

An Epidemiological Study of Measles Incidence and Vaccination Coverage in Urban Slums of Ahmedabad, India

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ABSTRACT

Background: Measles is the public health problem in India, causing mortality and morbidity in children. Measles vaccination is included in the Immunization program but low coverage is still a major problem. There is a lack of data on measles incidence and coverage in vulnerable population for measles. **Methodology:** A cross-sectional study was carried out to find out the incidence and vaccination coverage based on parents recall in identified 30 slums of Ahmedabad by using cluster sampling method. 3000 children, less than five years of age were included by selecting 100 children from each cluster. Pre-designed and pre-tested standardized questionnaire of UNICEF was used to assess symptoms of measles and history of the Immunization. **Result:** The measles incidence was found 20.8% based on symptoms and 3.03% based on confirmed diagnosis by doctors as per parents recall in the past six months. The overall vaccination coverage was found at 64.62%. The most common presenting symptom was found fever with rash in children with measles. **Conclusion:** No gender difference was found in vaccine coverage, measles incidence and status of treatment received. Vaccine efficacy found to be 42% which is very low and high incidence of measles was reported which shows the need for an effective targeted program for the urban slums.

Key words: Immunization, Measles, Symptoms, Vaccine efficacy, Cluster, Ahmedabad.

INTRODUCTION

Measles is an infectious disease caused by Morbillivirus,¹ which usually affects children with more than 80% secondary attack rate. However, multiple outbreaks of the disease have even been reported among adults in urban slums, disaster relief camps, during international travel, etc.²⁻⁵ The disease is characterised by the presence of fever, cough, and coryza, followed by the appearance of a typical rash.¹ The disease is transmitted by the airborne route. Being a viral disease large proportions of cases are self-limiting, still, multiple deaths have been reported because of disease-associated complications.⁶ In developing countries like India, more than 2 million children die of measles every year. Live attenuated measles vaccination is an effective means of reducing the incidence of measles in many countries and presently the age of immunisation with measles vaccine is nine months with two doses of measles vaccination have been suggested as a strategy to control measles. Measles vaccination was introduced in India under the universal immunisation (UIP) during 1985-86. Vaccination coverage increased to 87% in 1994-95 resulting in a decline in measles incidence from 160216 cases in 1985 to 61381 cases in 1996.⁷ In spite of extensive immunisation coverage under the universal immunisation program (UIP) in Gujarat, measles still remains a major cause of childhood morbidity and mortality. Gujarat is one of the industrialised states of India. Ahmedabad is the biggest city in Gujarat. Urbanisation has led to

migration from a rural area which resulted in the growth of urban slums. Overcrowding, lack of hygiene and sanitation facilities may lead to spread of infectious diseases like measles. Lack of awareness and health seeking behaviour further leads to low vaccine coverage of measles thus children living in urban slums are vulnerable to measles. Poor treatment seeking behaviour due to cultural beliefs leads to higher chances of complications of measles and might be resulted in death. There is a paucity of measles incidence and vaccination coverage data due to non-reporting of the cases.⁸⁻⁹ For effective immunisation programme, its implementation and monitoring baseline data are required and with this background the present study was conducted to assess the incidence of measles and vaccination coverage in the slums of Ahmedabad city.

MATERIALS AND METHODS

A community-based cross-sectional study was carried out adopting cluster sampling method. A sample size was calculated by expecting coverage of about 70 % vaccination¹⁰ for children less than 5 years of age and expecting all the unvaccinated children to have got an attack of measles by the age of five years uniformly through the five years. Thus, 6% cases of measles in the study population per year assumed with an relative precision of 25 percent and design effect of 3 at 95 percent significance level (alpha risk of

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5 percent), the required sample size was calculated as 2888, by using formula manually, $N = Z^2 \frac{p(1-p)}{D^2}$ [Where p is prevalence and D is relative precision ($Z=1.96$)].¹¹ So, 3000 children were included in this study. Total 30 wards out of 64 wards in Ahmedabad city were selected by cluster sampling method according to population proportionate to sample size technique; each of the selected clusters was divided into four quadrants. From each quadrant's total households a random number was selected and the houses were studied beginning from that number till a total number of 25 children in that quadrant between the age of 9-59 months, giving a total of 100 children in each cluster. A predesigned and pretested standardised Performa used for measles incidence study by UNICEF¹² and recommended for the baseline incidence study was used after pretesting and necessary modifications as per local requirements. Measles was suspected when the mother had given a history of the measles for her child in last six months. It was further confirmed by inquiring the presence of symptoms:

1. History of fever more than 38 degree Celsius or 'hot to touch'
2. Rash for 3 days or more
3. Cough and cold/URTI
4. Conjunctivitis or redness of eyes
5. Distribution of the rash which is from the face down to the body
6. Blackish Discoloration of the skin after the rash disappeared.

For, the measles incidence, mother's history was considered as reliable. However, to what extent the other confirmatory symptoms tally with the mother/relative's history was also documented. We also inquired whether the diagnosis was confirmed or not by the doctor. The relevant information regarding measles vaccination and vitamin A status was also obtained and documented.

Data Collection

The project coordinator had held a training session for the intern doctors and investigators who were going to be involved in the data collection and supervision respectively. A team composed of two field investigators will collect the data under the close supervision of project coordinators and investigators.

Data Analysis

Data collected and compiled into Microsoft excel and data entry was dually checked to prevent any error. Both qualitative and quantitative variables were analysed with the help of Epi-info 7 software and significance was tested.

RESULT

Table 1 is showing that, out of 3000 children, 1715 (57.2%) were boys while 1285(42.8%) were girls. Mean age of boys and girls was 29.99 ± 14.21 and 29.52 ± 14.20 respectively and the difference wasn't found statistically significant ($Z=0.89$, $P>0.05$).

Table 2 is showing an association of sex with measles vaccination status and measles disease. There is no statistically significant association found between sex of child and measles disease, vaccination status and treatment of measles as per chi-square test. ($p>0.05$)

Table 3 displays measles cases as per the history given by the parents regarding measles in past six months. It explains very high incidence (20.8%) of measles in the urban slums of Ahmedabad city. It shows a high incidence of measles among 12-23 months age (29.6%) followed by 24-35 months (28.7%) while lower incidence (9.3%) during the first year of life. Out of 624 cases, only 91 cases were confirmed the diagnosis of measles by the doctors. If we consider this than the incidence of measles is 3.03. Highest proportion (34.0%) of cases was from 12-23 months of

Table 1: Socio-demographic profile of study participants.

Sr. No.	Variable		N=3000	%
1	Sex	Male	1285	42.8
		Female	1715	57.2
2	Age In months	9-11	367	12.2
		12-23	937	31.2
		24-35	735	24.5
		36-47	623	20.8
		48-59	338	11.3
3	Religion	Christian	4	0.1
		Hindu	2903	96.8
		Muslim	93	3.1
4	Type of family	Joint	1399	46.6
		Nuclear	1601	53.4
5	SEC	Low	2387	79.6
		Middle	613	20.4

Table 2: An association of vaccination and measles with the sex of children.

		Vaccinated	Measles Vaccination Status		Total	X ² value	P value	
			Unvaccinated					
1	SEX	BOY	1110	605	1715	3.5	0.061	
			GIRL	788	497			1285
			TOTAL	1898	1102			3000
	Received	Vitamin A supplementation						
		Not received						
2	SEX	BOY	26	22	48	1.98	0.15	
			GIRL	16	27			43
			TOTAL	42	49			91
	Yes	Measles case						
		No	(according to History)					
3	SEX	BOY	263	1022	1285	0.15	0.69	
			GIRL	361	1354			1715
			TOTAL	624	2376			3000
	Received	Treatment						
		Not received						
4	SEX	BOY	36	12	48	0.31	0.57	
		GIRL	29	14	43			
		TOTAL	65	26	91			

age while lowest (8.8%) cases were from 9-11 months of age. There was no statistically significant association was found between age and measles occurrence ($\chi^2=2.98$, $p=0.56$).

Table 4 is showing coverage rate of measles vaccine among boys and girls in different age groups. 48-59 months age group children having highest vaccine coverage rate, following age group of 36-47 months children.

Table 3: Age-wise distribution of measles cases.

Age(Months)	Diagnosis as per History	Incidence rate (%)	Diagnosis by Doctor	Incidence rate (%)	Total
9-11	58	9.3	8	2.18	367
12-23	185	29.6	31	3.36	937
24-35	179	28.7	18	2.46	735
36-47	138	22.7	23	3.7	623
48-59	64	10.5	11	3.25	338
Total	624	20.8	91	3.03	3000

Table 4: Age wise coverage of measles vaccination.

Age(Months)	boys		girls		total	
	Total children	Coverage rate (%)	Total children	Coverage rate (%)	Total children	Coverage rate (%)
9-11	171	29.01	196	23.85	367	26.43
12-23	455	43.8	482	45	937	44.4
24-35	293	71.9	442	68.5	735	70.2
36-47	257	87.5	366	90.3	623	88.9
48-59	109	94.2	229	92.18	338	93.19
Total	1285	65.282	1715	63.97	3000	64.624

The majority (52.7%) of patients had consulted government facility for the diagnosis and treatment of measles. Only 24 patients had given a history of hospitalisation because of measles but couldn't remember the reason for the hospitalisation.

The vaccine efficacy calculated from this study was 42%, calculated by comparing attack rate among vaccinated and unvaccinated with following formula;

$$\text{Vaccine efficacy (\%)} = \frac{\text{ARU} - \text{ARV}}{\text{ARU}} * 100 = (1 - \text{RR}) * 100$$

ARU= attack rate among unvaccinated

ARV= attack rate among vaccinated

$$\text{RR} = \frac{\text{ARV}}{\text{ARU}}$$

DISCUSSION

India is having a diverse population with different cultural beliefs and geographic locations. Education of parents, poverty, taboos related health and other factors severely affect the health of their children. Measles is still a public health problem in India even though intensive immunisation program. Measles is still contributing to child mortality and morbidity till now. Measles vaccination coverage rate is low than others vaccines.¹⁰ Thus, incidence of measles and death related to complications of measles are still not so uncommon in India, thus the Government of India has adopted strategies which include achieving high coverage with the first dose of the measles vaccine (i.e. first-dose coverage for the measles vaccine must be >90% at the national level and >80% for each district); intensive surveillance activities; appropriate case management (including administration of vitamin A); and implementation of catch-up measles vaccination campaigns for children aged 9 months to 10 years in states with <80% evaluated coverage with the first dose of measles vaccine.⁸⁻⁹ The Indian District Level Health Survey_3 reported that only 30% of

vaccinated infants received the measles vaccine at the recommended age of 9 months despite intensive measures taken by the Government.¹³

The present study has found incidence rate of measles by the history of the child based on symptoms presented at that time. The incidence rate was found 20.8%. Out of them, 91 children have been diagnosed as a confirmed case of measles by doctors and thus 3.03% children having confirmed measles disease. The incidence of measles in Ahmedabad was documented 11.20% in a study done by Bhagyalaxmi A *et al.*¹¹ A Study conducted by Desai VK *et al.* in Surat has found an incidence rate of measles 7.67% in one year period in children of age less than five years.¹⁴ The incidence study conducted in 1999 in Ahmedabad has shown 11.4% incidence of measles.¹⁵ The present study was conducted in urban slums which might be a cause of higher incidence rate of measles. Data has been collected by trained intern doctors assuring least chance of skipping any case, which might be one of the reasons of reported higher incidence. The study conducted by Dollimer N *et al.* has shown overall estimated measles incidence rate 24.3 per 1,000 child-years in rural Ghana.¹⁶

The vaccine coverage rate was found 64.624% in the present study in 9-59 age group and similar kind of study conducted in Ahmedabad by Bhagyalaxmi A *et al.*¹¹ has shown 59.88% coverage rate of vaccination of measles. A coverage rate of measles vaccination in 12-23 age group children was found 44.4% and Desai VK *et al.*¹⁴ has documented 49.8% coverage rate of measles vaccination in children of 12-23 months in Surat city and 48.3% children of 9-59 months. A study conducted by Dollimer N *et al.*¹⁶ in rural Ghana has shown 48% coverage of measles vaccine. The incidence studies carried out in Ahmedabad, Rajkot and Jamnagar revealed overall vaccination coverage between 46.7 to 58.9% in 1999. According to NFHS 3 data vaccine coverage in Gujarat state is documented 65.7%¹⁰ and 65.2% according to DLHS-2 in Gujarat state.¹³ According to DLHS-2 report, vaccination coverage in the urban area is documented 76.8%. The present study is showing low vaccination coverage might be because of recall bias due to retrospective nature of the study and high prevalence of illiteracy and less awareness regarding health services. Many vaccinations related taboos are also prevalent in urban slums which may also affect it.

The vaccine efficacy is found 42% in the present study, which is low than documented efficacy of measles which is 85-90%^{1,17} might be due to study is conducted in a slum area of Ahmedabad which is more vulnerable to disease transmission due to poor housing, sanitation facility and overcrowding. Vaccination status and occurrence of measles were based on parents recall which might be biased. And improper cold chain maintenance could be another reason of low vaccine efficacy. It has been calculated by finding risk ratio (attack rate in vaccinated/unvaccinated children). Measles vaccine efficacy was observed even lower which is 36% in a study conducted in Ahmedabad by Bhagyalaxmi A *et al.*¹¹ A similar kind of study conducted by Desai VK *et al.*¹⁴ in Surat city has documented vaccine efficacy 55%, which is showing a similar result with our study, as both studies have been conducted in urban slums.

Thus, to decrease morbidity and mortality of children due to measles effective targeted program should be framed for Urban slums which have different socio-demographic characteristics and poor environmental living condition. Effective immunisation could be possible by ensuring proper cold chain maintenance and >90% coverage by the involving community in it. Targeted IEC efforts should be framed to increase awareness regarding measles and its vaccination. Reporting of measles cases and prompt treatment should be assured by effective surveillance of measles.

Limitation of study

The present study is carried out by asking history of children to the parents, thus it is retrospective in nature but an incidence study design should be prospective for a period of a year but it is resource and time-consuming. In this study only past six months data were collected from the parents to minimise recall bias. This study has shown some important findings of immunisation coverage and measles incidence in the slum of Ahmedabad city which can be utilised for further control strategies.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

UNICEF: United Nations Children's Fund; **URTI:** Upper respiratory tract Infection; **DLHS:** District Level Household Survey; **NFHS:** National Family Health Survey

SUMMARY

The present study was conducted to find out vaccination coverage and measles incidence in last 5 years as per parent's recall in urban slums of Ahmedabad by using cluster sampling method. The measles incidence was found 20.8% based on symptoms and 3.03% based on confirmed diagnosis by doctors as per parents recall in the past six months. The

overall vaccination coverage was found at 64.62%. No gender difference was found in vaccine coverage, measles incidence and status of treatment received. Vaccine efficacy found to be 42% which is very low and high incidence of measles was reported which shows the need for an effective targeted program for the urban slums.

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