatives affect the overall timely immunisation on a long run.

Socioeconomic development needs to be ensured. Special efforts has to be made to sensitise pregnant women about the importance of ANC visits, programs that will help women in developing familiarity with our healthcare systems; so that they can rely on our healthcare services again for the benefits of their children.

ACKNOWLEDGEMENT

We would like to thank all our IPC staffs for their support during the study and to the children and their caretakers who participated in this study.

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