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

Pankaj Kumar Gupta, Prasad Pore, Usha Patil

Department of Community Medicine, Bharati Vidyapeeth Deemed University Medical College, Pune, India

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 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. 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. 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. 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. 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. According to the National Population Policy (NPP) universal immunization of children against all vaccine-preventable diseases should be achieved. 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 Policy, 85% coverage is still a distant goal. To combat vaccine-preventable diseases, the Ministry of Health and Family Welfare, Government of India, has launched the UIP, which has been able to avert many deaths because of the six childhood diseases. The UIP was launched in India in the year 1985 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. According to the National Population Policy (NPP) universal immunization of children against all vaccine-preventable diseases should be achieved. 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 Policy, 85% coverage is still a distant goal. To combat vaccine-preventable diseases, the Ministry of Health and Family Welfare, Government of India, has launched the UIP, which has been able to avert many deaths because of the six childhood diseases. The UIP was launched in India in the year 1985 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. According to the National Population Policy (NPP) universal immunization of children against all vaccine-preventable diseases should be achieved. 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 Policy, 85% coverage is still a distant goal. To combat vaccine-preventable diseases, the Ministry of Health and Family Welfare, Government of India, has launched the UIP, which has been able to avert many deaths because of the six childhood diseases. The UIP was launched in India in the year 1985 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. According to the National Population Policy (NPP) universal immunization of children against all vaccine-preventable diseases should be achieved. 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 Policy, 85% coverage is still a distant goal. To combat vaccine-preventable diseases, the Ministry of Health and Family Welfare, Government of India, has launched the UIP, which has been able to avert many deaths because of the six childhood diseases.
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),[8] in India only 44% of the children of age one to two years have received the basic package. According to DLHS-3 (2007-2008),[9] 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.[9]

**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,
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].

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 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.

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

| Reason for partial immunization/unimmunization in children | No. | Percentage |
|-----------------------------------------------------------|-----|------------|
| 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)                          | 1   | 4          |
| Rumors                                                     | 1   | 4          |
| Unaware of need for immunization                          | 1   | 4          |
| Wrong idea about contraindication                         | 1   | 4          |

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 (52.55) | 81 (44.75) | 181 (86.19) |
| HBV3               | 97 (54.49)  | 81 (46.55) | 178 (84.76) |

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 for partial immunization (25) | No. | Percentage |
|--------------------------------------|-----|------------|
| 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    | –   | –          |

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%            |

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. The importance of having a card should be stressed to them as being similar to the other documents. The DLHS-3 data 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 for rural Maharashtra (93.5%) and DLHS-3 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
level also. 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. 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., Ugade et al., and Ray et al., 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.

**Acknowledgement**

The authors acknowledges team of the department i.e., Dr. Gothankar JS, Dr. MurarkarSK, Dr. Patil RS, Dr. Bogan RR, Dr. Pallar SH, Dr. Raul AV, Dr. Pokale AB, Medical Officer PHC Mutha District Pune for their help in data collection.

**References**

1. Chaudhary V, Kumar R, Agarwal VK, Joshi VK, Sharma D. Evaluation of Primary immunization coverage in an urban area of Bareilly city using Cluster Sampling Technique. NJIRM 2010;1:10-5.

2. Nath B, Singh JV, Awasthi S, Bhushan V, Kumar V, Singh SK. A study on determinants of immunization coverage among 12-23 months old children in urban slums of Lucknow district, India. Indian J Med Sci 2007;61:598-606.

3. Yadav S, Mangal S, Padhiyar N, Mehta JP, Yadav BS. Evaluation of immunization coverage in urban slums of jam Nagar city. Indian J Community Med 2006;31:300-1.

4. Park K. Textbook of Preventive and Social Medicine. 21st ed. Jabalpur: Banarasidas Bhanot Publishers; 2011. p. 456.

5. National Family Health Survey 2005-2006 (NFHS-3). India Reports International Institute for Population Sciences (IIPS), Mumbai, 2006.

6. District Level Household and Facility Survey (DLHS-3). 2007-08: International Institute for Population Sciences (IIPS). India, Maharashtra: Mumbai IIPS; 2010.

7. Murthy BN, Radhakrishna S, Venkatasubramanian S, Periannan V, Lakshmi A, Joshua V, et al. Lot Quality Assurance Sampling for Monitoring Immunization Coverage in Madras City. Indian Pediatr 1999;36:553-9.

8. The module for mid-level for managers: The EPI coverage survey WHO/IV B/08.07, 2008. Available from: http://www.who.int/immunization/documents/mlm/en/index.html. [Last accessed on 2016 Jan 15].

9. Chaturvedi M, Nandan D, Gupta SC. Rapid assessment of immunization practices in Agra district. Indian J Public Health 2007;51:132-4.

10. Sharma R, Desai VK, Kavishvar A. Assessment of immunization status in the slums of Surat by 15 clusters multi indicators cluster survey technique. Indian J Community Med 2009;34:152-5.

11. Singh P, Yadav RJ. Immunization status of children in BIMARU states. Indian J Pediatr 2001;68:495-500.

12. Gulati SC, Bhatt PN, Sharma S. Rapid Household Survey-RCH project phase II, Agra, Uttar Pradesh, Population Research Center, University Enclave. New Delhi: 1999.

13. Punith K, Lalitha K, Suman G, Pradeep BS, Jayanth Kumar K. Evaluation of Primary immunization coverage of infants under universal immunization programme in an urban area of Bangalore city using cluster sampling and Lot quality assurance sampling techniques. Indian J Community Med 2008;33:151-5.

14. Chopra H, Singh AK, Singh JV, Bhatnagar M, Garg SK, Bajpai SK. Status of routine immunization in an urban area of Meerut. Indian J Community Health 2007;19:19-22.

15. Swami HM, Thakur JS, Bhatia SP, Bhatia V, Bhan VK. Coverage evaluation survey of pulse polio immunization in chandigarh. IJCM 2005;25:83-5.

16. Ughade SN, Zodpey SP, Deshpande SG, Jain D. Factors responsible for delayed immunization among children under 5 years of age. J Indian Med Assoc 2000;98:4-5, 14.

17. Ray SK, Dasgupta S, Dube M, Biswas R, Mehta P, Baishya AC; IPHA. An evaluation of routine immunization coverage in some district of west Bengal and Assam. Indian J Public Health 2004;48:82-7.