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Original Research Article

Evaluation of primary immunization coverage among children in a rural block of district Rohtak, Haryana, India

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ABSTRACT

Background: Vaccination is the most important preventive and cost-effective intervention to decrease morbidity and mortality rates in children. Every year, vaccination averts an estimated 2-3 million deaths from diphtheria, tetanus, pertussis and measles. These are all life threatening diseases that disproportionately affect children. An estimated 1.5 million children die annually from diseases that can be prevented by immunization. In the past 50 years, vaccination has saved more lives worldwide than any other medical products or procedures. The objectives of the study were to evaluate primary immunization coverage along with 1st dose of Vitamin-A supplementation coverage, age-appropriate immunization and also to know the reasons for partial or non-immunization among children.
Methods: Community-based cross sectional study was conducted among 540 children in the rural area of Rohtak, Haryana during June 2015-May 2016. Information was collected from the mothers regarding immunization status of their children aged 12-23 months old and socio-demographic variables using a semi-structured interview schedule.
Results: 395 (73.15%) of 12-23 months old children were fully immunized and the rest 145 (26.85%) were partially immunized. The major reason for drop-out rate was found to be unawareness regarding need for immunization. Immunization coverage was found to be significantly associated with the presence of immunization card and literacy level of mothers.
Conclusions: Though the immunization coverage showed improvement through intensive immunization campaigns in recent years, still a lot needs to be done to increase awareness regarding importance of full immunization at the right time as mentioned in the National Immunization schedule (NIS).

Keywords: Immunization, Coverage, Cluster, Age-appropriate

INTRODUCTION

Vaccination is the most important preventive and cost-effective intervention to decrease morbidity and mortality rates in children. Vaccines have already saved many lives and they have the potential to save many more as increasingly elaborate technologies deliver new and effective vaccines against both infectious diseases—for which there are currently no effective licensed vaccines such as malaria, tuberculosis, and HIV and non-infectious diseases such as hypertension and diabetes.[1]

Every year, vaccination averts an estimated 2-3 million deaths from diphtheria, tetanus, pertussis (whooping cough) and measles. These are all life threatening diseases that disproportionately affect children. Approximately 17% of deaths in children under five are vaccine-preventable. An estimated 1.5 million children

die annually from diseases that can be prevented by immunization. In India, around 2.7 crore newborns are targeted for vaccination each year through 90 lakh immunization sessions held annually. The very low risk of an adverse event caused by a vaccine outweighs the risk and cost of illness and complications caused by natural infections.[2]

Today, millions of children world over routinely get vaccines for protection against many killer diseases and many of these diseases are at their lowest level in history and disease like polio is on the verge of eradication globally.[3] With the exception of safe water, no other modality, not even antibiotics, has had such a major effect on mortality reduction and population growth. In the past 50 years, vaccination has saved more lives worldwide than any other medical products or procedures.[4] The poorest, most vulnerable children who need immunization the most, continue to be the least likely to get it.[5] Age-inappropriate vaccination impacts adversely especially on the effectiveness of India's measles immunization program due to sub-optimal sero-conversion, if given premature, and increased vulnerability to vaccine preventable diseases, if delayed.

The Indian government declared 2012–2013 to be a period of intensification in childhood immunization, with a focus on remote and often inaccessible rural areas, urban slums and migrant and mobile communities. Subsequently, in December 2014, India's Ministry of Health and Family Welfare launched Mission Indradhanush with the aim to vaccinate all pregnant women against tetanus and ensure that all children are fully vaccinated against seven vaccine-preventable diseases before they reach an age of two years.

In view of this, it was necessary to undertake this study to determine primary immunization and 1st dose of Vitamin-A supplementation coverage, fully understand the reasons for partial or non-immunization of children and finding out age-appropriate immunization coverage as per national immunization schedule (NIS).

METHODS

A community-based cross-sectional study was conducted under CHC Chiri, Block Lakanmajra, which is the rural field practice area of Department of Community Medicine, PGIMS Rohtak, Haryana, India. The study was carried out during 1st June 2015 to 31st May 2016. About 540 children in 12-23 months age group were selected from areas under 30 Anganwadi centres (AWCs) taken as clusters out of total of 125 AWCs located in 28 villages under CHC Chiri by two-stage cluster sampling technique based on probability proportional to size (PPS).

Exclusion criteria

- Mothers unwilling to participate in the study.
- Mothers living in the area for less than 6 months period.

Sample size

- To estimate the sample size for immunization coverage, following formula was used-

$$N = Z^2 \times P(1-P) / L^2$$

Where,

N= required sample size; Z= value for selected alpha level (Type 1 error) of 0.005 = 1.96;
P= prevalence of immunization coverage in rural area = 60.3% (NFHS-3 Haryana data);[6]
L= desired level of relative precision of estimates ± 10%.

To ensure the adequacy of the sample, proportion of fully immunized children (P), aged 12-23 months, according to National Family Health Survey-3 Haryana (NFHS-3) is 60.3%. A confidence limit of 95% and relative precision (d) of 10% of prevalence was taken for the calculation of sample size {(3.84×0.6×0.4)/ (0.1×0.1×0.6×0.6) = 256.10 ≈ 256}. This was then multiplied by the design effect of 2 to account for cluster randomization. Thus the minimum sample size required was calculated to be = 256 × 2 = 512. This was then further increased to 540 to distribute equal number of children in each of the 30 clusters.

Thus, the number of children selected per cluster was therefore 540/30=18 children. If the required 18 eligible children could not be found in the selected cluster then the area just adjacent to the cluster was taken to complete the sample size.

Data collection

Either parent of children aged 12-23 months old, preferably mothers, were the primary respondent. In case of absence of mother, father was taken as the respondent. In case of absence of both parents, the adult in the household who remained with the child for most of the time or had taken the child for immunization on at least one occasion, he/she was taken as the respondent to get the desired information and thus was interviewed.

The investigator conducted the study by door to door visits to gather the information using semi-structured schedule. All the respondents of study subjects were fully informed about the purpose of study and then written consent was taken before conducting the interview.

To ascertain the information regarding immunization, the respondents were asked to produce immunization/ mother and child protection (MCP) card. In case of unavailability of the card, the information regarding the administration of vaccines was recorded on the basis of the respondent's memory. The respondents of those children who were

partially immunized or unimmunized were interviewed about the reasons of refusal and dropouts to the immunization.

Following criteria for full, partial and unimmunized child was used:[7]

- Fully immunized: Any child who had received one dose each of BCG and Measles, and three doses each of Pentavalent vaccine and Polio (excluding Polio 0-dose) by one year of age.
- Partially immunized: Any child who received atleast one dose of vaccination by one year of life, but did not complete all the required doses.
- Unimmunized: If a child had never received any of the vaccines up to one year of age.

The coverage of immunization will be calculated as:

Coverage = (Fully immunized children / 540) × 100
Drop-out rate will be calculated by using formula:[8]

- For full immunization dropouts: (BCG – Measles) × 100 / BCG
- For Pentavalent dropouts: (Pentavalent1 – Pentavalent3) × 100 / Pentavalent1
- For OPV dropouts: (OPV1- OPV3) × 100 / OPV1
- For measles dropouts: (Pentavalent1 – Measles) × 100 / Pentavalent1

Data analysis

The collected data was entered in Microsoft Excel and analyzed using SPSS (Statistical Package for Social Science) software for Windows version 20.0. Categorical data was presented as percentage (%). Chi-square test of significance was applied to test the association between various variables and status of immunization coverage. Normal distributed data was presented as means and standard deviation, or 95% confidence intervals (CI). All tests were performed at a 5% level significance, thus an association was statistically significant if the value was less than 0.05 (P value <0.05).

RESULTS

In the study, more than two-fifth of mothers were in the age group of 21-25 years with mean age of 24.78 years ± 3.555. The mothers in the age group of 26-30 years had more than half of female children (52.89%) whereas majority of mothers in age group of 16-25 years had male children (Table 1).

More than three-fourth of all mothers (78.15%) belonged to joint family and only 4.07% belonged to nuclear family. The majority of mothers (82.59%) visited Anganwadi centre for immunization services of their children on 2 or more than 2 occasions (Table 2).

Around three-fourth of children under study (73.15%) were fully immunized till one year of age whereas partially immunized children were found to be 26.85%. However, no unimmunized child was found during the study period. Out of fully immunized children majority were males (71.89%) as compared to females (28.11%) whereas out of partially immunized children, females were more (68.28%) as compared to males (31.72%) (Table 3).

Table 1: Age of mothers and gender-wise distribution of study subjects (n=540).

Gender	Age(years)		
	16-20	21-25	26-30
Males	57 (77.03)	167 (69.29)	106 (47.11)
Females	17 (22.97)	74 (30.71)	119 (52.89)
Total	74 (100)	241 (100)	225 (100)

Figures in parentheses indicate percentage.

Table 2: Distribution of mothers according to various parameters (n=540).

Parameters	Frequency
Family size	
1 child	205 (37.96)
2 children	260 (48.15)
3 children	75 (13.89)
Type of family	
Nuclear	22 (4.07)
Joint	422 (78.15)
Three generation	96 (17.78)
Socio-economic grade (Udai-Pareek scale)	
Upper Middle (Grade-II)	23 (4.26)
Lower Middle (Grade-III)	338 (62.59)
Upper Lower (Grade-IV)	179 (33.15)
Literacy status of mother	
Illiterate	15 (2.78)
Read and write	5 (0.93)
Primary	76 (14.07)
Middle	177 (32.78)
High school	81 (15)
Graduate and above	186 (34.44)
Occupation status of mother	
Unemployed	533 (98.7)
Labourer	1 (0.19)
Independent profession	6 (1.11)
Preferred place for immunization services	
District Hospital	5 (0.93)
Primary Health Centre	2 (0.37)
Sub-Health Centre	87 (16.11)
Anganwadi centre	446 (82.59)

Figures in parentheses indicate percentage.

It was found that BCG coverage was highest (97.4%) as compared to coverage of all other vaccine antigens among the study subjects. The coverage for all 3 doses of pentavalent and OPV vaccines were found to be 95.93% and 89.07% respectively among study subjects. About

4.07% (22/540) study subjects did not visit health centre for third dose of pentavalent and OPV vaccinations. About 6.85% (37/540) of study subjects missed either 1 or all the 3 doses of OPV vaccination due to some reasons.

The coverage for Measles vaccination (83.89%) was found to be lowest as compared to coverage of other vaccine antigens and about one-third (33.33%) of study subjects were left out from 1st dose of Vitamin-A supplementation given with Measles vaccine to children at the age of completed 9 months (Table 4).

Table 3: Immunization status according to gender of children (n=540).

Immunization status	Children					
	Males		Females		Total	
	Number	Percent	Number	Percent	Number	Percent
Fully immunized	284	71.89	111	28.11	395	73.15
Partially immunized	46	31.72	99	68.28	145	26.85

Table 4: Coverage of individual vaccine antigens among children. (n=540).

Coverage	BCG	Pentavalent	OPV	Measles	Vitamin-A (1st dose)
Three doses	-	518 (95.93)	481 (89.07)	-	-
Two doses	-	22 (4.07)	56 (10.37)	-	-
One dose	526 (97.4)	-	-	453 (83.89)	360 (66.67)
Nil	14 (2.6)	-	3 (0.56)	87 (16.11)	180 (33.33)
Total	540 (100)	540 (100)	540 (100)	540 (100)	540 (100)

Figures in parentheses indicate percentage.

Table 5: Children showing age-appropriate (timely) immunization.

Vaccine antigen	Children who received Age-appropriate immunization
BCG	480 (88.89)
Pentavalent-1	356 (65.93)
OPV-1	356 (65.93)
Pentavalent-2	334 (61.85)
OPV-2	334 (61.85)
Pentavalent-3	299 (55.37)
OPV-3	299 (55.37)
Measles	298 (55.19)

Figures in parentheses indicate percentage.

Table 6: Distribution of mothers having immunization card at the time of visit.

Immunization card availability	Number	Percent
Available with (a) complete entries	180	33.33
(b) incomplete entries	205	37.96
Present but unable to produce	70	12.96
Never had card	85	15.74
Total	540	100

The children who received age-appropriate (timely) immunization were being highest for BCG vaccination (88.89%) as compared to other vaccinations. The lowest values were observed for 3rd dose of pentavalent/ OPV vaccinations (55.37%) and for Measles vaccination (55.19%). Overall age-appropriate primary immunization for all the antigen vaccines was found only in 39.26% (212/540) of children (Table 5).

The immunization card was available with 71.29% (385/540) of study subjects, out of which majority cards (205/385) had incomplete entries.

About 28.70% (155/540) children did not have immunization card at the time of visit, out of which majority children (85/155) were never given immunization card by the heath-workers (Table 6).

The drop-out rate was highest for pentavalent-1 to measles (16.11%) whereas drop-out rates for BCG to measles and OPV-1 to OPV-3 were 13.88% and 10.93% respectively. The value for pentavalent (1-3) drop-out rate was 4.07% (Table 7).

The majority of partially immunized children missed some of the vaccine antigens during 1st year of life due to either lack of awareness of importance/need of full immunization as believed by the mothers (44.14%), followed by lack of availability of vaccines at the healthcare centres (33.79%) on their day of visits, children were not brought for session when got sick due to any minor illness (10.34%). Other reasons were health-worker was rude (6.89%), mother was busy in domestic work and session site was too far from home (4.14%) and in the rest cases sessions were not held (0.69%) (Figure 1a).

Table 7: Dropout rates among study subjects.

Dropout rate	Percent
Pentavalent-1 to Pentavalent-3	4.07
OPV-1 to OPV-3	10.93
BCG to Measles	13.88
Pentavalent-1 to Measles	16.11

Table 8: Association of immunization status with its various determinants.

Variable	Fully immunized	Partially immunized	P value*
Socio-economic grade			0.212
1) Grade-II	16	7	
2) Grade-III	256	82	
3) Grade-IV	123	56	
Type of family			0.002
1) Nuclear	11	11	
2) Joint	322	100	
3) Three generation	62	34	
Immunization card			0.894
1) Available	281	104	
2) Unavailable	114	41	
Mothers Literacy status			<0.00001
1) Upto Middle school	224	49	
2) Higher education	171	96	

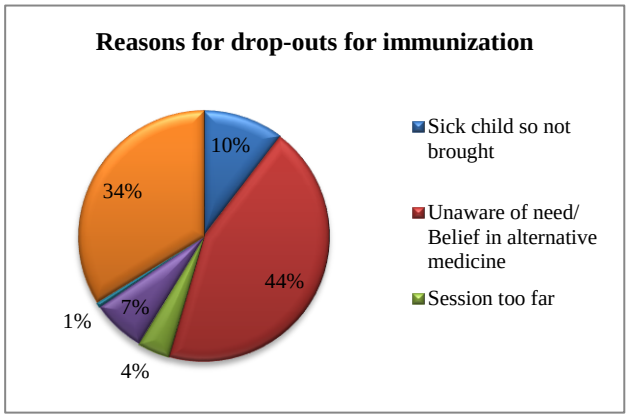

Figure 1(a): Mothers responses of partially immunized children regarding reason for dropouts for immunization.

Similarly out of 180/540 (33.33%) children who were left from 1st dose of Vitamin-A supplementation, majority of children (59.44%) were denied due to unavailability of Vitamin-A syrup, followed by lack of awareness of its importance/need (29.44%) (Figure 1b).

A significant association was found between immunization statuses of children with the literacy status of mothers (P <0.05). The relation between type of family and the immunization status was also found to have significant association (P <0.05). The most likely reason for this was found that if any mother was busy due to some household work on some occasions then other family members could bring the child for immunization sessions.

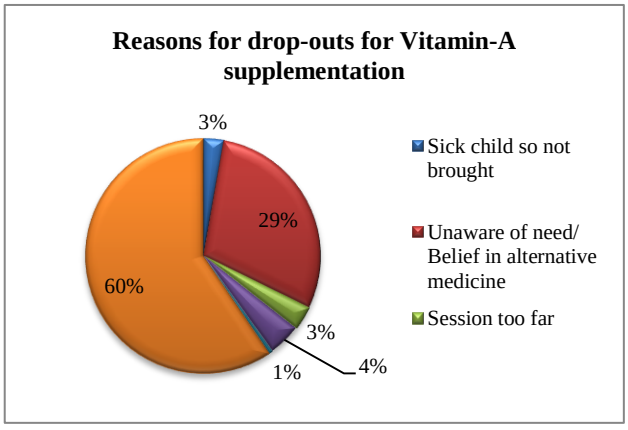

Figure 1(b): Mothers responses regarding reason for dropouts for 1st dose of Vitamin-A supplementation.

However, the relation of immunization status with socio-economic status and immunization card availability were found to be statistically non-significant (Table 8).

DISCUSSION

This study describes primary immunization and 1st dose of Vitamin-A supplementation coverage, the factors responsible for partial or non-immunization along with emphasizing on the role of timely age-appropriate immunization among children by one year of age.

In the present study, 73% (395/540) children were fully immunized which was somewhat greater than the immunization coverage reported by NFHS-3 Haryana data (2005-06) 65.3%. This has probably been due to increase intensification of immunization activities and special immunization drives as part of Mission Indradhanush which was launched in December 2014. The introduction of penatvalent vaccine in Haryana in 2013 also favoured compliance and utilization of health services by parents.

Around three-fourth fully immunized children were males; whereas 68% (99/145) partially immunized children were females. Kadri et al in 2006 also found similar results in their study that more number of male children was fully immunized whereas more number of female children was partially immunized.[9] The relation of immunization status with the gender of child was found to be non-significant (P >0.05).

The present study results were in contrast to the study conducted by Jain et al in rural areas of Alwar district of Rajasthan in 2006, in which it was found that only 28.9% were fully immunized whereas 26.5% were non-immunized and 44.5% were partially immunized.[10] The increase of partially and unimmunized children were due to increase rates of home deliveries by untrained dais and poor registration of births by health-workers as mentioned in the study.

Majority of male children (167/330) belonged to mothers in the age group of 21-25 years whereas majority of female children (119/210) belonged to mothers in the age group of 26-30 years. (Table 1) Similar findings were observed in studies done by Kadri et al and Chaudhary et al in which fully immunized children were higher in males than in females, however the difference was not found to be statistically significant.[9,11] The reason could be due to regional variation and survey technique. The another reason could be skewed sex ratio and negative attitude of some parents in most of the rural areas who still believe that there is not much need to fully immunize girl child as compared to boy child.

It is found that majority of mothers who had 2 or 3 children were able to fully immunize their children due to either increase in awareness about importance of immunization or male gender of last child born to them.

In our study majority of study subjects belonged to joint family (78.17%), followed by three-generation family (17.78%) and nuclear family (4.07%). This has showed statistical significance between the type of family and the immunization status of children. (Table 8) Our study finding was in contrast to the study done in urban areas by Chaudhary et al.[11]

In our study, the majority of children having mothers in the group of 21-30 years were fully immunized, probably due to the reason that with increase in age and literacy status, the mothers get to know more and can take independent decisions without any family pressure, to fully immunize their children. Our study results were in contrast to the study done by Angadi et al, in which about more than half (50.32%) of total mothers were illiterates.[12] The association between immunization status and mothers literacy status was found to be statistically non-significant. The lack of proper information and required motivation by the health-workers were stated as one of the important reasons given by the mothers in their study. This was also evident from the finding mentioned in the study that the sources of information regarding immunization among majority of the respondents were family members and relatives (42.48%), followed by health workers such as ANMs or AWWs (34.19%) and doctors (17.42%). Only 16.67% of the children whose sources of information were family members or relatives were completely immunized.

In the present study, it was also found that about 28.71% (155/540) mothers did not have MCP cards with them, out of which 54.84% (85/155) had never been given MCP cards for keeping record of immunization status of their children (Table 6). This was however due to irregular and inadequate supply of MCP cards on most of the occasions at sub-centres.

The increased coverage of BCG vaccination out of all other primary vaccinations could be due to increase in institutional deliveries during the past decade as evident from the NFHS-3 Haryana (2005-06) and NFHS-4 Haryana (2015-16) data which have shown greater increase in number of institutional deliveries from 35.7% to 80.5%. The data have also shown increase in BCG coverage from 84.9% to 92.8% in last decade. It is well known that almost all children who are delivered at tertiary health-care institutions especially in public sector are provided with BCG vaccination soon after delivery. The findings were in contrast to the study done by Jain et al in 2006 in which BCG coverage was found to be only 55.9%. The reasons for this were either poor birth registrations or due to most of the home deliveries being conducted under the supervision of untrained midwives as mentioned in the study.[10]

The coverage with 3doses of Pentavalent vaccine was 95.93% whereas rest 4.07% children missed one dose before the age of one year. Our study results were almost consistent with the studies conducted by Adhikary et al

and Gupta et al in 2011.[13,14] The findings suggest that the reason for small number of children who are left from availing all the 3 doses of vaccine could probably be due to mothers finding difficult to remember the triple dose schedule of the vaccine given during infancy as highlighted by Nath et al in their study.[15]

The present study showed only about 66.67% children were provided with 1st dose of Vitamin-A supplementation with Measles vaccination. The major reasons for absence of full coverage were found to be unavailability in adequate supply of Vitamin-A syrup bottles (59.44%) followed by unawareness of need/ importance (29.44%). Kadri et al in their study observed that coverage was about only 47.8%, whereas study by Odomani et al found coverage to be about 86.2%.[9,16]

The present study also had an important element of assessing age-appropriate primary immunization coverage of individual vaccine antigens. Based on the nationally recommended schedule, "timeliness of vaccination" was calculated based on data from those with MCP card and could represent those children only. In the present study, results have showed that timely age-appropriate immunization for BCG vaccine was about 88.89% (480/540), Pentavalent-1/OPV-1 vaccines was 65.93% (356/540), Pentavalent-2/OPV-2 vaccines was 61.85% (334/540), Pentavalent-3/OPV-3 vaccines was 55.37% (299/540) and Measles vaccine was 55.19% (298/540) in children. Overall age-appropriate immunization by all the vaccine antigens by one year of age was only in about 39.26% (212/540) children. The findings in our study were similar to the study done by Cakir et al, in which timely age-appropriately vaccination for BCG, DPT-3, OPV-3 and Measles were 87.2%, 67%, 63.9% and 77.9% respectively.[17] Shrivastwa et al found in their study that timely administration of BCG, DPT-3 and Measles vaccines among children were present in 31%, 19% and 34% respectively.[18]

It has been seen through various studies that if vaccines are given at right time and in correct doses through correct technique, effectiveness of vaccine antigens substantially increase in inducing adequate immune response in the body of children. It was also observed from the study done by Adhikary et al that first-born child, mother's literacy and domiciliary visit of health-workers were significantly related to age-appropriate vaccination among children.[13]

In our study, the reasons for drop-outs for primary immunization in children according to mothers were found to be unawareness regarding need for full immunization (44.14%) followed by denial due to lack of adequate availability of vaccines or other logistics (33.79%). Odomani et al also observed in their study that most frequently reported reason for non-vaccination in both rural (38.46%) and urban areas (33.33%) was unawareness for the need of immunization.[16] About 15.38% of rural and 27.78% of urban mothers were unaware of the need to return for the 2nd or 3rd doses. Other reasons were the family problems including illness of the mother (12.9%), illness of the child (9.67%) and fear of side effects (16.13%). Yadav et al, in their study also observed main reason as ignorance in mothers (80%) and inconvenience in the rest.[19] Gidado et al, found in their study that lack of knowledge (65.9%) was the major reason for non-vaccination.[20]

The rise in unawareness regarding importance of need for full immunization was the major reason in most of the studies conducted under different study settings. This problem can be tackled by increase in Information, Education and Communication (IEC) and, social mobilization activities by health workers, along with ensuring their proper periodical trainings through capacity building. Political commitment in ensuring regular supply of vaccines and other logistics at all the peripheral health centres is also must for continuing Immunization programme successfully in the country.

The strengths in this study compared to other studies:

- The effort was made to take large sample size for generalizability and increasing validity unlike most studies done using traditional WHO 30 by 7 cluster sampling technique.
- The study has highlighted importance of age-appropriate immunization among children during field study for which not many studies in Indian context are available.

CONCLUSION

Thus, it can be concluded from the observations made by the present study towards a pressing need to accelerate efforts in improving the immunization coverage in the area. The immunization status was found to be associated with mother's literacy and type of family. The importance of immunization among mothers was found to be poor, and thus needs to be looked into. This highlights the need of strengthening health services by periodical trainings of health-workers. The need of the hour is to make routine immunization a "felt need" of the community for achieving the goal of full immunization coverage.

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