Original Article

Indian Journal of Medical & Health Sciences
Volume 6 Number 1, January - June 2019
DOI: https://dx.doi.org/10.21088/ijmhs.2347.9981.6119.4

A Study of Seroprevalence of Rubella Among School Girls and Ante-Natal Women

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Abstract

Background: Rubella is the leading vaccine-preventable cause of birth defects. Rubella infection in pregnant women may cause fatal death or congenital defects known as congenital rubella syndrome. Still, Rubella vaccination is not part of the universal immunization program in the country.

Aim: To study the seroprevalence of rubella in adolescent school girls and ante-natal women.

Methods: A multi-centric study to determine the seroprevalence of rubella among children and families was carried out in Delhi and Pune so as to arrive at a decision to find out the magnitude of the problem. Six hundred antenatal mothers attending service hospital OPD and six hundred school students of classes VI to XII were evaluated for presence of rubella IgG and IgM. In addition, certain socioeconomic parameters were also studied.

Result: It was found that 29% girls in Pune and 24% in Delhi were susceptible to Rubella. The age-stratified seroprevalence shows susceptibility to rubella decreased as the age increased among the girls of Pune. Approximately 10% of the screened ante-women were susceptible to Rubella in both cities.

Conclusion: Ten percent of the mothers were susceptible to rubella infection during pregnancy and are thus at a risk of giving birth to babies with Congenital Rubella Syndrome. The adolescent girls though had a higher prevalence of seronegativity. World Health Organisation (WHO) has long ago recommended universal immunisation against Rubella. It is logical that rubella vaccine should be introduced in the immunization schedule for school going girls.

Keywords: Rubella; Seroprevalence; School girls; Ante-natal women.

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Received on 07.05.2019
Accepted on 08.06.2019

Introduction

Rubella is a contagious, generally mild viral infection that occurs most often in children and young adults. Rubella is the leading vaccine-preventable cause of birth defects. Rubella infection in pregnant women may cause fetal death or congenital defects known as congenital rubella syndrome. Prevention of Congenital Rubella Syndrome (CRS) is the main objective of rubella vaccination programs. Rubella Immunization has been introduced in most of the developed world and in many developing countries too. During 2000–2016, rubella-containing vaccine was introduced in 53 countries. By December 2016, 152 (78%) of 194 countries were using the vaccine. The increased Rubella vaccine coverage has resulted in a drastic decrease in reported rubella cases from 670,894 cases in 2000 to 22,361 cases in 2016. Elimination of rubella and congenital rubella syndrome was verified in the WHO Region of the Americas in 2015, and 33 (62%) of 53 countries in the European Region have now eliminated endemic rubella and congenital rubella syndrome [1]. However, in the developing countries there is insufficient data on rubella and CRS, due to limited disease surveillance and reporting system. Limited data is available from countries like China, Kenya, Tanzania, South Africa as well as India. In India some studies have been conducted in various cities that, to some extent, reflect the magnitude of the problem (Table 3 and 5).

The developing countries are undecided on the timing and modalities of introducing routine rubella vaccination [2]. Therefore, it is necessary to critically evaluate the prevalence of and the

susceptibility to rubella infection in the population of reproductive age-group. The most feasible method by which the disease burden can be determined is by seroprevalence studies among pregnant women and adolescent girls to study their serosusceptibility to rubella infection. A high level of seronegativity would highlight the fact that the population is not protected against the disease.

Aim: To study the seroprevalence of rubella in adolescent school girls and ante-natal women of two metro cities of India.

Materials and Methods

The study was carried out among ante-natal mothers and adolescent girls in Delhi and Pune. Though the study was conducted in two metros only, the study population was representative of the entire country. Ante-natal mothers attending the ante-natal outpatient of two major hospitals in Delhi and Pune were included in the study. The subjects were primi- and multi-gravida women in these condand third trimester of pregnancy. To study the seroprevalence among adolescent girls, all the girls without history of rubella immunisation in childhood as authenticated by their health record cards, attending classes VI to XII of a government school each in Pune and Delhi were included in the study. Exclusion criteria were previous rubella immunisation for adolescent girls and first trimester of pregnancy for ANC cases.

The optimum sample size per centre to be screened was worked out to 300 cases from the lowest seronegativity of Rubella as 5%, with 95% confidence interval. Thus, the first 300 cases of ante natal women attending the ante natal clinic in each city were included in the study. In the same way, 300 adolescent girls in each city were randomly selected from each school from those attending classes VI to XII. 300 x2 = 600 among ante natal mothers and another 300/centre among school students x2 = 600 adolescent girls for the complete study.

Identification of the study population from among the ANC attendees as well as the school children in each of these two cities was carried out based on the exclusion criteria. Following counseling of the expectant mother with the help of the Gynaecologist, a blood sample was collected. The same process was followed for school students after explaining the study and obtaining informed consent from their parents. These samples were sent to the hospital laboratories for serological tests by the Pathologist/Microbiologist. Both IgG & IgM antibodies were tested for Rubella using UBI kits.

Results

School Students

Sociodemographic Indicators: While studying the school going girls, students of class VI to XII were evaluated. 48% of girls were in 13-14 yrs age group

Table 1: Sociodemographic Indicators

	Delhi (n 300)	Pune (n 300)	Remarks
Adolescent girls			
Age			
<12 yrs	47	13	
13-14 yrs	158	141	48%
15-16 yrs	88	75	27%
>17 yrs	41	37	
Background			
Rural	180	180	60%
Urban	120	120	40%
Socio Economic status			
Lower Middle Class	240 (80%)	201 (67%)	
Middle Class	60 (20%)	99 (33%)	
Ante natal Mothers			
Age			
< 20	37	32	Mean
21-26 yrs	169	126	Delhi 22.5yrs
26-30 yrs	71	120	Pune 24.5 yrs
>31 yrs	37	32	
Background			
Rural	65%	78%	
Urban	35 %	22%	
Education			
<10 Class	27%	39%	

Matriculate	39%	50%
Higher Secondary	27%	10%
Graduates	7%	1%
No of children		
Nil	39%	32%
1-2	50%	56%
>2w	11%	12%
Age at marriage		
<18 yrs	24%	32%
18-25 yrs	74%	66%
>25 yrs	2%	2%

Table 2: Seroprevalence of Rubella among Adolescent Girls Worldwide

Sr No.	Country	% Seropositivity		
		10 yrs	15 yrs	20 yrs
1.	Brazil	86%	95%	90%
2.	Panama	20%	30%	40%
3.	Egypt	92%	96%	94%
4.	Gambia	90%	98%	96%
5.	China	90%	98%	97%
6.	Malaysia	55%	60%	55%
7.	Iran	75%	85%	85%

Table 3: Susceptibility to Rubella in Child Bearing Age Worldwide

Sr No	Location	Category	Sample Size	Serone gative	Workers, Year
1.	Jamaica	Women, 15-34 yrs	240	47%	Dowdle et al. 1970
2.	Sri Lanka	Women 15-45 yrs	534	43%	Mendis 1989
3.	Nigeria	Women/men 20-39	1202	34%	Odelola et al. 1977
4.	Thailand	Women antenatal	5142	32%	Phiromsawat et al. 1988
5.	Brazil	Women antenatal	473	18%	Black et al. 1986
6.	Mexico	Women 15-44 yrs	18,745	17%	Guatierrez-Trjillo et al. 1990
7.	Pakistan	Women antenatal	2000	16%	Rasul et al. 1990
8.	Oman	Women antenatal	207	8%	EPI 1994

Table 4: Susceptibility to Rubella During Child Bearing in India

Sr No	Location	Category	Sample Size	Serone gative	Workers, Year
1.	Calcutta	Women, 15-25 yrs	176	43%	Chakabarty et al., 1973
2.	Chandi garh	Women, 16-40 yrs	325	19%	Pal et al., 1974
3.	Delhi	Women, antenatal	603	31%	Satpathy, 1989
4.	Lucknow	Women, antenatal	300	22%	Mathur et al., 1982
5.	Hydera bad	Women, antenatal	274	5%	Bhaskaran et al., 1991
6.	Vellore	Women, antenatal	132	4%	Black, 19860

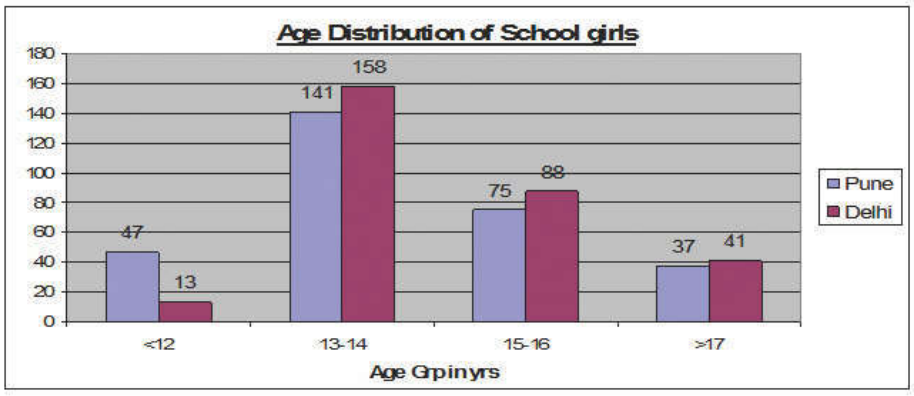
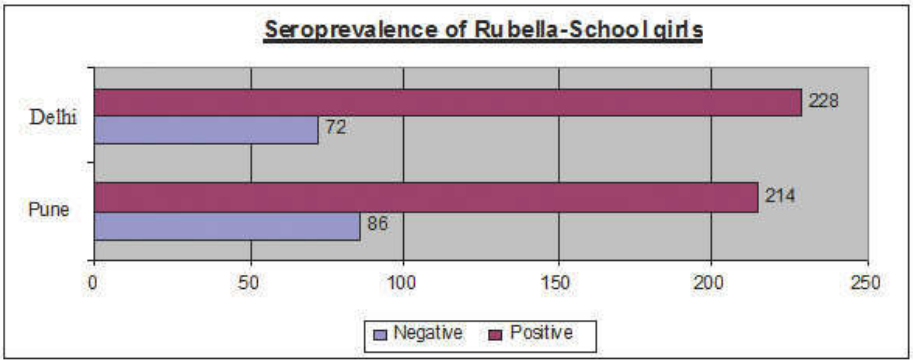


Fig. 1:

Fig. 2:



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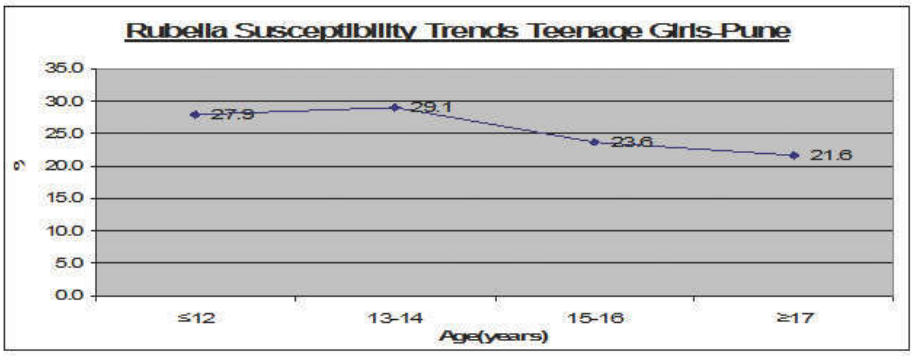

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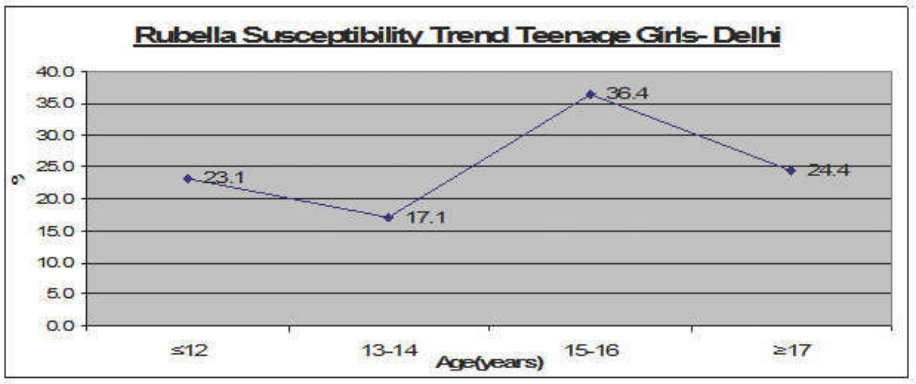

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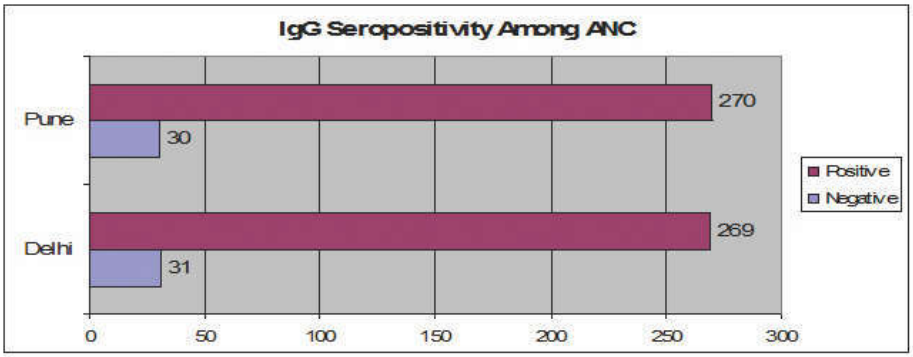

and 27% were 15-16 years of age (Table 1). Majority of their mothers were having education of less than tenth standard. Almost 60% of girls had rural background in both places. They came mostly from lower- middle income groups in both cities (67% and 80% respectively in Pune and Delhi). There was proportionate representation from almost all the states. In both cities only a small percentage of girls had any past history suggestive of Rubella (fever with rash) - 6% in Pune and 4% in Delhi.

Seroprevalence of Rubella: The seroprevalence of Rubella was studied by collecting the blood samples from the sample population and subjecting them to ELISA test for both IgG and IgM antibodies. The results of the IgG antibodies are depicted in Fig 1. As seen in the bar-diagram 72 (24%) girls in Delhi and 86 (29%) girls in Pune were found to be negative for IgG antibodies and therefore susceptible to Rubella.

The results of the ELISA IgM antibodies showedthat only a small percentage (3%) were positive for IgM antibodies in both cities. Since presence of IgM antibodies suggests active infection of rubella, it signified that the prevalence of active disease in this age group was very low.

The age specific seropositivity of rubella among school girls to find out any trends of susceptibility with increasing age (Figs. 2 & 3). The results show that though susceptibility to rubella decreased as the age increased among the girls of Pune there was no such trend seen among the girls surveyed in Delhi. The trend in Pune was statistically significant ($p < 0.05$).

Ante-Natal Women

Sociodemographic Indicators: While carrying out the study certain socio-economic parameters were also studied. Majority of the women were in the 21-26 and 26-30 yrs age group in both cities, with mean age of the study population being 24.5 years in Pune and 22.5 years in Delhi (Table 1). Almost all women were married before the age of 25 years with a large portion getting married before the age of 18 yrs (24% in Delhi and 32% in Pune). Although majority of the women were from rural background (65% in Delhi and 78% in Pune), a substantial number were from urban areas (35%) especially in Delhi. Majority of women had education less than Std X (approximately 44% in both cities). Thus, the profile of the study population was women who were in the 20-30 years age group, mostly from rural background, with education of less than Std X, who were married around 20-21 yrs and had two or less children, belonging to a wide cross section of the society representing most states of the country.

Seroprevalence of Rubella: Prevalence of protective antibodies among pregnant women was detected by carrying out similar test for Rubella IgG and IgM antibodies in their blood. The findings are elaborated in Fig 4. Both the cities had identical findings i.e.30 ante-natal women in Delhi and 31 in Pune (10% in both cities) were negative for IgG antibodies.

The serological tests done for IgM antibodies found 15 ANC women in Delhi (5%) and 21 in Pune (7%) to be positive indicating active rubella infection. All these women were counseled and offered MTP.

Discussion

Sero-surveillance of school girls

The profile of the girls studied and the results of the study could be extrapolated to the country as a whole. By studying the presence of IgG antibodies among girls it was found that 29% girls in Pune and 24% in Delhi were susceptible to Rubella.

Rubella serosurveillance among adolescent girls have been stopped in most countries since the vaccination program has been launched and hence results of recent studies are not commonly available. When compared with age-stratified surveys among girls of various countries, data available before the start of the vaccination program in their countries shows wide variation of rubella seroprevalence in different age groups of adolescent girls- around 30% in Panama to 98% in China (among girls of 15 yrs). In some countries, rubella is predominantly a disease of the childhood whereas in others, substantial infection continues to be evident among adults. Studies done at Brazil, Panama, Gambia, Egypt, China, Malaysia and Iran for different age groups of girls are tabulated in Table 1 [3,4,5,6,7,8,9]. Thus, in most of the countries majority of the girls had high levels of protective antibodies against rubella by the age of 10 years. As the age increased from 10 to 15 years there was a significant increase in the seropositivity after which there was hardly any rise. Another study recently carried out in Turkey in 2006 echoed similar findings of rising seroprevalence with increasing age-87% in children aged 10-12 years, 89% among those aged 13-14 years and 92% in the 15-17 years age group [10].

In India studies carried out in different parts of the country are tabulated in Table 3 [2,11,12,13,14,15,16]. There is a wide variation of serosusceptibility in different parts of the country.

Studies done in Delhi in 2001 and 2005 revealed only 10% and 17% seronegativity. Whereas those carried out in Jammu, Amritsar and Pune bring out higher serosusceptibility; 32.7%, 36% and 33.5% respectively. There is a variation between rural and urban areas too- rural areas in Maharashtra and Tamil Nadu had 27% and 13.5% seronegativity. In the current study, the seronegativity was 28% and 23% respectively in Pune and Delhi among children below 12 years of age. This figure dropped to 22% among >17 years age group in Pune girls whereas there was no such difference seen in Delhi. There is a regional variation in seropositivity among adolescent girls between north and south India which could be due to higher infection rate in childhood in north India. Overall, 29% girls in Pune and 24% in Delhi were susceptible to Rubella. Thus, it seems that a higher percentage of girls are susceptible to rubella in India than in other countries. This is a cause for concern since the socio-cultural milieu of our country drives the girls towards early marriage which further compound the problem. Girls get married off at a younger age, start bearing children even before the age of 18-20 yrs, and are thus more susceptible to rubella, vis-a-vis the elder age groups where the seropositivity rises to 90%.

Sero-surveillance of Women

Since the start of the Rubella vaccination program in most countries, the studies on sero-surveillance among pregnant women have also become fewer. Studies done in 1990s show a global variation in susceptibility to rubella among women of child bearing age. Surveys from 45 developing countries showed that the proportion of women who were seronegative to rubella wasless than 10% in 13 countries (29%), 10-24% in 20 countries (44%) and at least 25% in 12 countries (27%). Countries with the highest susceptibility rates (>25%) among women of childbearing age, include Jamaica, Malaysia, Panama, Singapore and Sri Lanka. In other countries with high or moderate susceptibility rates such as Brazil, parts of India, and Nigeria, the absolute risk of CRS is difficult to estimate and there maybe substantial within-country variation [17]. The results of some of the recent seroprevalence studies carried out in mostly developing countries are depicted in Table 4[18,19,20,21,22]. The seronegativity is much lower in African countries; 4.7% in South Africa, 7.4%in Kenya and 7% in Tanzania, compared to China (16%) and Italy (14.2%).

In India studies had been conducted in different cities of the country. These studies are summarized in Table 5 [23,24,25,26,27,28,29]. There is considerable intraregional variation of sero-negativity for rubella; from lower range in Vellore (11.8%), Madurai (12.5%) and Delhi (14%) to some higher values in Mumbai (38%), Trivandrum (34%) and Delhi (21%). Most of the studies have been conducted on antenatal mothers. These values could represent the geographical variation because the studies were conducted among women or girls of one geographical location. This regional variation does not give a true representation of the overall seroprevalence of rubella among women in India. Our study also shows that susceptibility to rubella decreased as the age increased. Similar results were brought out in a study conducted at Amritsar; the serosurveillance among various age groups of women showed a rising titer of IgG antibodies indicating higher protection as the age increases (64% in 11-16 years to 69% in 16-25 years and 77% in 26-35 years. Gandhoke et al. studied data collected between 1988 and 2002 on seroprevalence of IgG Rubella antibodies in Delhi. Over 15 years, the susceptibility of pregnant women decreased from 51% in 1988 to 13% in 2002 [25].

The present study was a multicentric one and since the reference population was from a cosmopolitan area, located in North (Delhi) and South (Pune) adequate representation from entire country was ensured. Almost identical results were seen in both cities i.e. about 10% antenatal women were negative for IgG antibodies against rubella, therefore susceptible to rubella infection in both, Delhi and Pune.

Although it is only one out of ten women attending the antenatal clinics that are susceptible to Rubella, the outcome of the disease and its effect (both medical and psychosocial) on the fetus as well as on the family as a whole is a huge burden to the society.

Conclusion

The study has highlighted that the seroprevalence of rubella in the antenatal women is approximately 90%. That means 10% of the mothers are susceptible to rubella infection during pregnancy and are thus at a risk of giving birth to babies with Congenital Rubella Syndrome.

The study population came from different parts of the country and therefore was representative of the entire country. The adolescent girls though had a higher prevalence of seronegativity (24% in Delhi and 29% in Pune).

World Health Organisation (WHO) has long ago recommended Universal Immunisation against Rubella. It is therefore, only logical that Rubella vaccine should be introduced in the immunization schedule for school going girlsso as to protect them from Rubella during pregnancy.

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