Seroprevalence of Rubella Virus among Pregnant Women in the Red Sea Region of Sudan

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Aims: We aimed to investigate the occurrence of the rubella virus among pregnant women, including those who had a history of abortions in the Red Sea region of Sudan.
Study design: Cross-sectional study.
Place and Duration of Study: The study was conducted at the Port Sudan referral tertiary hospital.
Methodology: Blood samples were collected at random from 100 participants who were pregnant or had a history of abortion and who were referred to the hospital. Side flow chromatography immunoassay was used for detection, and the Elisa technique was used for confirmation.
Results: From a total of 100 participants, rubella virus Immunoglobulin G (IgG) was detected in 20 (20%), and 80 were seronegative (80%). The seronegative Immunoglobulin M (IgM) was 0 (00.0%), with no participant had a recent infection. The prevalence of 11 rubella virus IgG was significantly high (P = .003) among the females who had abortions 61 (61%). However, no statistically significant relationship was found with the frequency of IgG of rubella virus and age, gestational age, level of education, or occupation.

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Conclusion: The study concluded that the prevalence of rubella infections was higher among pregnant females and who had a history of abortions in the Red Sea region. The detection of human rubella virus IgG previous infection was higher than IgG recent infection.

1. INTRODUCTION

The *rubella virus* is well known as three-day measles or German measles [1]. *Rubella virus* is an enveloped virus that contains single-stranded RNA with positive polarity and has one antigenic type. The transmission of *rubella* is transplacental or respiratory droplets and is prevalent among the pregnant females [2]. This virus causes a mild disease similar to the flu that often passes unnoticed. Wang et al. found that this infection can end up to three days and is likely to resolve more quickly in children. However, this disease has adverse effects on pregnant women if it is contracted in the first 20 weeks of pregnancy, and it can result in a child being born with congenital rubella syndrome (CRS). This involves several severe chronic diseases, and it causes miscarriage in about 15% of reported cases [3]. Another type of this virus is not congenital. It is acquired through different ways, including the emission of airborne droplets from the upper respiratory tract.

There are different ways to detect the virus, such as analyzing urine, stools, and skin. According to Leung et al. this virus has an incubation period of two to three weeks, and it has no carrier state, as the reservoir exists entirely in the active human cases [4]. Rubella virus intrauterine infection can cause CRS. This can cause a wide range of deficiencies, including auditory, cerebral, cardiac, ophthalmic, and auditory deficiencies [5]. The other types of deficiencies that can be caused by the virus are anemia, neonatal thrombocytopenia, premature birth, low birth weight, and hepatitis. Infections that occur in the first trimester pose a greater risk for causing defects or organogenesis. Rubella infections during pregnancy are the main reason for the development of a vaccine [6]. The disease in children can last for two days and can be accompanied by symptoms such as posterior cervical lymphadenopathy, low body temperature (less than 38.3°C or 101°F), and a rash that begins on the face and spreads to the rest of the body [7-9].

The symptoms of the disease can vary according to age; for example, in adults and children, symptoms can be in the form of aching joints, coryza and swollen glands, bleeding problems, and brain infections. The antibodies can persist for more than a year, and precautions should be taken after positive test results [10]. The diagnosis can be confirmed by the characteristic rash and detection of antibodies during or a short time after the illness [11]. Early identification of these women by serologic testing might be used as part of a strategy to prevent perinatal transmission of *rubella viruses*.

The current situation regarding the identification of the virus is gloomy in Sudan due to the limited data available on *rubella* [12]. Pregnant women and their unborn babies are vulnerable to congenital *rubella* syndrome [13]. To the best of our knowledge, no previous study has investigated the prevalence of *rubella* infections among pregnant females and who had a history of abortions in the Red Sea region of Sudan. Thus, the study aimed to investigate the prevalence of *rubella* infections in the Red Sea region of Sudan.

2. MATERIAL AND METHODS

2.1 Study Design and Participants

This cross-sectional study was conducted at a tertiary referral hospital in Port Sudan City, Sudan. A questionnaire to collect demographic data, personal information, and health and socio-economic data. Participants were informed about the purpose of the study, and the samples were collected only from those who agreed to participate. The privacy and confidentiality of participants were ensured. The blood samples of 100 participants were collected at random from pregnant women and women with a history of abortion who had been referred to the hospital.

2.2 Specimen Collection

After washing hands and putting on gloves, the researcher collected a 3 ml blood sample from each participant through venipuncture. The patient was positioned with an arm extended. An appropriate vein was selected; then, about 3-4 inches above the collection site, a swab with 70% isopropyl alcohol was passed smoothly in a circle over the puncture site, moving in an

outward spiral from the zone of penetration. A plain sterile vacationer was used to collect the blood samples. The blood samples were centrifuged for 15 minutes at 3000 rpm to separate the sera. Then, they were stored at −20 °C until they were needed.

2.3 Immunological Analysis

TORCH IgG/IgM Rapid chromatographic immunoassay (On-site IgG/IgM Combo Rapid Test, CTK Biotech™, USA) was used to detect IgG and IgM antibodies of rubella virus and its differentiation. The ELISA method was used to obtain clinical findings from the reactions of specimens reactive with the TORCH IgG/IgM Rapid test [whole blood plasma/serum]. A control group of five known positive samples and five negative samples was created. Before using this technique, the room temperature was adjusted to a range of 15 °C –30 °C, and then the test, specimen, and buffer were brought in. The manufacturer's directions said that for best results, the assay should be performed within an hour. The test was removed from its sealed package and placed on a clean, level surface. The devices were labeled as belonging to a patient or from the control group for identification. Using a dropper from the test kit, we carefully transferred 1 drop (25 ul) of serum or plasma to the sample well (S) and then added 1 drop of buffer to the sample well (S). For the whole blood specimen using the provided dropper, carefully transfer 2 drops (50 ul) of whole blood to the sample well (S) and then added 1 drop of the buffer to the sample well (S). The sample migrated across the membrane, and the results read within 15 to 20 minutes.

Anti-rubella and anti-CMV IgM and IgG antibodies were assayed by an enzyme-linked immunosorbent assay (ELISA) method using an Abbott kit (Axsym, Abbott, USA) according to the manufacturer's instructions. Anti-rubella IgM antibody titers greater than 0.6 and anti-rubella IgG antibody titers greater than 10.0 IU/ml were considered positive.

2.4 Statical Analysis

Statical analysis was performed on SPSS v.23 using the chi-square test, and $P < .05$ was considered as a significant association.

3. RESULTS

3.1 Prevalence of *rubella virus* IgG among Pregnant Women and with the History of Abortions

Of the 100 participants, the prevalence of *rubella virus* IgG was 20 (20%), while 80 were seronegative (80%). There was no evidence of recent infection, based on seronegative IgM 0 (00.0%) (Table 1). The study group was subdivided into four groups based on the subjects' ages: 18-24 years old, 25-30 years old, 31-35 years old, and 36-40 years old. The frequency of *rubella virus* IgG in the four groups was as follows: For those 18–24 years old, five subjects (5% of the original group of participants) were seropositive with IgG. For those 25–30 years old, 10 subjects (10%) were seropositive. For those 31-35 years old, 4 subjects (4%) were seropositive, and for those 36-40 years old, 1 subject (1%) was seropositive. These results were found to be statically insignificant ($P = .9$) (Table 2).

3.2 Frequency of IgG of *rubella virus* to Gestational Age

The prevalence of *rubella virus* based on the stage of pregnancy also was found not to be statistically significant: 4 seropositive subjects (4%) were in the first trimester, 4 (4%) were in the second trimester, and 12 (12%) were in the third trimester. The prevalence of *rubella virus* based on gestational age was not statistically significant ($P = .8$) (Table 3).

Table 1. The prevalence of *rubella virus* IgG among pregnant women and those who had a history of abortions

RV	Frequency	Percentage (%)
IgM	0	0%
IgG	20	20%
Negative	80	80%
Total	100	100%

Table 2. Frequency of IgG of *rubella virus* by age

Age		RV			*P*-value
		IgG positive	IgG Negative	Total	
18–24	Count	5	16	21	.9
	%	5%	16%	21%	
25–30	Count	10	44	55	
	%	10%	44%	55%	
31–35	Count	4	15	19	
	%	4%	15%	19%	
36–40	Count	1	5	6	
	%	1%	5%	6%	
Total	Count	20	80	100	
	%	100.0%	100.0%	100.0%	

Table 3. Frequency of IgG of *rubella virus* to gestational age

Gestational age		RV			*P*-value
		IgG positive	IgG Negative	Total	
1st trimester	Count	4	21	25	.8
	%	4%	21%	25%	
2nd trimester	Count	4	15	19	
	%	4%	15%	19%	
3rd trimester	Count	12	44	56	
	%	12%	44%	56%	
Total	Count	20	80	100	
	%	100.0%	100.0%	100%	

Table 4. Frequency of *rubella virus* IgG according to abortion history

Abortion		RV			*P*-value
		IgG positive	IgG Negative	Total	
Yes	Count	11	61	72	.003
	%	11%	61%	61%	
No	Count	9	19	28	
	%	9%	19%	28%	
Total	Count	20	80	100	
	%	100.0%	100.0%	100%	

3.3 *Rubella virus* IgG according to Abortion History

The frequency of *rubella virus* IgG among the females who had a history of abortions and non-aborted pregnant women was 11 (11%). The results were found to be significant for the group of women with a history of abortion 61 (61%) P=0.003 (Table 4). Moreover, there was no statistically significant relationship between the frequency of *rubella virus* IgG and education level (*P* = .5) or occupation (*P* = .2).

4. DISCUSSION

There is a high morbidity and mortality rate caused by *rubella,* especially to fetuses of mothers with congenital or neonatal infections. The result is a wide range of medical abnormalities that also create social and financial burdens to families and countries. This has made the screening of pregnant women an important research activity. The present study found that 20 pregnant women and women with a history of abortion (20% of the participants) were positive for antibody IgG. These results agreed with those of Elamin and Khidir (2017), who found that rubella IgM and IgG antibodies were high among pregnant women in the City of Khartoum, Sudan. They also reported that 5 participants (around 5.4% of their subjects) were reactive to *rubella* IgM, in contrast to 48 participants (51.6%) who were reactive to *rubella* IgG antibodies [13]. Other researchers found *rubella* IgG antibodies

in 35% of pregnant women in Khartoum [14]. Lulandala et al., reported a high number of rubella-associated abortions among females with 12±3.2 weeks pregnancy in Tanzania [15]. Rubella IgG antibodies are positive in 97.4% of females with abortion history and 95.9% with no abortion history [16]. Moreover, the seroprevalence of measles, rubella antibodies, and mumps affected 97% of healthcare workers, 93.5%, 90.8%, and 94.1%, respectively, among adult volunteers. In children, the percentages ranged from 99.2% to 63.6% [12]. In a meta-analysis of 28 studies in Sub-Saharan countries, the pooled seroprevalence of anti-rubella IgG among pregnant women was found to be about 89.0% (95% CI: 84.6–92.3%), and for rubella IgG and IgM, the pooled prevalence among pregnant women was 5.1% (95% CI: 2.6–9.9) [17].

In the present study, no anti rubella IgM was detected. This agrees with results obtained by Wafa et al., who reported IgM seronegative in their study in Khartoum [18]. In contrast, of 231 pregnant women in a study in the Western region of Sudan, 51 (65.3%) were positive for rubella IgG, and only 8 women (3.4%) were rubella IgM positive [19]. However, a study from India revealed that 39.2% of pregnant women in a sample were seropositive for rubella IgG antibodies, whereas around 20.86% of non-pregnant women were tested positive. That study also showed that of the 76 seropositive women, only 4 (5.26%) revealed IgM antibodies. This indicates that the results of both the rapid immunochromatographic test (39.20%) and the ELISA (40.61%) were low, and the specificities of the two methods were similar (79.13%) [20]. Furthermore, a study of 184 sera samples from Nigeria included 176 (95.7%) and 22 (12%) who were seropositive for IgM and rubella IgG. Twenty (11%) of those seropositive for IgM were also positive for IgG; only two (1%) were positive only for IgM.

IgG prevalence was highest among those 26–30 years old (98.3%) and IgM was highest for those 31–35 years old (18.8%) [21]. In this study, no statistically significant relationship was found between the frequency of rubella IgG and age group, gestational age, level of education, or occupation. However, Akele et al. (2020) concluded the prevalence rate for rubella IgG was highest among those 26–30 years old (98.3%) and 31–35 years (18.8%) for IgM [22]. These variations may be due to differences in sample size, study duration, or the techniques used to detect the virus.

5. CONCLUSION

In conclusion, this study found that the prevalence of the rubella virus was high among pregnant females who had a history of abortions in the Red Sea region of Sudan. The detection of human rubella virus IgG from previous infections was valuable, while no case of recent infection was found. The prevalence of the rubella virus compared to age, level of education, and occupation was not statistically significant. However, the presence of rubella virus IgG in Sudan should be given careful attention. It is recommended that antibodies be detected among the listed tests for pre-married girls and those receiving prenatal care. This study increased public awareness and knowledge about the rubella virus, as it provided universal infant immunization to decrease the circulation of the virus.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICS APPROVAL

The study followed the ethical guidelines of the World Medical Association (WMA) Declaration of Helsinki, and the ethical committee of Omdurman Islamic University Sudan approved the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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