Prevalence of Rubella Specific IgG Antibodies among Expectant Mothers in Two Tertiary Hospitals in Rivers state, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors IOO, CCA and NNO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CCA, TS and LOA managed the analyses of the study. Authors IOO, NNO and CCA managed the literature searches. Authors NNO, TS and LOA supervised the whole study which, Author CCA used as part of her PhD Thesis in the Department of Microbiology, Rivers State University, Port Harcourt, Nigeria. All authors read and approved the final manuscript.

ABSTRACT

Aims: Infections caused by rubella, though mild and self-limiting, can cause severe complications to newborn babies. It affects pregnant women mainly during their first trimester, invades the fetus leading to congenital rubella syndrome. This study was carried out to assess a population of pregnant women for rubella virus IgG antibodies and to determine their level of susceptibility to the viral infection in Rivers State.

Study Design: Cross-sectional study.

Place and Duration of Study: University of Port Harcourt Teaching Hospital (UPTH) and Rivers State University Teaching Hospital (RSUTH), both in Rivers State, Nigeria, between June 2019 and June 2020.

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Methodology: Two hundred and seventy (270) consenting pregnant women, attending Rivers State University Teaching Hospital and University of Port Harcourt Teaching Hospital, were randomly assessed for the study. The sera were analyzed for detectable anti-rubella virus IgG antibody following the manufacturer’s description using ELISA kits.

Results: Of the 270 samples evaluated for rubella Immunoglobulin G antibody, 241 (89.3%) were positive and 29 (10.7%) were negative. Rubella IgG seroprevalence was not associated with age, gestational stage, occupation and education.

Conclusion: The level of rubella IgG among the pregnant women in Rivers State was highly suggestive of exposure with several bouts of the viral infection. Therefore, there is an urgent need to improve Rubella infection surveillance, create awareness and organize Rubella screening for pregnant women.

Keywords: IgG antibody; rivers state; pregnant women; rubella.

1. INTRODUCTION

Rubella infection is caused by the Rubella virus, the most important human pathogen in the Togavirus family [1]. It is a single-stranded RNA virus, which belongs to the genus, Rubivirus. [2]. The disease is transmitted via direct or droplet contact with respiratory secretions and causes disease through two main pathways; postnatally and congenitally [3].

This disease is often mild with half of the people not realizing that they are infected [4]. It affects children and adolescents worldwide and can also affect young adults [5]. Infections occur most commonly in children and the resulting natural immunity is most probably lifelong [6]. In pregnant women, the risk of intrauterine transmission is up to 90% if infection occurs in early pregnancy (8-10 weeks gestation) [7]. When rubella virus infects susceptible women early in pregnancy, it may be transmitted to the fetus and may cause miscarriage or birth defects known as congenital rubella syndrome (CRS) [8]. Congenital rubella infection can affect almost all organ systems in the fetus and has high morbidity and mortality [9]. Typical features of congenital rubella syndrome are cataracts, intrauterine growth restriction, thrombocytopenia, purpura, patent ductus arteriosus, osteitis, and hearing impairment [10].

Each year more than 100,000 children, particularly in developing countries, are born with congenital rubella syndrome [8]. Hence, the World Health Organization (WHO) recommended all countries not using rubella vaccine to assess their rubella situation and to make plans for the introduction of the vaccine [11]. In this regard, it is helpful to assess the susceptibility profile of women of childbearing age by conducting antenatal serosurveys in such countries.

In Nigeria, rubella and CRS are not notifiable diseases, and there is no national incidence figure, but recently, studies have been carried out in some parts of the country to determine the prevalence of rubella among women of childbearing age and pregnant women [12]. These cities include Kaduna with 96.5% of positive cases [13], Ibadan 91.54% [14], Oshogbo 87.5% [12] and Niger 59% [15].

Despite the high perinatal mortality rate in Nigeria, screening for and vaccination of women and children against rubella is neither part of the antenatal nor among diseases recommended for vaccination in National Program on Immunization [16,17].

Several parts of the country have not experienced such public health research services either due to lack of man-power, infrastructural facilities or political will. However, this project was implemented in Rivers State due to its strategic socio-economic position in the Niger Delta as well as in Nigeria. Such information is crucial since there is paucity or fragmentary scientific data on the seroprevalence of rubella IgG antibody in pregnant women in the State. Hence, it is imperative to determine the Rubella susceptibility of pregnant women in a population to highlight the health risk associated with the disease and for health policymakers to proffer feasibility measures for Rubella vaccination as a national policy. Thus, this study aimed to evaluate the prevalence of rubella virus IgG antibody among pregnant women attending antenatal clinics in two tertiary institutions’ hospitals in Rivers State, Nigeria.
2. MATERIALS AND METHODS

2.1 Study Design
A cross-sectional study was carried out among pregnant women attending Rivers State University Teaching Hospital (RSUTH) and University of Port Harcourt Teaching Hospital (UPTH) both in Rivers State. A structured questionnaire was administered randomly to consenting pregnant women to obtain information on socio-demographic factors before sample collection.

2.2 Blood Sample Collection and Processing
Three millilitres (3ml) of blood were collected from 270 consenting pregnant women by venipuncture, between June 2019 and June 2020. The blood was allowed to clot and centrifuged at 3000 rpm for 5 minutes. The sera were carefully aspirated into plain bottles and stored at -20°C until analyzed [17].

2.3 Analysis of blood Samples
Laboratory analysis was carried out in the Department of Microbiology, University of Port Harcourt, Choba, Rivers State. The samples were analyzed for rubella virus IgG antibodies by using the commercially available ELISA kit manufactured by DIA.PRO Diagnostic Bioprobes Srl Via G. Carducci no. 27 20099 Sesto San Giovanni (Milano), Italy. The micro-plates were washed 5 cycles with an automated washer (Biotek ELx 50, USA). The coloured reaction product was measured by using a spectrophotometric plate reader (Biotek ELx808i, USA) at an absorbance of 450-630 nm [10]. All stages of the ELISA tests were performed according to the manufacturer’s instructions. The concentration of 10 IU/ml was used to determine the negative and positive samples after standardization of the equipment following the manufacturer’s instructions. Samples with a concentration lower than 10 WHO IU/ml were considered negative for anti-Rubella Virus IgG antibody (Dia Pro Diagnostik BioprobesSrl). Samples with a concentration higher than or equal to 10 WHO IU/ml were considered positive for anti-Rubella Virus IgG antibody [12].

2.4 Data Analysis
The data obtained from questionnaires and laboratory analysis were entered into Microsoft Excel, analyzed using Statistical Package for Social Sciences version 21. Pearson Chi-square was calculated at 95% confidence interval and P-value < 0.05 was considered significant to determine the association between the presence of the antibodies to the virus and other parameters [18,19].

3. RESULTS AND DISCUSSION

3.1 Results
Out of the 270 sera samples collected from expectant mothers and tested for Rubella IgG antibodies, an overall seropositivity rate of 89.3% (241/270) was observed, while 10.7% (29/270) of the expectant mothers tested negative for Rubella IgG antibodies (Fig. 1).

![Fig. 1. Pie chart showing rate of Rubella IgG seropositivity and seronegativity among expectant mothers](image)

Higher seropositivity of Rubella IgG antibodies was observed among the expectant mothers from UPTH, Rivers State, Nigeria (93.3%), compared to their counterparts from RSUTH, Rivers state, Nigeria (85.2%). A significant difference ($P = 0.031$) was observed in relation to their locations (Table 1).

Prevalence based on age group showed marginal differences, 88.2% and 88.9% in 20-29 years and ≥ 40 years respectively. It was slightly higher (89.8%) in 30-39 years women (Table 2). No significant difference ($P = 0.928$) was observed in relation to their age.

The seroprevalence concerning the gestational stage of pregnancy is shown in Table 3. The highest prevalence was obtained among
pregnant women in their third trimester (93.3%), followed by those in the second trimester (87.3%) and 87.2% in the first trimester. No significant difference based on the gestation stage was observed ($P = 0.330$).

Percentage prevalence of Rubella IgG antibody among pregnant women according to educational level is presented in Table 4. The highest prevalence of 89.8%, occurred among pregnant women with a tertiary level of education, 88.9% for secondary school education and 80.0% among those with primary education. There was no significant difference between the seropositivity rates concerning education ($P = 0.617$).

In the case of occupation, the highest seropositivity, 93.5% was observed among the traders followed by the artisans (93.3%). 86.1% was obtained among civil servants and 89.7% among the unemployed. The lowest seropositivity, 78.9% was obtained among students (Table 5). There was no significant difference ($P = 0.334$) between the seropositivity rates concerning the occupation.

### 3.2 Discussion

The result of this study revealed a high incidence of Rubella virus seroprevalence among pregnant women in Rivers State, Nigeria. This may be due to natural rubella infection [20] or vaccination. This presupposes that 89.3% have had previous contact with the virus while 10.7% are susceptible to rubella infection which corroborates reports from other African countries such as Ethiopia (79.5%) [21], Senegal (90.1%) [22], Cameroun (88.6%) [23] and Namibia (85.0%) [24]. Similar findings have been reported in Nigeria by [25] in Ibadan and [12] in Oshogbo, where the IgG prevalence rates were 89.4% and 87.5% respectively.

### Table 1. Prevalence of rubella IgG antibodies among pregnant women according to location

<table>
<thead>
<tr>
<th>Location</th>
<th>No analyzed</th>
<th>Rubella IgG positive (%)</th>
<th>Rubella IgG negative (%)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPTH</td>
<td>135</td>
<td>126(93.3)</td>
<td>9(6.7)</td>
<td>0.031</td>
</tr>
<tr>
<td>RSUTH</td>
<td>135</td>
<td>115(85.2)</td>
<td>20(14.8)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>270</td>
<td>241(89.3)</td>
<td>29(10.7)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Prevalence of rubella IgG antibodies among pregnant women according to age group

<table>
<thead>
<tr>
<th>Age group</th>
<th>No analyzed</th>
<th>Rubella IgG positive (%)</th>
<th>Rubella IgG negative (%)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>85</td>
<td>75(88.2)</td>
<td>10(11.8)</td>
<td>0.928</td>
</tr>
<tr>
<td>30-39</td>
<td>167</td>
<td>150(89.8)</td>
<td>17(10.2)</td>
<td></td>
</tr>
<tr>
<td>≥40</td>
<td>18</td>
<td>16(88.9)</td>
<td>2(11.1)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>270</td>
<td>241(89.3)</td>
<td>29(10.7)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Prevalence of rubella IgG antibodies among pregnant women according to the gestation stage

<table>
<thead>
<tr>
<th>Gestation stage</th>
<th>No analyzed</th>
<th>Rubella IgG positive (%)</th>
<th>Rubella IgG negative (%)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Trimester</td>
<td>47</td>
<td>41(87.2)</td>
<td>6(12.8)</td>
<td>0.330</td>
</tr>
<tr>
<td>2nd Trimester</td>
<td>134</td>
<td>117(87.3)</td>
<td>17(12.7)</td>
<td></td>
</tr>
<tr>
<td>3rd Trimester</td>
<td>89</td>
<td>83(93.3)</td>
<td>6(6.7)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>270</td>
<td>241(89.3)</td>
<td>29(10.7)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. Prevalence of rubella IgG antibodies among pregnant women according to Level of Education

<table>
<thead>
<tr>
<th>Level of education</th>
<th>No analyzed</th>
<th>Rubella IgG positive (%)</th>
<th>Rubella IgG negative (%)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>10</td>
<td>8(80.0)</td>
<td>2(20.0)</td>
<td>0.617</td>
</tr>
<tr>
<td>Secondary</td>
<td>54</td>
<td>48(88.9)</td>
<td>6(11.1)</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>206</td>
<td>185(89.8)</td>
<td>21(10.2)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>270</td>
<td>241(89.3)</td>
<td>29(10.7)</td>
<td></td>
</tr>
</tbody>
</table>
Table 5. Prevalence of rubella IgG antibodies among pregnant women according to Occupation

<table>
<thead>
<tr>
<th>Occupation</th>
<th>No analyzed</th>
<th>Rubella IgG positive (%)</th>
<th>Rubella IgG negative (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traders</td>
<td>77</td>
<td>72(93.5)</td>
<td>5(6.5)</td>
<td>0.334</td>
</tr>
<tr>
<td>Civil servant</td>
<td>72</td>
<td>62(86.1)</td>
<td>10(13.9)</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>19</td>
<td>15(78.9)</td>
<td>4(21.1)</td>
<td></td>
</tr>
<tr>
<td>Artisan</td>
<td>15</td>
<td>14(93.3)</td>
<td>1(6.7)</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>87</td>
<td>78(89.7)</td>
<td>9(10.3)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>270</td>
<td>241(89.3)</td>
<td>29(10.7)</td>
<td></td>
</tr>
</tbody>
</table>

Comparatively, several investigators have earlier reported a low prevalence rate of IgG in other cities in Nigeria such as; Niger (59%) [15], Kaduna (63.3%) [26], Ilorin (15.22%) [27] and Benin (53%) [28]. Whereas others have reported a higher prevalence rate of 93.05% in Abakaliki [29], 91.54% in Ibadan [14], 93.1% in Zaria [18] and 96.5% in Kaduna [13] against that recorded in this study. Interestingly, however, the high prevalence rate of rubella antibodies have been reported to confer a high rate of immune protection in pregnant women and is associated with low levels of complications [20].

The variation in the results of studies may not be unconnected with the difference in the endemicity of the virus, the sample size of the studies, laboratory methods, as well as the cut-off points of the assays, used [21]. On the other hand, it may also be linked to poor hygienic practices, lack of basic knowledge on the possible route of transmission of the virus, poor immunization coverage and negligence on the part of the pregnant women [15].

The exposure of all the pregnant women to the same experimental conditions may best explain why the seroprevalence was similar across the age groups. The percentage increase in the number of immune women was independent of the increase in maternal age and such phenomenon was adduced to reflect on the high endemicity of the virus [18] and concurs with the findings of other researchers [26,20] but at variance with reports by [12], [30] and [31] that prevalence of rubella antibodies increased with age. However, there was no significant difference ($P < 0.05$) between age groups and the prevalence rate of IgG antibodies, thus, establishing the fact that rubella affects all age groups [12].

The occurrence of Rubella IgG antibodies in all the trimesters of pregnancy with the highest prevalence obtained in the third trimester was in consonance with earlier literature report [29] but contrasted with the works of [15,18,27] which showed the highest prevalence rate in pregnant women in their second trimester. This result showed that most pregnant women in their third trimester are sero-immune, therefore their babies are not at risk of CRS [12]. Consequently, the lower prevalence obtained in the first trimester makes them more prone to rubella and predisposes their babies at risk of CRS. There was no statistical relationship between the gestation period of the pregnancy and the IgG titre levels which supports the work of [27] but differs from that of [32]. The reason for such variation could be attributed to the level of exposure to rubella virus, coupled with the weak immune system [15].

The higher prevalence rate among women with tertiary education was in agreement with the previous reports [29,20] and maybe attributed to prolonged exposure to the virus from various environments and lifestyle pattern as students are generally more mobile [28]. These findings are contrary to reports that primary school graduates had the highest prevalence of IgG titre [12]. The results of this study showed that the educational status of the pregnant women was an insignificant risk factor. A finding consistent with reports by other researchers [15,29]. Furthermore, the prevalence of Rubella IgG was independent of the occupation of pregnant mothers ($P=0.33$). The high prevalence rate of 93.5% was recorded among mothers who are traders and may be due to the predisposition of these women to factors that enhance the spread of rubella virus infection [20].

4. CONCLUSION

The seroprevalence of rubella IgG antibody among pregnant women in Rivers State was high (89.3%) and suggestive of a sustained infection and endemicity of the viral infection in the population. The result of this study revealed a high incidence of Rubella virus seroprevalence
among pregnant women in Rivers State, Nigeria. The exposure of all the pregnant women to the same experimental conditions may best explain why the seroprevalence was similar across the age groups. This underscores the need to improve Rubella infection surveillance, create awareness and organize rubella screening for pregnant women and women of child-bearing age in the State.

CONSENT

All authors declare that written informed consent was obtained from the patients for publication of this study.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the Hospital Research Ethics committees of University of Port Harcourt Teaching Hospital (UPTH) and Rivers State University Teaching Hospital (RSUTH) and have, therefore, been performed following the ethical standards laid down in the 1964 Declaration of Helsinki.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES