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Original Research Article

A retrospective study on timeliness of vaccination among children aged 0 to 23 months in a rural area of Pondicherry

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ABSTRACT

Background: Immunization is the cost-effective public health intervention that prevents and protects against vaccine preventable diseases. The objective was to estimate the timeliness in receiving age appropriate vaccines and to study selected factors influencing the timeliness of age appropriate vaccines as per national immunization schedule among children aged 0 to 23 months in a rural area of Pondicherry.
Methods: A retrospective study was done at a Community Health Centre, Karikalampakkam, Pondicherry using data from immunization registers of children aged 0 to 23 months, who were born between July 01, 2013 to July 31, 2015. If the child was vaccinated within 7 days of the scheduled time, it was considered as timely vaccination.
Results: Out of 679 children, 52% were males and 48% were females. The median days of delay in vaccination were ranged from 1-171 days. The proportion and the median days of delay were increased progressively as the age of the child increased. The place of delivery was significantly associated with birth doses of OPV, Hepatitis B and BCG vaccination. There was a significant difference in timeliness of vaccination across the birth order of the children for the first, second and third doses of OPV and Pentavalent vaccines (p=0.02). Birth weight of the children was not statistically associated with vaccination delay.
Conclusions: Delay in vaccination in varying frequency was observed for the vaccines administered under the national immunisation schedule. Hence, the age-appropriate vaccinations should be given up-to-date as well as on time.

Keywords: Timeliness of vaccination, Pondicherry, Delayed vaccination, National immunization schedule

INTRODUCTION

Immunization is one of the world's most successful and cost-effective public health intervention that prevents and protects against vaccine-preventable diseases (VPDs).[1] To deliver a complete number of doses of potent vaccines in a timely, safe, and effective way to all children and women is the aim of our routine immunization programme.[2]

Our vaccination schedules are so designed to target the different ages for optimal immunization response with high population coverage to achieve high levels of vaccine effectiveness.[3] A significant delay in vaccination can potentially exist even with high vaccination coverage levels.[4]

Vaccination delay can affect the protective effect of vaccines during infancy and early childhood when the disease incidence and mortality are highest and it is a strong risk factor for pertussis and haemophilus influenzae type B invasive diseases.[4] Delay at vaccination may raise safety concerns depending on the age-related risk of adverse events i.e. rota shield vaccination against

Rotavirus, that was associated with an increased intussusception risk among children >12 weeks.[5]

Delayed vaccination also means that the sequence of vaccination is altered which may have implications for vaccine effectiveness.[4] Delayed vaccination has a consequence for the development of herd immunity and disease transmission.[3]

Assessment of delay in age-appropriate vaccination provides more information about the timeliness of vaccination than up-to-date vaccination coverage as they reflect the adequacy of protection.[6] Thus the timing of vaccination is important to access the performance of a vaccine programme.[5]

All these crucial findings point towards the lacunae in understanding the exact status about vaccination delay which will enable to plan and execute corrective steps to enhance the timely coverage of immunization.

Hence, the objective of the study was to estimate the timeliness in receiving age appropriate vaccines and to study selected factors influencing the timeliness of age appropriate vaccines as per national immunization schedule among children aged 0 to 23 months.

METHODS

A retrospective study was done at a community health centre (CHC), Karikalampakkam which is a Rural Health Training Centre of Indira Gandhi Medical College and Research Institute, Pondicherry. It caters for a population of 33,195 residing in 19 villages. Immunization clinics are conducted once in a week on Thursdays in CHC. The details of child's immunization are updated in both child immunization tracking card and immunization registers, which are maintained by the respective ANM in-charge and monitored by PHN and MO In-charge of CHC.

The study includes children aged 0 to 23 months, who were born between July 01, 2013 to July 31, 2015, and registered for immunization at CHC, Karikalampakkam. The children who expired and/or migrated and/or missed data were excluded.

The data includes parameters like child's date of birth, date of an individual dose of vaccine administered, gender, birth weight, birth order, place of delivery, mother's age & their economic status. The data were collected from the immunization registers using a data collection form from May 2018 to June 2018.

Delay in vaccination was operationally defined as delayed if the vaccination of the child took place beyond 7 days of the expected date, considering the immunization clinics are conducted once in a week in CHC.[7] If the child was vaccinated within 7 days of the scheduled time, it was considered as timely vaccination. Thus, timeliness of vaccination was estimated by subtracting the date of vaccine administered from the date at which it was supposed to be given as per national immunization schedule.[4]

Data were entered in Microsoft Excel version 2016 and analysed using SPSS software version 16.0. Proportions were used to summarize the study variables. The median duration of delay (in days) was calculated for each dose of vaccine administered and the proportion of delay was compared using nonparametric tests across the selected factors influencing the timeliness of vaccination.

Administrative approval was obtained from Deputy Director of Immunization and in-charge MO of CHC Karikalampakkam. The study was approved by Institute Ethics Committee of IGMC & RI, Pondicherry. As it was a record based study, obtaining informed consent was exempted.

RESULTS

A total of 772 children were registered and immunised at CHC, Karikalampakkam, between July 01, 2013 to July 31, 2015. The children who died, migrated and whose data missed from the registers are excluded (n=93). Out of 679 children, 52% were males and 48% were females. The mean age of the mothers was 25.15±3.6 years (SD) and 12.4% of them were aged 30 years and above. The majority (90%) of the deliveries were conducted at government institutions and most of them (75.6%) were belonged to below poverty line (BPL). It was observed that 8.7% were low birth weight babies (<2.5 Kgs). Based on the birth order of the children, 47.7% of them were first born whereas 41.5% were of second birth order and 10.8% belonged to the birth order of three and above (Table 1).

Table 1: Socio-demographic characteristics of the study participants (n=679).

Characteristics	N	%
Gender		
Male	353	52.0
Female	326	48.0
Economic status		
Below Poverty Line	513	75.6
Above Poverty Line	166	24.4
Place of delivery		
Government institutions	612	90.1
Private institutions	67	9.9
Birth weight		
< 2.5 Kgs	59	8.7
≥ 2.5 Kgs	620	91.3
Birth order		
1	324	47.7
2	282	41.5
≥3	73	10.8
Maternal age (years)		
< 30	595	87.6
≥ 30	84	12.4

Table 2: Distribution of delay in vaccination and median duration of delay (n=679).

National immunization schedule	Vaccines	Vaccinated with more than 7 days of delay from the due date (%)	Vaccinated with more than 14 days of delay from the due date (%)	Median days of delay in vaccination (IQR)
At birth	BCG *	14	14	1
At birth	OPV *	13	13	1
At birth	Hep B *	13	13	1
6 weeks	OPV 1 & Penta 1	45	13	7 (4-10)
10 weeks	OPV 2 & Penta 2	64	31	9 (5-16)
14 weeks	OPV 3 & Penta 3	78	48	14 (8-23)
9 months to 12 months	MCV (9mon)	81	58	18 (9-29)
	MCV (12mon)	1	1	72 (61-81)
16 months to 24 months	OPV b, DPT b1 & MMR (16 mon)	98	97	69 (56-82)
	OPV b, DPT b1 & MMR (23 mon)	0	0	171 (158-184)

***more than 1 day from the due date was considered as delayed vaccination.

Table 3: Factors associated with delayed vaccination of birth doses (n=679).

Factors	BCG			OPV			Hep B		
	Delayed N (%)	On time N (%)	P value*	Delayed N (%)	On time N (%)	P value*	Delayed N (%)	On time N (%)	P value*
Female babies	251 (37)	75 (11)	0.56	256 (38)	70 (10)	0.29	256 (38)	70 (10)	0.29
Delivery at government institutions	477 (70)	135 (20)	0.00	482 (71)	130 (19)	0.00	482 (71)	130 (19)	0.00
Economic status -BPL	401 (59)	112 (16)	0.02	401 (59)	112 (16)	0.12	401 (59)	112 (16)	0.12
Maternal age <30 yrs	460 (68)	135 (20)	0.03	462 (68)	133 (20)	0.13	462 (68)	133 (20)	0.13
Birth weight <2.5 kg	41 (6)	19 (3)	0.15	41 (6)	19 (3)	0.11	41 (6)	19 (3)	0.11
Birth order ≥2	261 (38)	94 (14)	0.11	265 (39)	89 (13)	0.25	265 (39)	90 (13)	0.18

* Chi-square test.

Table 2 depicts that the median days of delay in vaccination was ranged from 1-171 days. There was a 13% delay in vaccination for birth doses of OPV and hepatitis B and 14% delay for BCG with more than 24 hours of delay. The maximum proportion and duration of the delay were observed for booster doses of OPV, DPT and MMR vaccines. The proportion of delay in vaccination was higher when vaccinated with more than 7 days of delay to compare with more than 14 days of delay from the due date. The proportion of children with delayed vaccination and the median days of delay were increased progressively as the age of the child increased. Among the study participants, the delay in vaccination was higher at the lower range of the recommended age as compared to the upper range. For MCV, the delay was 81% at 9 months as compared to 1% at 12 months (Table 2).

Statistically, the place of delivery was significantly associated with birth doses of OPV, hepatitis B, BCG, first and second doses of OPV and Pentavalent vaccination. It was observed that even though 90% of the deliveries were conducted at government institutions, 70% of them were delayed for BCG vaccination (p=0.00). The delay in BCG vaccination was also significantly associated with their economic status and maternal age (Table 3).

There was a significant difference in timeliness of vaccination across the birth order of the children for the first, second and third doses of OPV and Pentavalent vaccines as well as first dose of MCV vaccines. About 42% out of 52% of the study participants of the birth order of two and above were delayed for the third dose of OPV and Pentavalent vaccination. (p=0.02) (Table 4).

It was observed from table 5 that there was no significant association between vaccination delay and the selected factors for the booster doses of OPV, DPT and MMR. Among 679 study participants, 81% were delayed for MCV at 9 months and 44% out of 81% were birth order of two and above and statistically significant (p=0.00). Birth weight of the children was not statistically associated with vaccination delay.

Table 4: Factors associated with delayed vaccination of 1st, 2nd and 3rd doses of OPV and Pentavalent vaccines (n=679).

Factors	OPV 1 & Penta 1			OPV 2 & Penta 2			OPV 3 & Penta 3		
	Delayed N (%)	On time N (%)	P value*	Delayed N (%)	On time N (%)	P value*	Delayed N (%)	On time N (%)	P value*
Female babies	151 (22)	175 (26)	0.44	201 (30)	125 (18)	0.24	251 (37)	75 (11)	0.70
Delivery at government institutions	282 (42)	330 (49)	0.04	401 (59)	211 (31)	0.00	476 (70)	136 (20)	0.76
Economic status - BPL	238 (35)	275 (41)	0.14	340 (50)	173 (25)	0.02	405 (60)	108 (16)	0.14
Maternal age <30 yrs	267 (39)	328 (48)	0.89	387 (57)	208 (31)	0.10	465 (68)	130 (19)	0.37
Birth weight <2.5 kg	28 (4)	32 (5)	0.76	40 (6)	20 (3)	0.64	45 (7)	15 (2)	0.61
Birth order ≥2	180 (27)	175 (26)	0.00	245 (36)	110 (16)	0.00	288 (42)	67 (10)	0.02

* Chi-square test

Table 5: Factors associated with delayed vaccination of MCV & booster doses of OPV, DPT & MMR (n=679).

Factors	MCV (9 mon)			MCV (12 mon)			OPV b, DPT b1 & MMR (16 mon)			OPV b, DPT b1 & MMR (24 mon)		
	Delayed N (%)	On time N (%)	P value *	Delayed N (%)	On time N (%)	P value **	Delayed N (%)	On time N (%)	P value	Delayed N (%)	On time N (%)	P value **
Female babies	262 (39)	64 (9)	0.90	2 (0)	324 (48)	0.11	321 (47)	5 (1)	0.66*	0 (0)	326 (48)	0.50
Delivery at government institutions	497 (73)	115 (17)	0.20	9 (1)	603 (89)	1.00	602 (89)	10 (1)	0.34**	1 (0)	611 (90)	0.19
Economic status –BPL	419 (62)	94 (14)	0.20	7 (1)	506 (75)	0.71	505 (74)	8 (1)	0.47**	0 (0)	513 (76)	0.06
Maternal age <30 yrs	482 (71)	113 (17)	0.43	10 (1)	585 (86)	0.62	585 (86)	10 (1)	0.65**	1 (0)	594 (87)	0.23
Birth weight <2.5 kg	44 (6)	16 (2)	0.14	1 (0)	59 (9)	0.61	58 (9)	2 (0)	0.29**	0 (0)	60 (9)	1.00
Birth order ≥2	302 (44)	53 (8)	0.00	7 (1)	348 (51)	0.35	350 (52)	5 (1)	0.46*	1 (0)	354 (52)	1.00

*****Chi-square test ** Fisher's exact test

DISCUSSION

This retrospective study conducted at a Community Health Centre of Pondicherry reflects the timeliness of vaccination among the children aged 0-23 months in a rural area. In the present study, 52% were males and 48% were females. 324 (47.7%) out of 679 study participants were first order child. The distribution of the study participants was similar to the study done by Ramaswamy et al in the primary care setting of Pondicherry.[8] The mean age (±SD) of the mothers was 25.15 years (±3.6 years). The study conducted at the Urban Health Training Centre, Mumbai showed that the mean age of the mothers was 23.15 years (range 18-32).[7] These differences might be due to the changes in the cultural practices related to the childbirth in the rural and urban areas of India.

Our study observed the median duration of delay for the first, second and third doses of OPV and Pentavalent vaccines and MCV (9 months) were 7,9,14 and 18 days respectively. The study done by Ramaswamy et al reported 6,13,19 and 11 days of delay respectively for the same vaccines.[8] In the present study, considering vaccination with more than 14 days of delay from the due date, the proportion of children whose vaccination were delayed for the first, second and third doses of OPV and Pentavalent vaccines and MCV (9 months) were 13%, 31%, 48% and 58% respectively. Using the same period of delay, 7.4%, 41.9%, 64.5% and 38.8% of the children were delayed respectively for the same vaccines in the study done by Ramaswamy et al.[8] The reduction in the proportion and the duration of the delay in vaccination might be due to the improved health services in the study setting.

As there was no standard definition for delayed vaccination, we considered "if the vaccination of the child took place beyond 7 days of the expected date as delayed vaccination, except for birth doses where one day cut off was considered as delayed.[7]

For the first, second and third doses of OPV and Pentavalent vaccines and MCV (9 months), the proportion of children vaccinated with more than 7 days of delay from the due date were 45%, 64%, 78% and 81% respectively. The study conducted by Dyavarishetty et al found 25%, 25%, 34% and 60% of delay for the same vaccines respectively.[7] Other studies revealed the regional inequalities in the timeliness of vaccination.[9] Access to the health facilities may be different in these study settings.[8]

The delay for BCG vaccination was 14% and it was statistically significant with their maternal age and the place of delivery.[7] It would have been expected that almost all babies should have received BCG vaccines on-time since they were born in a health facility.[10] On time vaccination increases with maternal age, which has been attributed to the experience of the mothers over the time on the importance of vaccination and also on fatalities that might have occurred to children who were not vaccinated.[9] The economic status of the study participant was significantly associated with the delay in BCG vaccination.[11] Birth weight of the children was not significantly associated with the timeliness of vaccination.[11]

There was male predominance in delayed vaccination in the current study. The study conducted at PHC, Nellimarla showed similar results.[12] There was no statistical significance in delayed vaccination based on gender. The same findings were noted elsewhere in India.[8,11]

The current study also found out a significant difference in the delay for the third dose of OPV and Pentavalent vaccination and children with birth order of two and above. These findings were corresponding to the study done in Pondicherry.[8] The decreased parental worries on the older children may influence the timeliness the vaccination.[13]

Our study was based on the high-quality reliable data from the CHC, Karikalampakkam, where the ANMs are giving vaccines to the children and maintaining the immunization registers by themselves under the regular supervision of the in-charge MO. Owing to the fact that it was a record based study, the other factors that may influence the timeliness of the vaccination like the type of the family, education and occupation of the mothers and their family income were not elicited.

As it was a facility-based study, the children who were not registered in this CHC were not studied. That may limit the generalisability of the study findings. Timely vaccination should be emphasised in addition to up-to-date vaccination by health interventions like mandatory certification of birth dose vaccination on discharge from the health facility, health education to the mothers, and regular training of health care providers on timely vaccination.

CONCLUSION

Depending on the operational definition used, there was varying proportion of delay in vaccination observed among the beneficiaries. Hence, the age-appropriate vaccinations should be given up-to-date as well as on time.

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