# **Original Research Article**

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# Not covered enough: inadequate age appropriate immunisation in urban slums of Delhi: a community based cross sectional survey

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#### **ABSTRACT**

Background: The urban average of childhood immunization coverage rates are partial against children living in slums and mask the disparity within the urban poor. The objective of study was to measure the age appropriate immunization as per India's Universal Immunization Program (UIP) schedule, explore determinants of coverage and reasons for incomplete immunization in urban slums of New Delhi.

Methods: A cross sectional survey was carried out in selected urban slums of West and South East districts of New Delhi. WHO's coverage cluster survey sampling methodology was used. Three hundred mothers of under five children were selected. Age appropriate immunization status of the children was recorded on physical examination of the vaccination card.

Results: Fifty eight percent (56% West; 60% South East district) of sample population was age appropriately immunized. The odds of age appropriate immunization were higher for institutional delivery (OR 10.5, 95% CI 4.27-23.6) and among third born children (OR: 1.8, 95% CI: 1.04-3.30). The odds were equal for people from Delhi or migrated from different state (OR: 1.015, 95% CI: 0.62-1.64). Most common reason for incomplete immunization were obstacles (72.8%) and lack of information (23.2%).

Conclusions: There was a consistent drop in coverage among vaccines with more than one dose and by the subsequent dose of vaccine. The difference in coverage estimates among studies emphasise the need for identifying the key reasons of incomplete immunization and finding area specific solutions to improve coverage.

**Keywords:** Age appropriate, Incomplete, India, Immunization, Urban slums, Vaccination

#### INTRODUCTION

The global vaccine action plan 2011-2020 calls on all the countries to reach more than 90% national coverage and more equitable access to existing vaccines for people in all communities by 2020. Roughly three million children to vaccine preventable diseases approximately 34 million children are not completely immunized every year, with almost 98% of them living in developing countries.<sup>2</sup> In 2016, approximately 123 million children received at least one dose of diphtheria, tetanus and pertussis (DTP1) vaccine and only 103.5 million received all three DTP doses during the first year of life. Of these defaulters, 16% is from India.<sup>3,4</sup>

India's routine immunization program is one of the largest in terms of beneficiaries served, vaccinations spread.5 delivered, geographical and the immunization coverage rates at national level looks impressive as it moved from 37.5% in 2005-06 to 62.1% in 2015-16.6,7 The National Capital Territory (NCT) of India, is the fifth most populous city in the world with an

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estimated population of 16.3 million living in urban Delhi.8 Kesarwani et al, and Sharma et al, reports, children of urban slums are highly exposed to outbreaks of vaccine preventable diseases as a result of high population density and continuous inflow of infective agents in migratory population.<sup>9,10</sup> Literature has acknowledged that child health indicators are worse among urban slum dwellers than the general urban societies. Mathew, concluded, urban average of immunization coverage rates are partial against children living in slums and often mask the disparity when compared to urban infants. 11,12 Prinja et al reported that it is important and critical to increase the immunization coverage along with their administration at the appropriate age as per the immunization schedule, because this will provide protection from disease when the risk is highest. 13 Vaccination delays until well after the recommended ages may predispose child to an unnecessarily prolonged risk of diseases at an age where they are most vulnerable.14

A number of health surveys and health management information system record coverage status of childhood immunization. But there has been a difference in their frequency, scope, generalizability and detail.<sup>15</sup>

### **Objectives**

The objectives of the study were to assess the current status of immunization among children under five years of age in Jhuggi Jhopri clusters of Delhi, to understand the socio-demographic factors influencing childhood vaccination coverage amongst children under five years of age, including barriers and facilitators, to identify common reasons of incomplete vaccination in the sample population and to make programme recommendations for improving vaccination coverage among children under five years of age residing in Jhuggi Jhopri clusters of Delhi.

# **METHODS**

A cross sectional study was conducted in the Jhuggi Jhopri (JJ) clusters of New Delhi from December 2017 to January 2018. Jhuggi Jhopri (JJ) clusters are squatter settlements in Delhi with high population density and debilitating environmental conditions for living. The Delhi Urban Shelter Improvement Board have identified approx. 675 of JJ clusters across all districts of Delhi.

Sample size was calculated through a three stage sampling technique. In the first stage, using simple random technique, two districts of New Delhi, West and South East, were selected. In the second stage, WHO's coverage cluster survey i.e. EPI Cluster Survey Guidelines was used. This recommends using at least 15 clusters per district or more than 30 clusters per district for precise estimation of the vaccination coverage, with a minimum sample size of seven per cluster leading to a recommended minimum sample size of 210. 16 Based on

the affordability, availability of time, resources and convenience of conducting fieldwork, two districts of Delhi, West and South East were selected randomly. In the second stage fifteen clusters per district were selected. The final sample size was arrived at by selecting ten children from each of the thirty selected clusters leading to a total number of 300. Though the heuristic sample suggested by the EPI cluster survey suggested 210, a higher number was deemed necessary to account for refusals. The first household was chosen randomly using the direction of pencil nib and moved in the same direction until the desired number of children (10 children from each cluster) were met from that cluster.

For the purpose of survey, sample participants were mothers of under-five children. Households that had at least one child in the age group of 0-5 years and could present the child's vaccination card on the day of survey were selected for the interview. The immunization status was recorded by physically examining the card. The mother's recall or vaccination mark on arm was not taken into consideration.

A structured close ended and pretested questionnaire was administered to the mothers to record the immunization status of the child and other socio demographic characteristics like age, gender, parent's education and employment status, earning members and monthly income of the household. Factors like place of child delivery, type of institution for child's delivery or for the vaccine administration were also included. The reasons for incomplete immunization was taken directly from the WHO's questionnaire on Immunization coverage survey. 16

India's UIP specifies that infants should be vaccinated with: one dose of bacillus calmette-guerin (BCG) at birth or within a month; DPT or pentavalent vaccine (against diphtheria-tetanus-pertussis hepatitis B and Hib) at 6, 10 and 14 weeks of life; oral polio vaccine (OPV) and hepatitis B vaccine at birth or within 48 hour, OPV at 6, 10 and 14 weeks of life; One dose of measles vaccine at 9 to 12 months. <sup>1,17,18</sup> Main outcome measure of the study was "age appropriate immunization coverage"-defined as 'vaccines received appropriate for age and schedule mentioned in the UIP by the youngest child of the family under five years of age'. "Full immunization coverage"-defined as the 'child received one dose of BCG, 3 doses of Penta or DPT, OPV, hepatitis B and one dose of measles excluding birth dose of OPV and hepatitis B'.

The Institutional Ethics Committee of Indian Institute of Public Health Delhi (ECR/124/Inst/HR/2014) approved the study and adhered to its data protection norms to maintain the data security of the participants. Written consent of participants were taken after explaining the purpose of the study.

Data analysis was done using IBM SPSS version 21. Background characteristics of the sample, coverage status

of age appropriate immunization and reasons of incomplete immunization are presented in mean or frequency percentage. Bivariate analysis was done to establish association of age appropriate immunization with exposure variables using difference of means and chi square test. Determinants of age appropriate vaccination were identified by a logistic regression.

#### **RESULTS**

Socio-demographic details: Out of the 300 children, 51% were boys and 49% girls. Sixty five percent of the study

population were not native residents of Delhi and migrated from Uttar Pradesh (54.4%) and Bihar (28.2%). The mean age of the children at the time of the study was 25 months. The mean age of mothers was 25 years and 73% of them had some level of schooling. Most of the families had one or two earning member with the maximum seven in one of the household. The average family earning was approximately Rs.11201 per month. District wise socio-demographic details of the present study participants are summarised in Table 1.

Table 1: Socio-demographic details of the present study participants by the districts.

Variables	West district (n=150)	South East district (n=150)	Total sample (n=300)
Age of children (months) Mean (SD)	25.4 (14.1)	20.0 (14.9)	22.7 (14.8)
Age of mother (years) Mean (SD)	25 (4.013)	25 (3.8)	25.27 (3.9)
Age of father (years) Mean (SD)	29 (4.52)	29 (4.1)	29.12 (4.3)
Mother's educational status	N (%)	N (%)	N (%)
No formal education	36 (24)	45 (30)	81 (27)
Class 1-5	27 (18)	19 (12.7)	46 (15.3)
Class 6-10	66 (44)	52 (34.7)	118 (39.3)
Class 11-12	17 (11.3)	24 (16)	41 (13.7)
Graduation and above	4 (2.7)	10 (6.7)	14 (4.7)
Occupation of the mother			
Not working	136 (90.7)	132 (88)	268 (89.3)
Working	14 (9.3)	18 (12)	32 (10.7)
Father's educational status			
No formal education	28 (18.7)	29 (19.3)	57 (19)
Class 1-5	29 (19.3)	6 (4)	35 (11.7)
Class 6-10	77 (51.3)	74 (49.3)	151 (50.3)
Class 11-12	12 (8)	29 (19.3)	41 (13.7)
Graduation and above	4 (2.7)	12 (8)	16 (5.3)
Occupation of the father			
Not working	10 (6.7)	4 (2.7)	14 (4.7)
Working	140 (93.3)	136 (91.3)	286 (95.3)
No of earning members (mean SD)	1.47 (0.97)	1.16 (0.49)	1.32 (0.7)
Family income of the respondent total family earnings (INR)	12350 (9817)	10053 (6882)	11201 (8541)
Resident of Delhi			
Yes	84 (56)	21 (14)	105 (35)
No	66 (44)	129 (86)	195 (65)
Native states of migrants			
Uttar Pradesh	26 (39.4)	80 (62)	106 (54.4)
Bihar	19 (28.8)	36 (28)	55 (28.2)
Others	21 (31.8)	13 (10)	34 (17.4)

Immunization appropriate for age: Around 99% of the children received BCG vaccine within one month of the age, but only 74% received OPV and 61% hepatitis B vaccine at birth. Ninety eight percent of the children received first dose each of DPT/ Penta and OPV but coverage fell to 88% and 86% for the third doses of DPT/ Penta and OPV respectively. Measles coverage further reduced to 77%. While the full immunization status was

74%, the age appropriate immunization reduced to 58%. In west 56% and South East 60% of the under five children were age appropriate immunized. It is important to note that both the districts were not compared to each other, as they were not evaluated for the health systems availability or other basic facilities in their area. District wise coverage of various vaccines appropriate for age among under five children are summarized in Table 2.

Table 2: Coverage of various vaccines appropriate for age among under five children.

Vaccines appropriate for age received at	West district % (95% CI) (n=150)	South East district % (95% CI) (n=150)	Total population % (95% CI) (n=300)
Birth			
OPV (within 48 h)	70% (63.4%-77.8%)	78% (71.4%-85.1%)	74% (70%-79.7%)
Hepatitis B (within 48 h)	57% (49.1%-64.8%)	65% (57%-73%)	61% (55.7%-67.3%)
BCG (0-1 month)	99% (98%-100%)	99% (97.8%-100%)	99% (98.3%-100%)
6 weeks of age			
DPT/ Pentavalent	97% (94.5%-99.4%)	98% (96.6%-100%)	98% (96.3%-99.3%)
OPV	98% (96.5%-100%)	97% (94.4%-99.4%)	98% (96.3%-99.3%)
10 weeks of age			
DPT/ Pentavalent	94% (90.8%-98.1%)	93% (89%-97.3%)	94% (91.3%-96.7%)
OPV	94% (89.6%-97.4%)	92% (87.1%-96.3%)	93% (90%-95.7%)
14 weeks of age			
DPT/ Pentavalent	92% (88.2%-96.7%)	83% (76.9%-89%)	88% (84.3%-91.7%)
OPV	90% (85.5%-95.2%)	82% (76.4%-88.4%)	86% (83%-90.3%)
9-12 months of age			
Measles	86% (80.2%-91.5%)	68% (59.7%-76%)	77% (72.3%-82%)
12 months of age			
Fully immunized	82% (75.79%-87.8%)	66% (58.3%-74.5%)	74% (69.3%-79.3%)
Age appropriately immunized	56% (47.7%-63.6%)	60% (52.3%-68.8%)	58% (53%-64%)

Determinants of age appropriate immunization: Variables found significant in literature review and variables with minimum p value of 0.05 from the study results were analysed with age appropriate immunization. Results are presented an adjusted odds ratios (AOR, 95% confidence interval) with p value. Age appropriate immunization developed a significant association with children delivered at institution and time taken to reach the vaccination centre. Children delivered at institution have higher odds (10, 4.5-22.7) compared to delivery at home; more time taken decreases the odds (0.75, 0.61-0.93) of

age appropriate vaccination. The odds of receiving age appropriate immunization was almost equal for male and female children (1.05, 0.62-1.79) and for people from Delhi or migrated from different state (1.08, 0.60-1.92). The odds of age appropriate immunization increases with increase in earning members of family from no-one to at least one (2.30, 0.23-22) and for third born child compared to first born (1.21, 0.53-2.75). However, no statistically significant association was detected after adjusting for other variables. Results of logistic regression are given in Table 3.

Table 3: Results of logistic regressions: adjusted odds of age appropriate immunization by various exposure variables.

Variable	Adjusted Odds ratio (AOR)	95% CI	P value
Age child (months)	1.04	0.98-1.02	0.68
Age mother (years)	0.74	0.40-1.37	0.34
Age father (years)	1.04	0.94-1.14	0.43
Gender of child			
Boy	Ref.	Ref.	0.83
Girl	1.05	0.62-1.79	0.83
Birth order of child			
1st	Ref.	Ref.	0.31
2nd	0.70	0.37-1.31	0.30
3rd or higher	1.21	0.53-2.75	0.64
Mother's educational status			
No formal education	Ref.	Ref.	0.31
Class 1-5	0.63	0.26-1.49	0.29
Class 6-10	1.15	0.59-2.25	0.67
Class 11 and above	0.64	0.27-1.53	0.32

Variable	Adjusted Odds ratio (AOR)	95% CI	P value	
Father's educational status				
No formal education	Ref.	Ref.	0.71	
Class 1-5	0.86	0.31-2.36	0.77	
Class 6-10	0.92	0.45-1.86	0.81	
Class 11 and above	0.61	0.24-1.50	0.28	
Earning member of family				
No one working	Ref.	Ref.	0.39	
One	2.30	0.23-22	0.47	
Two	1.58	0.15-16	0.71	
Three or more	4.10	0.34-49	0.26	
Delivery site of children	Delivery site of children			
Home	Ref.	Ref.	0.00	
Institutional	10.05	4.27-23.6		
Type of institution (vaccine delivery)				
Private facility	Ref.	Ref.	0.38	
Public facility	0.30	0.02-4.26		
Time taken to reach vaccine delivery site (minutes)	0.75	0.61-0.93	0.01	
Native of Delhi				
No	Ref.	Ref.	0.70	
Yes	1.08	0.60-1.92	0.79	

Table 4: Reasons for incomplete immunization status.

Reasons	Total sample (n=125)
	N (%)
Lack of information	29 (23.2)
Unawareness of need of immunization	3 (2.4)
Place and/ or time of immunization unknown	22 (17.6)
Others	4 (3.2)
Lack of motivation	5 (4)
Postponing until another time	2 (1.6)
No faith in immunization	1 (0.8)
Others	2 (1.6)
Obstacles	91 (72.8)
Time of immunization inconvenient	7 (5.6)
Vaccine not available	31 (24.8)
Child ill-not brought	10 (8)
Child ill-brought, but not given vaccine	1 (0.8)
Others	44 (35.2)

# **DISCUSSION**

In general, the countries undergoing an economic transition and development shows a pattern of difference in their health indicators either by urban-rural or in terms of different socio economic status. <sup>19</sup> Today India is a leading producer and exporter of vaccines. Despite that vaccine preventable diseases are responsible for over five

lakh deaths annually in India.<sup>20</sup> The study observed age appropriate immunization as per the UIP schedule was 58% among the children residing in Jhuggi Jhopri clusters of the Delhi. The data is lower than that of national survey reporting overall urban figure on full immunization of 66% for Delhi.<sup>21</sup> While the BCG coverage was optimum at 99%, very low focus was on other two vaccines to be given at birth or within 48 hours of birth. The coverage of DPT/ Pentavalent fell from 98% to 88% and OPV 98% to 86% from their first to third dose. It points to the fact that with increasing age of child there is a dropout for their subsequent doses of the vaccine.

The age appropriate immunization coverage was found to be higher than the full immunization coverage reported by Devasenapathy et al. and lower as recorded by Sharma et al. conducted in different urban resettlement colonies of Delhi.<sup>22,23</sup> There was a trend of coverage drop among vaccines with more than one dose and with increasing age as also reported by Pramanik et al.<sup>15</sup> Majority of children (98%) received vaccination from the public health facility, consistent with NFHS 4 reported data of 92.2% for the urban area of Delhi.<sup>21</sup> This highlights the availability of government clinics or Aaganwadi centers at or near the urban slums and it took on an average four minutes fifty seconds for the beneficiary to reach the center for vaccine administration.

Results reveal that the odds of age appropriate immunization was almost equal between the people who are from Delhi and those who migrated from different states. This could be because almost 98% of the children

were receiving vaccinations from the public facility present in the area or a homogeneity in community influence and living conditions for all residing in the urban slums. No difference in immunization status was found by the gender of the child which was in accordance with the results of Singh, reporting decline in gender differences analysing the immunization status using NFHS data from 1992 till 2006. <sup>19</sup> This point to the absence of any gender bias in immunization within the study population.

The odds of receiving age appropriate immunization was higher among third order child. However, higher proportion of first-born child (62%) completed the immunization schedule and only 47% of third born child completed age appropriate immunization similar to what concluded by Mathew. 12 This observation was similar to the reports of integrated child health and immunization survey, rounds 1 and 2, where the coverage of first dose of DPT or pentavalent vaccine was 92% in first born and fell to 85% in third born child. 15,24 The declining coverage could be because of families' becoming less vigilant about vaccination in higher order infants but at the same time experience with first-born familiarized mothers with the vaccination schedule. Factors like institutional delivery, less time taken to reach center for administration of vaccine was found to be significantly associated with age appropriate immunization and consistent with results of other studies suggesting better availability of health care facilities positively impact age appropriate immunization. Factors like age and gender of child, age and educational status of both parents and families not native to Delhi did not show any positive influence on age appropriate immunization. This suggests absence of any considerable inequities in immunization by various social factors.

# Strengths and limitations of the study

The study reports the current estimates of childhood immunization appropriate for age and schedule from the 30 urban slums, 15 each from West and South East districts of Delhi. The data was collected using vaccination cards therefore limiting the potential recall bias from mothers. However, the sample population may not be representative of all urban populations, thus limiting generalizability. Numerator bias in considering age appropriate immunization rather than standard definition may represent underestimation of the coverage from the study area.

# **CONCLUSION**

One of the largest immunization program in world, India's UIP aims to administer free vaccines to approx. 26 million newborns each year through 9 million outreach immunization sessions. The financial outlay for 2014-15 routine immunization drive was Rs 740 crore. <sup>25</sup> The difference in coverage estimation records amid studies emphasise the need for periodic local surveys to better

target the interventions in the area. The study has observed the difference in immunization coverage, when checked by age appropriate vaccination as per UIP guidelines than the standard definition of fully vaccinated child. Age appropriate vaccination needs to be included as a monitoring indicator for programme managers along with the standard indicator of "full immunization" in order to help in administering vaccines appropriately at the correct age maximizing the effect of vaccination. The main challenge beyond the sub optimal full immunization coverage is completion of those vaccines, which require multiple does for example: DPT / Pentavalent vaccine, OPV, and vaccines given at birth or within 48 hours. Study findings have also reported the main reasons for missing out vaccination doses by the family. Further exploration in identifying the key reasons of incomplete immunization and targeting area specific solutions are very much required to improve coverage rates.

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