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The Prevalence of Rubella Virus among Children and Adolescents in Adamawa State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Authors UA and SS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SS managed the analyses of the study. Author UA managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Rubella is an infectious and generally mild childhood viral disease. The disease is of public health importance because infection acquired during early pregnancy often results in foetal abnormalities termed congenital rubella syndrome (CRS). This study was undertaken to determine the prevalence of Rubella IgG antibodies among 455 children and adolescent aged between 5 and 19 years in Adamawa state, Nigeria. Sera were screened for Rubella IgG antibody using commercially produced ELISA Kit and Rub IgG kit manufactured by Genesis Diagnostic Laboratory Ltd pharmaceutical company, Henry Crubb road Littleport, UK. Of the 455 subjects screened, Rubella antibody was found in 268 samples giving an overall prevalence of 58.1% with the southern senatorial zone having the highest prevalence though not statistically significant. Rubella seroprevalence increased with age (51.1%, 63.6%, 65.1% for the age group 5-9, 10-14, 15-19 years respectively), with females having significantly higher prevalence rate than male (67%). There was no statistically significant difference in seropositivity with regards to the type of settlement and

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educational level of the parents. This study shows that overall children between ages 5-19 have no antibodies to Rubella (41.1%). This is indicative of widespread viral transmission in the study population. In Nigeria, Rubella vaccine is not part of the routine immunization programme; this study can be used as a based line data to guide immunization strategy for this important viral disease. Given the serious impact of viral infection incasing congenital rubella syndrome, it is advisable to consider vaccination as a mode of prevention especially in adolescent girls.

Keywords: Rubella; Congenital Rubella Syndrome (CRS); ELISA.

1. INTRODUCTION

Rubella virus, the sole member thus far of the *Rubivirus* genus, is well known worldwide to cause disease only in humans. Rubella is a viral illness characterized by a mild, maculopapular rash. The rubella rash occurs in 50–80% of rubella-infected persons and is sometimes misdiagnosed as measles or scarlet fever. Children usually develop few or no constitutional symptoms, but adults may experience a 1–5 day prodrome of low-grade fever, headache, malaise, mild coryza, and conjunctivitis. Post auricular, occipital and posterior cervical lymphadenopathy is characteristic and precedes the rash by 5–10 days. Arthralgia or arthritis may occur in up to 70% of adult women with rubella. Rare complications include thrombocytopenic purpura and encephalitis [1,2]. The aim of this study is to estimate the prevalence of rubella virus among children and adolescents in Adamawa state, Nigeria.

2. MATERIALS AND METHODS

2.1 Methodology

The study commenced after receiving approval from the Ministry of education, Universal Basic Education Board (UBEB), and permission from respective school principals. Written or informed consent was obtained from the subject's parents or legal guardians before distribution of questionnaire, screening and enrollment. The questionnaire contained biometrics and life style of the subjects as well as their parents.Blood samples were collected from the subjects using sterile syringe and needles with the aid of medical personnel and transferred into sterile tubes. All samples were transported to the laboratory in a sterile container. Samples were properly labelled. Blood samples were allowed to clot and then centrifuged at 3000 rpm for 5 min. The sera were harvested into the clean, sterile bottle and frozen at -20°C until needed. The analysis was done using qualitative ELISA (Enzyme-Linked Immunosorbent Assay) methods with RUB IgG test kits.

2.2 Sample Analysis

The specimen were analysed for rubella IgG antibodies, using RUB IgG test kits in the EID BIOTEK laboratory, Federal Medical Centre, Jalingo, Taraba State. The kit used for this test was prepared and manufactured by Genesis Diagnosis laboratories Ltd, Pharmaceutical company, Henry Crabb road, Litlleport, UK, and it contained: a microplate 96 wells pre-coated with inactivated rubella virus antigen; a sample diluent (Tri-buffered saline, pH 7.2 with antimicrobial agent) concentrate; a wash buffer concentrate; a conjugate (peroxidase conjugated rabbit anti-human IgG) ready to use; a TMB Substrate ready to use; a stop solution ready to use; a calibrated standard ready to use; a positive control ready to use; a negative control ready to use and an instructions leaflet.

The test procedures were performed according to the manufacturer's instructions as follows:

All materials are at room temperature before the beginning of the experiment. The sample diluent was diluted 1:14 in distilled water to make sufficient buffer for the assay. The subject's samples were also diluted (1:100, 5 ul serum plus 0.5 ml diluents). The first well A1 was left blank, and 100 ul of the positive control, standard, and negative control were dispensed into B1, C1, D1, E1, F1 respectively having the standard in 3 wells. 100 ul of diluted samples were then dispensed in the remaining wells.

The plate was covered and incubated at room temperature for 20 min. Meanwhile, the wash buffer was diluted, 1:9 in distilled water. After incubation, the plate was washed automatically using biotech washer three times, and then blotted on adsorbent paper. Then, 100 ul of the conjugate was dispensed into every well and incubated for 20 minutes at room temperature. After 20 minutes, the plate was washed three times and blotted to remove final drops of washed fluid. 100 ul of TMB substrate was dispensed in each well and incubated for 10 minutes. Finally, 100 ul of stop solution was

added to each well. The optical density was read within 10 minutes using biotech reader at 450 nm. The results were printed and interpreted. IgG test results were interpreted as a ratio of the sample optical density (OD) of 450 nm and the sample rate/cut-off value as follows: <0.283 U/ml = negative and >0.283 = positive. The controls and the calibrators passed the validation check recommended by the manufacturer.

2.3 Data Analysis

Data were collected, tabulated and analyzed using STATA version 11.

The statistical tool Pearson chi-square was used with the following formula:

$$X^2 = \{(\text{Observed value} - \text{Expected value})^2 / (\text{Expected value})\} \quad [3]$$

Pearson chi-square was used to evaluate the relationship between the presence of rubella IgG and parameters such as age group, gender, type of settlement and socioeconomic status. P-value <0.05 was considered statistically significant.

3. RESULTS

3.1 Rubella Prevalence within Study Area

Rubella seropositivity was observed in 268 samples, making an overall prevalence of 58.9%. Among the selected zone, southern senatorial had the highest prevalence, 61.6% though statistically not significant. (Table 1).

3.2 Rubella Prevalence about Age

A total of 268 (58.9%) out of 455 children tested were positive for rubella IgG antibody whereas rubella seropositivity increased with age, 51.1%, 63.6%, 65.1%, for the age group 5-9, 10-14, 15-19 years respectively. This was shown to be statistically significant and X^2 =8.0170 (Table 2).

3.3 Rubella Prevalence about Type of Settlement

The presence of the rubella about the type of settlement of the subjects is shown in Table 3. Those in rural areas have the highest prevalence 151 (62.7%) compared to urban areas settlers, 117 (54.7%). Meanwhile, this result was shown to be statistically insignificant with chi-square= 2.9838. (Table 3).

3.4 Rubella Prevalence about Educational and Socioeconomic Status

Seroprevalence of rubella in the subjects, about the socio-economic status of the family, is shown in Table 4 with a statistically significant value. 117 (67.6%) of the subjects had parents with low economic status. The highest prevalence occurred in children whose parents have not attended formal education, 18 (69.2%). (Table 5).

4. DISCUSSION

This school-based study captured children aged 5–19 years, and it reflected on age-specific seroprevalence rates through a wide age range. The overall rubella seropositivity rate was found to be 58.9% making a significant percentage (41.1%) of children vulnerable to infection. This is indicative of widespread viral transmission in the study population. This is a significant value indeed, since, in the United States, a single case of rubella infection is considered a potential outbreak. It implies that the infected children have the potential to transmit the infection to others in a congregate environment like households, day cares, schools, places of worship and other social gathering [4]. The female population especially women of child bearing age who are not immune to Rubella are at risk if they come in contact with these infected children because they may

Table 1. Rubella IgG antibody prevalence about zone (Senatorial)

Zones	Number screened	Number positive	(%) positive	X^2	P value
Northern senatorial zone	131	76	58.0		
Central senatorial zone	199	115	57.8	0.52	0.77
Southern senatorial zone	125	77	61.6		
Total	455	268	58.9		

P value > 0.05, insignificant result

Table 2. Distribution of Rubella IgG antibody about age group and gender

Age group	Male tested	Number positive	Female tested	Number positive	Total tested	Seropositivity	X^2	P value
5-9	96	43	90	52	186	95(51.1%)	1.93	
10-14	74	41	69	50	143	91(63.6%)	0.54	0.018
15-19	64	36	62	46	126	82(65.1%)	0.82	
Total	234	120	221	148	455			

P value < 0.05, significant result

Table 3. Distribution of Rubella IgG antibody about type of settlement

Type of settlement	Number screened	Number (%) positive	X^2	P value
Urban	214	117 (54.7)	0.65	0.084
Rural	241	151 (62.7)	0.58	

P value > 0.05, insignificant result

Table 4. Distribution of Rubella IgG antibody about economic status of parents

Economic status	Number screened	Number positive (%)	X^2	P value
High (> minimum wage)	282	151 (53.5)	1.37	
				0.0003
Low (< minimum wage)	173	117 (67.6)	2.24	

P value < 0.05, significant result

Table 5. Distribution of Rubella IgG antibody about educational status of parents

Educational status	Number screened	Number (%) positive	X^2	P value
Non-formal	26	18 (69.2)	0.47	
Primary	169	107 (63.3)	0.56	0.186
Secondary	208	117 (56.2)	0.25	
Tertiary	52	26 (50)	0.70	

P value > 0.05, insignificant result

contract the infection at their first trimester or second trimester and transmit it vertically to the developing foetus and hence, risk of congenital rubella syndrome (Gregg, 1991).

In this study, there was a significant age effect on rubella seropositivity within the environment with older subjects showing high seropositivity against rubella. Some preceding studies similarly showed the age effect on rubella immunity [5,6]. Another study found that the seropositivity decreased with decreasing age, increased with age from 58.5% among those aged 4–6 years to 93.8% among those aged over 13 years [7]. Increasing seropositivity with age can be explained by the complex effect of natural disease exposure over time [8].The rates found in this study are comparable to a study carried out in children 0–10 years in Jos, North Central Nigeria (45.2%) [9]; some studies among women of child bearing age in Nigeria which showed that between 53% and 77% have had rubella (presence of rubella IgG antibodies in unimmunized women) [10-13].

Looking at the gender-wise distribution, female subjects appeared to be more susceptible than males. This was shown statistically to be significant, and contradicts the finding of the study carried on children in Jos [9] and those of Abia state [14]. Exposure to the crowded environment as extra activities practised by these females could serve as the cause of this vulnerability. Nevertheless, in the control of rubella, immunization should be given to all male and female children to reduce the circulation of the virus in a community [15].

There is a high percentage rate of rubella in a rural area compared to urban area. This is consistent with findings in a study in Abia [14], Akwa Ibom [16]. This might be because children who live in the rural areas are generally poorer, more malnourished and more susceptible to infections [17].

Rubella seroprevalence in children with parents who had received education at any level was statistically lower than that of children with parents who received informal education; an explanation to this could be lack of awareness on hygiene and disease transmission for an air-borne infection such as rubella. A higher number of prevalence in children of parents (especially mothers) with low education and low socioeconomic status is expected, as also observed by other authors [18,19]. Parents with low economic status had a statistically significant prevalence. It was also reported by other authors [19,7,9]. This finding implied that children from lower socio-economic backgrounds got infected much earlier in life compared to their counterparts who lived in better conditions in the same area and even attended the same schools. This could be explained by high chances of rubella infection due to close contact or overcrowding and acquisition of natural immunity in the lower socioeconomic group.

5. CONCLUSION

Findings from this study are an important step in generating baseline seroprevalence data on rubella infection among children and adolescents in Adamawa state, Nigeria. 41.1% of children and adolescents are still not immune, therefore vulnerable to Rubella infection. There are risks of CRS occurring even with a low proportion of vulnerable individuals [20]. Rubella seropositivity in Adamawa state increases predominantly with age. It is also more prevalent in females, in those living with low socioeconomic status and in rural areas of the state.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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