Prevalence of Rubella IgG Antibodies among Pregnant Women in Rivers State, Nigeria

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Authors’ contributions

This work was carried out in collaboration among all authors. Author BJO wrote the proposal for ethical approval, procured the materials used for sample collection, addressed the subjects, collected samples, ran the laboratory analysis and read the results. Author IOO conceived and designed the study, partially financed the whole study and laboratory analysis. He also assisted in the collection of samples, the laboratory analysis and contributed principally in writing up the manuscript as well as the data and statistical analysis of this study. Author TIC participated in the laboratory analysis and reading of the results. Author OO participated in the study design, reviewing and supervision of the whole study which, author BJO used as part of her M.Sc. Thesis in the Department of Applied Microbiology, Ebonyi State University, Abakaliki, Nigeria. All authors contributed equally in writing up this manuscript, editing, proof-reading and approval of the final manuscript for this publication. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Rubella virus is the cause of the communicable viral infection that can affect the foetus causing foetal loss or congenital rubella syndrome. Plasma samples from 180 pregnant women attending tertiary hospitals in River State, Nigeria were examined randomly to evaluate the prevalence of rubella virus (RubV) IgG antibodies.

Study Design: Cross-sectional study.

Place and Duration of Study: University of Port Harcourt Teaching Hospital (UPTH) and Braithwaite Memorial Specialist Hospital (BMSH) now Rivers State University Teaching Hospital (RSUTH) between September 2015 and August 2017.

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Methods: The sample of this study was composed of 180 pregnant women. ELISA was used to detect the RubV IgG antibodies and prevalence was correlated with sociodemographic factors.

Results: The study result revered that 155(86.1%) were positive for RubV IgG while 25(13.9%) were negative for RubV IgG. Of the 90 samples examined from BMSH, 71(78.9%) were IgG-positive. From UPTH, 84(93.3%) were positive for RubV IgG. The highest (100%) seropositivity for RubV IgG was found in age groups 39-43 years. No RubV IgG was recorded in age groups 44-48 years. Women in their third trimester had the highest prevalence of RubV IgG antibodies (94.7%). Those with secondary education had the highest prevalence of RubV IgG (93.4%). Vaccinated pregnant women had the highest prevalence (87.4%). Among the variables evaluated, education (p=0.023), occupation (p=0.040), marital status (p=0.001) and vaccination history (p=0.005) were the main correlates in this study.

Conclusions: This study has shown evidence of immunity among expectant mothers in this study (86.1%) with 13.9% being vulnerable to rubella virus infection. Completion of adequate rubella vaccination along intensified surveillance of the vulnerable population remains the keystone for the control of congenital rubella syndrome in Nigeria.

Keywords: Antibodies; IgG; prevalence; pregnant women; Nigeria.

1. INTRODUCTION

The global burden of rubella virus (RubV) infection is large, as the World Health Organization estimated that over 100,000 babies with congenital rubella syndrome (CRS) are delivered annually and 85% of the world’s disability in babies is caused by rubella virus in low-income countries [1]. Outbreaks, which may go unrecognized due to the mild nature of the infection, could account for variation in the prevalence of rubella IgG and IgM antibodies in various populations [2].

Serological test using ELISA is an important tool for measuring rubella-specific IgG and IgM, and it is considered as a suitable, sensitive, and precise method of diagnosis [3]. Despite the high perinatal mortality in Nigeria, screening for rubella virus is neither incorporated into gynaecological care nor among the diseases listed for immunization in the nationwide programs [4,5].

In Nigeria, past studies have revealed seroprevalence of rubella IgG in pregnant women to be 53.0% in Benin [2] 84.8% in Ilorin [6], 90.6% reported in Jos [7], 96.5% in Kaduna [8], 83.3% in Borno State [9], 87.5% in Osogbo [10], 73.8% in Lagos [11], 95.4% in Southeastern Nigeria [12], 91.54% in Ibadan [13] and 3.1% in Zaria [14].

Sporadic outbreaks of rubella infection, with its associated significant harm, make full immunization in childhood and women of child-bearing age, imperative [2,15,16]. Although a major section of pregnant women is vaccinated, cases of rubella infection occur in Nigeria among pregnant women [17]. There has also been a lack of attention on rubella in Rivers State, Nigeria. This study seeks to evaluate the occurrence of RubV IgG antibodies in pregnant women to ascertain their immunity and vulnerability to RubV infection in the Rivers State of Nigeria.

2. MATERIALS AND METHODS

2.1 Study Areas

This cross-sectional study was conducted from September 2015 to August 2017 among pregnant women attending the antenatal clinics in the University of Port Harcourt Teaching Hospital (UPTH), in Rivers State, Nigeria and the Braithwaite Memorial Specialist Hospital (BMSH), now the Rivers State University Teaching Hospital (RSUTH), in Rivers State, Nigeria. Port Harcourt lies along the Bonny River in the Niger Delta region of Nigeria with its Coordinates: 4°53’23”N 6°54’18”E and covers an area of 360 km². Port Harcourt metropolis consists of Obio/Akpor Local Government Area and Port Harcourt Local Government Area [18], which comprises largely Ikwere ethnic group and several other ethnic groups from all around Nigeria. According to the 2006 National Census, Port Harcourt City local government area and Obio/Akpor local government area had a population of 1,382,592 and 878,890 respectively [19].

2.2 Sample Size

The sample size for this study was determined using an established formula [20,21]: N =
\[ Z^2(PQ)/d^2, \] Where N is the desired sample size, \( Z = \) Normal standard distribution that corresponds to 95% at confidence interval as 1.96, \( p = \) Prevalence of Rubella (7.8% for Rivers state as reported by Okonko et al. [22], \( q = 1-p \) and \( d = \) degree of accuracy/precision expected at 0.05. Hence, the estimated sample size was 111 pregnant women with an additional 10% sampled to take care of study participants that may be lost to follow-up [20,21], providing an estimated total sample size of 122. Therefore, in this study, a total of 180 consenting pregnant women was used for this study.

2.3 Sampling Techniques

This is a cross-sectional study involving 180 pregnant women from two tertiary institutions in Rivers State, Nigeria. Necessary demographic, clinical, and epidemiological data of each of the participants were obtained using well-structured questionnaire forms. Women who had full documentation in the registration book were included, whereas women who had incomplete data like age, laboratory test results, and duplicate records (if one pregnant woman came twice or more at a different time) were excluded from the study. A random sampling of the pregnant women was done in the healthcare facilities mentioned above to total 180; this ensured that sampling was representative of the state.

2.4 Study Population

One hundred and eighty expectant mothers attending the antenatal clinics of University of Port Harcourt Teaching Hospital (UPTH) and Braithwaite Memorial Specialist Hospital (BMSH), Port Harcourt, Rivers State, Nigeria, participated in this study.

2.5 Sample Collection and Processing

A volume of five ml of whole blood was collected via venipuncture using a sterile syringe, which was transferred into a labelled sterile vial containing anticoagulants (EDTA). The blood samples were transported, on ice packs, to the Medical Microbiology laboratory of the Department of Microbiology, University of Port Harcourt. Plasma was obtained by centrifugation.

2.6 Rubella Virus IgG Antibodies Detection

Plasma samples were analyzed for rubella virus IgG antibodies using the commercially available ELISA kit manufactured by DIA.PRO Diagnostic BioprosesSrl Via G. Carducci n° 27 20099 Sesto San Giovanni (Milano) – Italy. The microplates were washed in 5 cycles with an automated washer (BiotekELx 50, USA). The color reaction product was measured using a spectrophotometric plate reader (Biotek ELx808i, USA) at an absorbance of 450-630nm [23]. All stages of the ELISA tests were performed according to the manufacturer’s instructions. Results were interpreted as recommended by the kit manufacturer.

2.7 Data Analysis

Descriptive statistics were used to describe the characteristics of the study participants. Chi-square test was used to determine relationships between the variables and the prevalence of rubella virus (RubV) IgG antibodies. The p-value was considered significant at 0.05. All analyses were conducted using complex samples analysis of the Statistical Package for the Social Sciences (SPSS), IBM version 22.

3. RESULTS AND DISCUSSION

3.1 Results

Of the 180 sera samples collected from expectant mothers and tested for RubV IgG antibodies, an overall seropositivity rate of 86.1% (n=155/180) was observed. However, 25(13.9%) of the expectant mothers tested negative for RubV IgG antibodies. Table 1 shows the baseline characteristics of the study population.

3.1.1 Study location-specific seropositivity of RubV IgG antibodies

Higher seropositivity of RubV IgG antibodies was observed among the expectant mothers from UPTH, Port Harcourt, Rivers State, Nigeria (84/90(93.3%)) compared with their counterparts from BMSH, Port Harcourt, Rivers State, Nigeria [71/90(78.9%)]. No significant difference (p=0.266) was observed in their locations.

3.1.2 Age-specific seropositivity of RubV IgG antibodies among pregnant women

The highest seropositivity for RubV IgG antibodies was found in pregnant women within age groups 39 years and above [7/8(87.5%)]. This was closely followed by age groups 34-38 years [33/38(86.8%)], 24-28 years
52/60 (86.7%), and 29-33 years 58/67 (86.6%). Lower prevalence was found in age groups 19-23 years 5/7 (71.4%). No age-specific seropositivity was found (p=0.125).

3.1.3 Seropositivity of RubV IgG antibodies in relation to gestation period among pregnant women

Highest seropositivity rates of RubV IgG antibodies were found among pregnant women in their third trimester [36/38 (94.7%)], followed by those in their first trimester [45/51 (88.2%)] and those in their second trimester had the lowest occurrence rates [74/91 (81.3%)]. No significant association was observed (p=0.116) between RubV IgG and gestation period.

3.1.4 Educational status-specific seropositivity of RubV IgG antibodies

Pregnant women with secondary education [71/76 (93.4%)] had the higher seropositivity rate of RubV IgG antibodies compared to those with tertiary education [78/95 (82.1%)] and primary education [6/9 (66.7%)]. A significant difference (p=0.023) was observed between RubV IgG antibodies and the educational status of pregnant women.

3.1.5 Occupation-specific seropositivity of RubV IgG antibodies

Occupation-specific (p=0.040) seropositivity was observed in this study. Pregnant women who were traders [75/81 (92.6%)] had the highest seropositivity. This was closely followed by civil servants [43/50 (86.0%)], housewives [23/29 (79.3%)] and students [14/20 (70.0%)].

3.1.6 Marital status-specific seropositivity of RubV IgG antibodies

Marital status-specific (p=0.001) seropositivity for rubella IgG antibodies was found among pregnant women in this study. Seropositivity of RubV IgG antibodies was found to be higher among the married [150/170 (88.2%)] than the singles [5/10 (50.0%)].

3.1.7 Vaccination history-specific seropositivity of RubV IgG antibodies

Of the 143 vaccinated pregnant women in this study, 125/143 (87.4%) were positive for RubV IgG antibodies. Also, of the 37 unvaccinated pregnant women, 30/37 (81.1%) were positive for RubV IgG antibodies. Vaccination history-specific RubV IgG seropositivity (p=0.005) was observed among pregnant women.

Table 1. Baseline characteristics of the study population (n=180)

<table>
<thead>
<tr>
<th>Social demographic characteristics</th>
<th>Groups</th>
<th>Number tested</th>
<th>IgG Positive</th>
<th>% Positive</th>
<th>P-value</th>
</tr>
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<td></td>
<td></td>
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<tr>
<td>19-23</td>
<td>7</td>
<td>5</td>
<td>71.4</td>
<td>p=0.125</td>
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<tr>
<td>24-28</td>
<td>60</td>
<td>52</td>
<td>86.7</td>
<td></td>
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<td>29-33</td>
<td>67</td>
<td>58</td>
<td>86.6</td>
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<td>39 years and above</td>
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<td>7</td>
<td>87.5</td>
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<td>Gestation period</td>
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<tr>
<td>1st Trimester</td>
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<td>45</td>
<td>88.2</td>
<td>p=0.116</td>
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<td>74</td>
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<tr>
<td>3rd Trimester</td>
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<td>94.7</td>
<td></td>
<td></td>
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<tr>
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<td>6</td>
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<td>70</td>
<td>p=0.040</td>
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<tr>
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<tr>
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<td>136</td>
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<td>p=0.115</td>
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<tr>
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<td>76.0</td>
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<td></td>
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<td>Location</td>
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<tr>
<td>BMSH</td>
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<td>71</td>
<td>78.9</td>
<td>p=0.266</td>
<td></td>
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<td>UPITH</td>
<td>90</td>
<td>84</td>
<td>93.3</td>
<td></td>
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</table>
3.2 Discussion

The 78.9% prevalence for pregnant women in Zaria [33] than 93.0% antibodies to rubella virus in Zaria, Nigeria [14]. UPTH agrees with antibodies among pregnant women presenting at Nigeria (78.9%). Higher seropositivity of RubV IgG antibodies was observed among the expectant mothers from UPTH, Rivers State. A significant difference (p=0.266) was observed. In terms of the different hospital locations, no significant difference (p=0.266) was observed. Higher seropositivity of RubV IgG antibodies was observed among the expectant mothers from UPTH, Rivers State, Nigeria (93.3%) compared to their counterparts from BMSH, Rivers State, Nigeria (78.9%). The 93.3% prevalence for IgG antibodies among pregnant women presenting at UPTH agrees with 93.1% reported for IgG antibodies to rubella virus in Zaria, Nigeria [14]. 93.0% in Khartoum State, Sudan [31] and 93.2% in Burkina Faso [32]. However, this value is lower than the 96.5% in Kaduna, Nigeria [9], 97.9% in Zaria [33] and 99.3% in Uganda [34].

The 78.9% prevalence for pregnant women presenting at BMSH agrees with 77.0% in Ouagadougou, Burkina Faso [35], 79.9% in Kenya [36]. This 78.9% prevalence disagrees with past studies carried out in and out of Nigeria; 7.0% in Ilorin [6], 52.9% in Benin [2], 54.1% in Maiduguri [29], 65.4% in West Sudan [31] and 55.1% in Bangui, Central Republic of Africa [37]. The difference in the prevalence of IgG from location to location might be due to climatic, cultural practice or sensitivity of the test kits.

Before the widespread use of rubella vaccines, this was mainly the disease of children. However, today it occurs most often in young adults [38]. In this study, all the pregnant women who participated were between the ages of 19 – 48 years and it was observed that the prevalence of rubella virus IgG antibodies increased with age, with the highest prevalence found in the age group 39-43 years. However, this age-specific association was not significant (p=0.125). This observation confirms the report of Ogbonnaya et al. [39], who showed that the seroprevalence of IgG antibodies increased with age.

No significant association was observed (p=0.116) between RubV IgG and gestation period. However, the highest seropositivity rates of RubV IgG antibodies were found among pregnant women in their third trimester. This observation accords with the findings made by Yahaya et al. [40] but contrasts with those of Bamgboye et al. [5] and Fokunang et al. [24]. The maternal protective antibody (IgG) will prevent the virus from crossing the placenta, thus causing the minimal congenital effect to the foetus [41]. Consequently, the small percentage (13.9%) of pregnant women who were found IgG seronegative especially in their first and second trimesters have a high risk of transmitting the infection to the foetus which could lead to CRS [42].

Educational status-specific statistical association (p=0.023) existed between rubella antibodies and educational status in this study. Pregnant women with secondary education (93.4%) had a higher seropositivity rate of RubV IgG antibodies compared to those with tertiary education (82.1%) and primary education (66.7%). This agrees with Junaid et al who reported that pregnant women with secondary school level of education have a higher prevalence of rubella IgG (20.4%) in relation to others [43]. The highest prevalence of rubella virus antibodies among secondary school holders could be as a result of their low level of education and hence, low socio-economic condition. The motivation of health education as regards to the peril of rubella

3.1.8 Residence-specific seropositivity of RubV IgG antibodies

Pregnant women from the urban area recorded higher seropositivity [136/155(87.7%)] compared to their counterparts from the rural areas [19/25(76.0%)]. However, this difference was not statistically significance (p=0.115).
seems helpful for women to reduce the burden of the disease.

Statistical occupation-specific association (p=0.040) also existed between rubella virus IgG seropositivity and the type of occupation of these pregnant women. The highest seropositivity for rubella virus IgG antibodies was established in expectant mothers that were traders. This may be as a result of the nature of their occupation which involves crowding environments which enhance their chance of exposure to rubella virus infection. This deviated from the findings of Yahaya et al. who reported no significant association between this variable and antibody prevalence of rubella in their study [40].

The present study showed the highest seroprevalence for rubella IgG antibodies among married pregnant women compared to the singles. Marital status-specific (p=0.001) seropositivity for rubella IgG antibodies was found among pregnant women in this study. This observation agreed with the findings of Ogbonnaya et al. [39] and that of Yahaya et al [40] who reported a statistically significant difference. The possible reason for the high prevalence among the married expectant mothers could be longer period and a higher rate of children and nursing knowledge also might be due to the lower sample size of the pregnant women that were single [40].

Vaccination history-specific RubV IgG seropositivity (p=0.005) was observed among pregnant women. Pregnant women that were vaccinated showed ahiger prevalence for rubella IgG antibodies than their unvaccinated counterparts and there was a significant difference concerning the history of vaccination (p=0.005). This study is congruent with a report that high seropositivity for rubella IgG antibodies has been obtained through vaccination in Finland [44]. Detection of rubella virus IgG antibodies (81.1%) among the non-immunized pregnant women in this study showed an indication of past exposure to the rubella virus which can be subclinical or clinically or owing to past vaccinations. Similarly, Fokunang et al. [24] observed overcrowding and the ease with which the virus spreads among unvaccinated population attributes to high seroprevalences. Hence, this agrees with the constant spread of rubella virus in a nation where protective rubella vaccine is merely accessible for knowledgeable adults’ populace at a very high price. This agrees with the findings by Pennap et al. [45] that the rubella virus has been spreading in Nigeria.

Higher frequency of rubella virus IgG antibodies was recorded among pregnant women from the urban area (87.7%) compared to their counterparts from the rural populations (76.0%). This difference was not statistically significant (p=0.115). This finding agreed with the findings of Bamgbaye et al. [5], Tahital et al. [32] and Mangga et al. [8] who showed a higher seroprevalence of rubella virus antibodies among expectant mothers in urban cities. While Tahital et al. [32] reported a higher prevalence in pregnant women from the urban setting (94.7%) compared to those from rural settings (92.3%) in Burkina Faso, Hashem et al also reported higher prevalence among women from urban settings (98.8%) than those from rural settings (90.8%) in Egypt [46]. The high prevalence among the urban-dwellers could be attributed to the overpopulated living state in the urban area that might enhance the opportunity of exposure to rubella virus infection.

Our findings deviated from that of Mwambe et al. [47] who reported a higher prevalence of Rubella IgG antibodies among rural (94.5%) than the urban (90.6%) areas of Mwanza, Tanzania. Likewise, Barreto et al. [48] reported a higher prevalence among pregnant women from rural settings (96.8%) than those from urban settings (92.8%) in Maputo, Mozambique. The variation in serologic profiles between urban and rural settings as found in this study might be due to malnutrition, overcrowding and inadequate or lack of supportive health care in rural communities [49].

This study further observed that 13.9% of pregnant women were seronegative for RubV IgG antibodies. This suggests that these populations are at risk for Rubella virus infection. This report established previous findings by Pennap et al. [45] and Olusanya and Blomberg [50] who testified that even in the presence of efficient vaccine for the avoidance and control of rubella malady, there are still cases of rubella virus malady and congenital rubella syndrome stated in other parts of Nigeria. Many researchers have suggested that the risk of CRS can be reduced through vaccination. Robertson et al. [3] also recommended that the screening for rubella-specific antibodies should be done in pregnant women during their antenatal clinics.

4. STUDY LIMITATION

The burden of rubella infection in most developing countries is however not well
documented because of limited epidemiological data. The limitations of this study were that avidity indices for these IgG antibodies and the molecular characterization of Rubella virus were not determined owing to scarce resources. However, this study has been able to document the prevalence of RubV IgG antibodies among pregnant women in Rivers State, Nigeria.

5. CONCLUSION

This study found an 86.1% prevalence of rubella virus (RubV) IgG antibodies among pregnant women in Rivers State, Nigeria. Thus, our study also established that there are pregnant women who are vulnerable to rubella virus infection and also have the possibility of transmitting the virus to their unborn child. Therefore, completion of adequate rubella vaccination policy along with intensified surveillance for evaluation of per cent populace vulnerable to rubella virus infection, remain the keystone for the control of congenital rubella syndrome in Nigeria. This result will help researchers and healthcare providers to uncover the critical areas of public health implications of rubella infection in pregnant women that many researchers and antenatal clinics in Rivers State were previously not able to explore.

CONSENT

All authors declare that written informed consent was obtained from the patient (or other approved parties) for publication of this study.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee 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


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