Original Article

Evaluation of Immunization Coverage in the Rural Area of Pune, Maharashtra, Using the 30 Cluster Sampling Technique

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Abstract

Background: Infectious diseases are a major cause of morbidity and mortality in children. One of the most cost-effective and easy methods for child survival is immunization. Despite all the efforts put in by governmental and nongovernmental institutes for 100% immunization coverage, there are still pockets of low-coverage areas. In India, immunization services are offered free in public health facilities, but, despite rapid increases, the immunization rate remains low in some areas. The Millennium Development Goals (MDG) indicators also give importance to immunization. **Objective:** To assess the immunization coverage in the rural area of Pune. **Materials and Methods:** A cross-sectional study was conducted in the field practice area of the Rural Health Training Center (RHTC) using the WHO's 30 cluster sampling method for evaluation of immunization coverage. **Results:** A total of 1913 houses were surveyed. A total of 210 children aged 12-23 months were included in the study. It was found that 86.67% of the children were fully immunized against all the six vaccine-preventable diseases. The proportion of fully immunized children was marginally higher in males (87.61%) than in females (85.57%), and the immunization card was available with 60.95% of the subjects. The most common cause for partial immunization was that the time of immunization was inconvenient (36%). **Conclusion:** Sustained efforts are required to achieve universal coverage of immunization in the rural area of Pune district.

Keywords: 30 cluster sampling technique, coverage evaluation, dropout, primary immunization

Introduction

Infectious diseases are a major cause of morbidity and mortality in children. One of the most cost-effective and easy methods for the healthy well-being of a child is immunization. The goal of immunizing children against Tuberculosis, Polio, Diphtheria, Pertussis, Tetanus, Hepatitis B, and Measles, responsible for child mortality and morbidity, is indeed a noble one.[1] The most important indicators mentioned in the Millennium Development Goals (MDGs) for which India is a signatory, are the under-five mortality rate (U5MR), Infant Mortality Rate (IMR), and proportion of one-year-old children immunized against measles (P1MV). About one-quarter or 25% of the under-five mortality is due to vaccine-preventable diseases.[2] In May 1974, the World Health Organization (WHO) officially launched a global immunization program known as the Expanded Program of Immunization (EPI), to protect all the children of the world against six vaccine-preventable diseases, by the year 2000. EPI, launched in India in January 1978, was re-designated as the Universal Immunization Program (UIP). UIP has been able to avert many deaths because of the six childhood diseases since 1985.[3] The UIP was started in India with the aim of achieving at least 85% coverage of the primary immunization of infants, that is, with three doses of Diphtheria, Pertussis, Tetanus (DPT) and Oral Polio Vaccine (OPV), one dose of Bacillus Calmette–Guérin (BCG), and one dose of measles, by the year 1990 [Table 1]. According to the National Population Policy (NPP) universal immunization of children against all vaccine-preventable diseases should be achieved.[4] Despite all the efforts put in by the governmental and non-governmental institutes for 100% immunization coverage, there are still pockets of low coverage areas. In India, immunization services are offered free in public health facilities, but despite rapid increases, the immunization rate remains low in some areas. According to the National Family

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Table 1: National immunization schedule (NIS) for infants, children in India

Vaccine for infants	When to give	Dose	Route	Site
BCG	At birth or as early as possible till one year of age	0.1 ml (0.05 ml until 1 month age)	Intradermal	Left Upper Arm
Hepatitis B***	At birth or as early as possible within 24 hours	0.5 ml	Intramuscular	Anterolateral side of the mid-thigh
OPV-0	At birth or as early as possible within the first 15 days	2 drops	Oral	Oral
OPV 1,2, and 3	At 6 weeks, 10 weeks, and 14 weeks	2 drops	Oral	Oral
DPT 1,2, and 3	At 6 weeks, 10 weeks, and 14 weeks	0.5 ml	Intramuscular	Anterolateral side of the mid thigh
Hepatitis B 1, 2 and 3***	At 6 weeks, 10 weeks, and 14 weeks	0.5 ml	Intramuscular	Anterolateral side of the mid thigh
Measles	Nine completed months – 12 months. (give up to 5 years if not received at 9-12 months age)	0.5 ml	Subcutaneous	Right upper Arm
Vitamin A (first dose) For Children	At 9 months with measles	1 ml (1 lakh IU)	Oral	Oral
DPT booster	16-24 months	0.5 ml	Intramuscular	Anterolateral side of the mid thigh
OPV Booster	16-24 months	2 drops	Oral	Oral
Japanese Encephalitis*	16-24 months with DPT/OPV booster	0.5 ml	Subcutaneous	Left Upper Arm
Vitamin A** (second to ninth dose)	16 months with DPT/OPV booster Then, one dose every 6 months up to the age of 5 years.	2 ml (2 lakh IU)	Oral	Oral
DPT Booster	5-6 years	0.5 ml.	Intramuscular	Upper Arm
TT	10 years and 16 years	0.5 ml.	Intramuscular	Upper Arm

* SA 14-14-2 Vaccine, in select endemic districts after the campaign; **The second to ninth doses of Vitamin A can be administered to children 1-5 years old during biannual rounds, in collaboration with Integrated Child Development Services (ICDS); *** In select states, districts, and cities.; BCG: Bacillus Calmette–Guérin; OPV: Oral Polio Vaccine; DPT: Diphtheria, Pertussis, Tetanus

Health survey (NFHS-3),[5] in India only 44% of the children of age one to two years have received the basic package. According to DLHS-3 (2007-2008)[6] rural area of Maharashtra, 67.8% children were fully immunized, 1.2% of the children were unimmunized, while the total rates in the state of Maharashtra were 69.1 and 1.1, respectively. Data of NFHS-3 revealed that the percentage of children between 12 and 23 months of age, in Maharashtra, with full immunization (BCG, measles, and three doses each of polio/DPT) was 58.8% and in the rural area of Maharashtra it was 49.8%. The WHO recommended a 30 cluster sample survey for estimating the immunization coverage among infants, and it has been found to be very useful by the public health administrators in developing countries, because it is rapid, operationally convenient, and cost-effective.[7] The present study was conducted to assess the immunization coverage, to find out the various reasons for partial or non-immunization of children in the rural areas of Pune district, using the 30 cluster sampling technique.

Materials and Methods

The present cross-sectional study was carried out in 40 Wastya–Wadya of 11 villages under the field practice area of the Rural Health Training Center of a Medical College, in Pune, in the month of October 2011, by a team from the Community Medicine Department. The total population in 40 Wastya–Wadya of 11 villages was 46,728, residing in an area of 14 sq. km. The study population was comprised of people living in these 40 Wastya–Wadya of 11 villages. The 11 villages included were Lavale, Nande, Urwade, Ambegaon, Marnewadi, Bhare, Bhukum, Pirangut, Chande, Mulkhed, and Gothawade [Figure 1].

The study sample included 30 clusters from the entire population of 40 Wastya–Wadya, selected as per the 30 × 7 cluster sampling method, as proposed by WHO.[8] A total of seven children aged 12-23 months were interviewed from each cluster on a pre-tested, pre-designed WHO proforma, thus giving us the sample size of 210. Although the sampling unit was the individual subject, the sampling was conducted on the household level. The subjects were chosen by selecting a household and every eligible subject in the household was included in the sample. Fifteen teams were prepared; each team had the responsibility of two clusters, one on subsequent days. These fifteen teams had a teacher, postgraduate student, intern, and social worker from the Community Medicine Department. The team was constructed in such a manner that one of the members had to know the Marathi language. The training of team members with regard to the method of data collection was conducted in the department. The team was trained on proper/appropriate filling of proforma, inspection of scar mark of BCG, source of immunization, making tally of households, relevant questions to be asked, and apart from that, one exercise was given to each team to fill the WHO designed proforma.[8]

Selection of study clusters

A list of all the 40 Wastya–Wadya with their population under RHTC was procured and arranged in cumulative frequency. A cluster interval of 1557 was obtained by dividing the total population by 30 (No. of clusters). Probability proportionate to the size (PPS): 46710 (Total population)/30 (No. of clusters) = 1557 (cluster interval). To obtain the first random number, a random number less than the cluster interval was generated with the help of the right page of a blindly opened book,

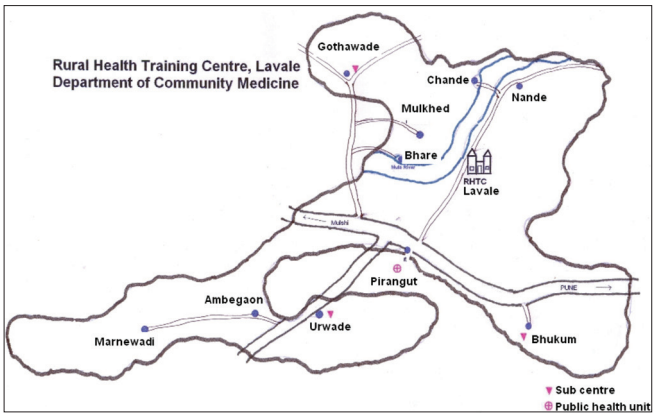

Figure 1: Map of Lavale one of the villages included in the study population

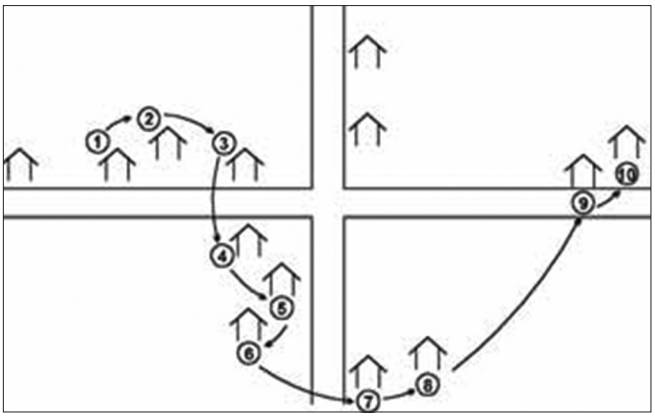

Figure 2: Selection of study clusters

that is, the page number opened blindly was 127. The first cluster (Wastya–Wadya) having a cumulative frequency equal to or more than 127, was picked up as the first cluster and subsequent clusters were selected by adding the cluster interval (1557), that is, (127 + 1557 = 1684). The Wastya–Wadya having a cumulative frequency equal to or more than 1684 was the second cluster. Thus, in this manner, 30 clusters were selected. The first household was selected randomly and every next household was studied in a sequence, until a total of seven eligible children in the age group of 12-23 months were covered [Figure 2].[8]

Proof of immunization

The child was considered as immunized or not immunized based on information on the immunization card. For those without an immunization card, information from the mother or any other responsible and reliable person in the family stating that the child had been immunized was considered. If the mother could not remember anything about the vaccination or in presence of any other confounding factor, the child was considered as not immunized with the vaccine under consideration. The child was considered fully immunized if he/she had received one dose of BCG, three doses of DPT, three doses of OPV, and one dose of measles, and as unimmunized if he/she had received none of these vaccines, and partially immunized if some doses were given, but immunization was not complete. The OPV given in PPI was not considered for classification. In case of a partially/non-immunized child the most important single reason for not immunizing was asked.

Statistical analysis

The data was analyzed by using Microsoft excel and simple proportions were calculated.

Results

A total of 1913 houses were surveyed for evaluation of the primary immunization coverage. A total of 210 children, aged 12 to 23 months (to evaluate primary immunization only), were included in the study, of which 113 (53.8%) were males and 97 (46.2%) were females.

Table 2: Distribution of children according to the sociodemographic characteristics

Characteristics	*n**	%
Sex of child		
Male	113	53.8
Female	97	46.2
Immunization card		
Present	128	60.95
Absent	82	39.05
Total	210	100
Total houses surveyed for evaluation of primary immunization	1913	

*n**: Number

Table 3: Immunization coverage of children aged 12-23 months using the cluster sampling technique

Status	Male	Female	Total
Completely immunized	99 (87.61)	83 (85.57)	182 (86.67)
Partially immunized	12 (10.62)	13 (13.40)	25 (11.90)
Unimmunized	2 (1.77)	1 (1.03)	3 (1.43)
Total	113 (53.81)	97 (46.19)	210 (100)

Figures in parentheses indicate percentages

The immunization card was available only in 60.95% of subjects [Table 2]. It was found that 86.67% children were fully immunized against all the six vaccine preventable diseases [Table 3]. When compared between two genders, the proportion of fully immunized children was higher in males (87.61%) than in females (85.57%) [Table 3]. Regarding individual vaccine coverage in children, the coverage was highest for BCG (98.57%) and lowest for measles (87.62%), and for DPT3, OPV3, and HBV 3 it was 92.38, 95.24, and 84.76%, respectively [Table 4]. A consistent decline in coverage rate from the first to the third dose was observed in DPT and OPV. Dropout rate for both DPT and OPV from the first to the third dose was 1.52 and 2.44%, respectively. The dropout rates for measles compared to BCG and DPT1 were 11.11 and 6.6%, respectively. The dropout rate was higher for female as compared to male [Table 5]. Coverage for all the vaccines was higher among males as compared to females. The main reasons for partial immunization were found to be that the

time of immunization was inconvenient (36%) and that the child brought in was ill, so immunization was not given (20%) [Table 6].

Discussion

The WHO 30-cluster sample survey for estimating immunization coverage among children has been found to be very useful by public health administrators in developing countries, because it is rapid, operationally convenient, and cost-effective. In the present study, the percentage of fully immunized children (86.67%) has been more for males (87.61%) than for females (85.57%). The NFHS-3 (2005-2006)[5] data of Maharashtra has reviewed the full immunization coverage in the rural area of Maharashtra, which is 49.8%, and is lower than that in the present study, and the coverage is 38.6% in rural India. A survey done by DLHS-3 (2007-2008),[6] has shown that full immunization coverage in rural Maharashtra is 67.6%. DLHS-3 data also shows a higher percentage of immunization in males than in females.[6] The full immunization coverage in the present study is higher, may be because the area is near the city (peri-urban) and DLHS/NFHS data is for the entire state of Maharashtra, which includes the backward districts/tribal areas also. The study finding is similar to the DLHS-3 data[6] for Pune district, which shows a coverage of 86.1%, which is equivalent to the present study in Pune district. The complete immunization status of children, against all six vaccine preventable diseases in other studies conducted by Chaturvedi M.[9] in the urban area of Agra (49.7%), Sharma *et al.*[10] in Surat (25.1%), Sing and Yada[11] in the BIMARU states (48%), a Rapid household survey-RCH II[12] (42%), and a study by Varsha Chaudhary and Rajeev Kumar[1] in Bareilly city (61.9%) have been much lower than in the present study. This could be due to regional variation. However, the same and higher coverage of full immunization (73.33, 84.09, and 93.25%) has been reported by various other studies.[3,13,14]

Only 60% had an immunization card indicating less importance given to the document by people. DLHS-3 data for Pune also showed that in only 51.2% of the children an immunization card was available.[6] The importance of having a card should be stressed to them as being similar to the other documents. The DLHS-3 data[6] mentioned that the percentage of the unimmunized in rural Maharashtra was 1.1%, which was similar to the present study (1.43%). The coverage of BCG was higher (98.57%) than in the NFHS-3[5] for rural Maharashtra (93.5%) and DLHS-3[6] for rural Maharashtra 95.4%. The higher coverage of BCG might be because of more institutional deliveries and the study area being near to the city. Similar to BCG, the coverage of OPV3, DPT3, and measles was also higher in the present study than in the NFHS-3 for rural Maharashtra and DLHS-3 for rural Maharashtra. The coverage for all vaccinations was found to be increased over a period of time, indicating a move toward universal immunization [Table 7].

The dropout rate in the present study was lower than the dropout rates in the study by Sharma, *et al.*[10] in Surat and the National

Table 4: Coverage level of different vaccines under UIP/NIS

Individual vaccine	Male	Female	Total
BCG *	111 (52.62)	96 (46.38)	207 (98.57)
OPV1**	111 (54.15)	94 (45.85)	205 (97.61)
OPV2	109 (53.96)	93 (46.03)	202 (96.19)
OPV3	108 (54)	92 (46)	200 (95.24)
DPT1***	106 (53.81)	91 (46.19)	197 (93.81)
DPT2	105 (53.85)	90 (46.15)	195 (92.86)
DPT3	105 (54.12)	89 (45.88)	194 (92.38)
Measles	101 (54.89)	83 (45.11)	184 (87.62)
HBV1****	101 (55.49)	81 (44.51)	182 (86.67)
HBV2	100 (55.25)	81 (44.75)	181 (86.19)
HBV3	97 (54.49)	81 (46.55)	178 (84.76)

Figures in parentheses indicate percentages; BCG*: Bacille Calmette Guérin (Tuberculosis) Vaccine; OPV**: Oral polio vaccine; DPT***: Diphtheria, Pertussis (Whooping Cough), Tetanus Vaccine, HBV****: Hepatitis B Vaccine

Table 5: Dropout rates

Vaccine	Male (%)	Female (%)	Total (%)
OPV (I to III)	2.70	2.13	2.44
DPT (I to III)	0.94	2.2	1.52
BCG to Measles	9.00	13.54	11.11
DPT1 to Measles	4.72	8.79	6.6

Table 6: Reasons for partial immunization/ unimmunization in children

Reasons	No.	Percentage
Reasons for partial immunization (25)		
Time of immunization inconvenient	9	36
Child brought in ill, so immunization not given	5	20
Unaware of need for immunization	3	12
Fear of side effects	3	12
Vaccine not available	3	12
Postponed till another time	2	8
Wrong idea about contraindication	–	–
Reasons for Non-immunization (3)		
Rumors	1	4
Unaware of need for immunization	1	4
Wrong idea about contraindication	1	4

Table 7: Comparison of immunization of present study with NFHS-3 and DLHS-3

Vaccines	NFHS-3 rural India 2005-2006	NFHS-3 rural Maharashtra 2005-2006	DLHS-3 rural Maharashtra 2007-2008	DLHS-3 Pune district 2007-2008	Present study 2011
Full immunization	38.6%	49.8%	67.6%	86.1%	86.67%
BCG	78.1%	93.5%	95.4%	97.8%	98.57%
OPV	78.2%	63.7%	85.3%	95.5%	97.61%
DPT	55.3%	69.7%	77.8%	92.1%	93.81%
Measles	58.8%	82.6%	84.3%	93.7%	87.62%

level also.[5] The present study was in a rural area, where the population was defined, and the service provided by the Health Department was better than in the urban area. In the rural area, contact between field staff and population is also better than in the urban area, probably resulting in a lesser dropout rate. The dropout rate is also present in case of HBV3. In the present study, the main single reason for partial immunization was, 'inconvenient time of immunization'. The same reason was also given by other studies like that by Swami.[15] The immunization was usually in the mornings when most of the parents went to the field or for work. Hence, this time was possibly inconvenient for immunization for parents as this was their work time and they could not afford to lose their daily wages. Yadav *et al.*,[3] Ugade *et al.*,[16] and Ray *et al.*,[17] in their studies, mentioned that the fear of side effects was the most common reason for partial immunization and unimmunization. This was the third reason in the present study. The reason for unimmunization was rumor and ignorance, which had to be changed by giving health education.

Conclusion

The aim of achieving 85% coverage has been achieved, but sustained effort is required to achieve universal coverage of immunization, as per the NPP 2000.

Recommendation

Observation from the present study pointed toward a pressing need to accelerate efforts in improving the immunization coverage in the rural area of Pune. For improving the situation, efforts should be made to impart information, education, and communication activities, to educate the mother, and also the pulse polio days should be utilized as a good opportunity for the advocacy of routine immunization to the target audience.

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