

# Seroprevalence of Rubella Virus Antibodies among Pregnant Women in Hodeidah City, Western Yemen

## Abstract

**Introduction:** Rubella infection in early pregnancy can lead to miscarriages, fetal death, or birth of an infant with congenital rubella syndrome (CRS). Like other developing countries, in Yemen rubella surveillance is not well-established. So, the aim of this study was conducted with the objectives of estimating the seroprevalence and potential risk factors in acquiring rubella infection by pregnant women in Hodeidah city Yemen.

**Methods:** A cross-sectional study was conducted for rubella infection among pregnant women attending antenatal clinics in Hodeidah city, western Yemen. Demographic data, obstetric characteristics, and blood samples were collected and tested for rubella specific antibodies (IgG and IgM) by using the Electro-Chemiluminescence Immunoassay (ECLIA) technique.

**Results:** The study revealed that Rubella virus antibodies were positive in 91.25% of the samples of which 89.2% were positive only for IgG class and 2.0% positive for both IgG and IgM antibodies. There was no statistically significant association between Rubella seropositive and all the socio-demographic characteristics and obstetric characteristics analyzed ( $P>0.05$ ).

**Conclusion:** Rubella virus is endemic in Hodeidah city, Western Yemen with a high seroprevalence of IgG antibodies among pregnant women. There is a strong recommendation for Rubella screening in pregnant women and to proceed to postpartum vaccination for seronegative women.

**Keywords:** Rubella virus, Seroprevalence, Pregnant women, ECLIA, Hodeidah Yemen

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**Abbreviations:** CRS, congenital rubella syndrome; ECLIA, electro-chemiluminescence immunoassay; EPI, expanded program of immunization; MMR, measles-mumps-rubella; WHO, world health organization

## Introduction

Rubella, commonly known as German measles or 3-day measles, is a contagious viral infection caused by Rubella virus, a spherical (40-80 nm), an enveloped positive-sense, single-stranded RNA virus, belongs to the family *Togaviridae*, which is the sole member of the genus *Rubivirus*, with only one serotype has been identified.<sup>1,2</sup>

Rubella virus infection is transmitted by respiratory droplets and causes a generally mild disease characterized by a rash and fever, primarily in children.<sup>1</sup> Although the disease affects both males and females, it is a disease of public health importance in pregnant women causing major problems such as spontaneous abortions, miscarriages, stillbirths, and congenital defects including hearing impairment, heart defects, and cataracts known as "Congenital Rubella Syndrome" (CRS).<sup>2</sup> From just before conception and during the first 8 to 10 weeks of gestation, rubella infection may cause multiple fetal defects in up to 90% of cases.<sup>3</sup>

Epidemiological surveys in the world indicate that the immunity level to Rubella virus in different communities is related to age, socioeconomic status, climate, as well as population size and density. Rubella occurs worldwide with a seasonal distribution. The peak incidence of infection is in late winter or early spring.<sup>3</sup> According to the World Health Organization (WHO) estimates, in Eastern Mediterranean Region (EMR) between 1996 and 2008, the average CRS incidence was 50 <100 per 100,000 live births and range between 25,245=285, 089.<sup>4</sup> Special surveillance investigations in

developing countries In different countries from Africa, the Americas, Asia, Eastern Europe, and EMR, have documented incidence rates of CRS, ranging from 0.4 to 4.3 per 1000 live births.<sup>5,6</sup>

Unfortunately, the epidemiology of Rubella virus in Yemini pregnant women is not well known, because there is no report or published data about the seroprevalence of Rubella virus among pregnant women. So, the current study was conducted with the objectives of estimating the seroprevalence and potential risk factors in acquiring rubella infection by pregnant women in Hodeidah, a city of western Yemen. The epidemiology of Rubella virus is not well known and there is no published data concerning and of seroprevalence in pregnant women in Yemen associated with some socio-demographic risk factors.

Thus, the objectives of the current study are to investigate seroprevalence associated possible risk factors for rubella infections among pregnant women in Hodeidah city (Western Yemen). The basic data from this study is important for health planners and care providers.

## Materials and methods

### Study design and study area

A cross-sectional study was collected from 400 pregnant women attending antenatal clinics in eight main hospitals and health centers in Hodeidah city western Yemen that is located on a flat and narrow coastal city placed between the foothills of the highlands and the Red Sea. It is the fourth largest Governorate in Yemen in the term of population. It is in a tropical zone, and the weather is typically hot and humid, during summer months of April to November are very hot with temperatures sometimes exceeding 38 to 40° C, during the rest of the year, the temperatures range between 27-35° C.<sup>7</sup>

## Sample and data collection

Data were collected using a structured questionnaire that included demographic data, obstetric characteristics, and laboratory findings. Five milliliters of total blood were collected from the subjects by venipuncture into labeled sterile tubes and allowed to clot undisturbed, at room temperature. Sera were separated by centrifugation at 3,000 revolutions per minute (rpm) for five minutes and the serum was transferred into cryovials and stored at -10 to -20°C until required for use.

## Laboratory testing

The serum samples were tested for Rubella virus-specific IgG and IgM antibodies using IgG and IgM Elecsys kit by ECLIA technique (Cobas e411 analyzer, Roche Diagnostic GmbH, Mannheim, Germany). Tests were carried out following the recommendations specified by the manufacturers.

## Ethics approval and clinical consent

The Ethical Clearance for this research was granted by the Biology Department, Faculty of Sciences, Sana'a University Ethical

Committee after due process had been followed. Before the collection of samples, information regarding to the study was explained to the women. A written consent for participation into the study was obtained in all cases.

## Statistical analysis

Data were entered and statistical analysis was performed using the Epi Info version 7.1.5 program (CDC Atlanta USA). Data were cleaned and descriptive analysis was done. Bivariate analyses were done using  $\chi^2$  test for categorical variables to find key determinants of rubella infection in Yemen and values of  $p < 0.05$  were considered as statistically significant.

## Results

A total of 400 pregnant women were included. The mean age of the population included was  $25.97 \pm 6$  years (SD) and ranged from 15 to 45 years. A total of 219 (54.75 %) were aged between 15 and 25 years. Two hundred and ninety (72.5%) were living in urban areas. One hundred and twenty-seven (31.7%) were illiterate. Most More than three of the participants 383 (95.7%) were housewives (Table 1).

**Table 1** Socio-demographic and obstetric characteristics of pregnant women and seroprevalence of Rubella virus-specific IgG and IgM antibodies

Category	Participants		IgG positive		P-value	IgM positive		P-value
	No.	%	No.	%		No.	%	
<b>Age</b>								
15-25	219	54.75	200	91.32	0.35	4	1.83	0.58
26-35	162	40.50	146	90.12		3	1.85	
36-45	19	4.75	19	100.0		1	5.26	
<b>Residence</b>								
Rural	110	27.50	98	89.09	0.35	2	1.82	0.87
Urban	290	72.50	267	92.07		6	2.07	
<b>Education level</b>								
Illiterate	127	31.75	111	87.40	0.18	2	1.57	0.29
Primary	62	15.50	59	95.16		0	0.0	
Secondary	178	44.50	163	91.57		6	3.37	
University	33	8.25	32	96.97		0	0.0	
<b>Occupation</b>								
Employee	11	2.75	9	81.82	0.4	0	0.0	0.83
Farmer	6	1.50	6	100.0		0	0.0	
Housewife	383	95.75	350	91.38		8	2.09	
<b>Trimester</b>								
First	120	30.0	109	90.83	0.79	1	0.83	0.54
Second	111	27.75	103	92.79		3	2.70	
Third	169	42.25	153	90.53		4	2.37	
<b>Parity</b>								
The first	146	36.50	130	89.04	0.43	4	2.74	0.72
One to three	200	50.0	186	93.0		3	1.50	
More than 3	54	13.50	49	90.74		1	1.85	
<b>History of preterm deliveries</b>								
Yes	16	4.0	14	87.50	0.59	0	0.0	0.56
No	384	96.0	351	91.41		8	2.08	
<b>History of abortions (Miscarriage)</b>								
Yes	105	26.25	94	89.52	0.47	0	0.0	0.08
No	295	73.75	271	91.86		8	2.71	
<b>History of stillbirths</b>								
Yes	50	12.50	43	86.0	0.16	1	2.0	1.0
No	350	87.50	322	92.0		7	2.0	
<b>History of malformed children</b>								
Yes	6	1.50	6	100.0	0.44	0	0.0	0.72
No	394	98.50	359	91.12		8	2.03	

In terms of obstetric history, 146 (36.5 %) were at her first pregnancy, 200(50%) had 1-3 children and only 54(13.5%) had more than three children. From all study participants 120 (30 %) were in the first trimester; 111(27.75%) were in the second trimester and the majority 169(42.25%) were in the third trimester.

Among all study participants, only 16 (4%) had a history of pre-term deliveries; 105 (26.25 %) had the previous history of abortion; 50(12.50%) had stillbirths antecedents and only 6 (1.5%) had malformed children.

The overall seroprevalence of rubella antibodies in Hodeidah city, Yemen was 91.25% (365/400) among pregnant women which 89.25% (357/400) were positive for only IgG and 2.0% (8/400) positive for both IgG and IgM antibodies. There were no statistically significant differences associated with rubella seropositive and all the socio-demographic characteristics and obstetric characteristics analyzed ( $P>0.05$ ).

## Discussion

To our knowledge, this is the first paper conducted on the seroprevalence of rubella IgG and IgM antibodies among pregnant women in Hodeidah city, western Yemen. The results obtained in this study indicated that Rubella virus antibodies were positive in 91.25% of the women participants. Out of 400 (89.2%) were only positive for IgG while, 2.0% were positive for IgM antibodies. The high prevalence of rubella IgG antibodies found in this study (91.25%) is close to previous studies conducted in Arab countries, such as Sudan (95.1% - 97.7%)<sup>8,9</sup> and Saudi Arabia (93.3%),<sup>10</sup> (95.6%) and in another African and Asian countries, like Iraq<sup>11</sup> and several studies conducted in the world, such as Turkey (94.3%, 95%, 96.1%, 97.8%),<sup>12-15</sup> Nigeria (93.1%, 95.7%, 97.9%),<sup>16-18</sup> Iran (96%)<sup>19</sup> and in Cameroon (94.4%).<sup>20</sup>

The data that we in present, have found similar results compared to most of the studies have confirmed, showing the pregnant women had positive IgG antibodies to Rubella virus in a high proportion, suggesting a previous exposure, rather than vaccination. This indicated that these pregnant women had close and prolonged contact with Rubella virus. Also suggested that a wild Rubella virus is prevalent in this area and probably this virus is endemic in western Yemen.

The high prevalence obtained may have been due to a sustained infection and the development of antibodies to Rubella virus. This suggested that Rubella virus is prevalent in the study area and that the majority of pregnant women had previously been exposed to the virus. The development of the IgG antibody is an effort made by the immune system to help neutralize the virus. This antibody prolongs life and confers immunity against reinfection. Therefore, it is correct to assume that pregnant women having IgG positive antibodies are immune to Rubella virus.<sup>17</sup>

The low prevalence of IgM antibodies in our study (2.0%) is very close to other studies done in Sudan 3.4%,<sup>21</sup> Iraq (1.25%),<sup>22</sup> Ethiopia (2.1%),<sup>23</sup> and Nigeria 3.26%.<sup>24</sup> However, a higher seroprevalence has been documented in Nigeria, ranged between 12% to 38.8%<sup>17,18,25-27</sup> and in Iraq 53.9%.<sup>28</sup> The high prevalence of IgM found in the study in Nigeria by Olajide et al may due to the occurrence of an outbreak during the time of the study that might have gone unnoticed, as outbreaks of rubella may not always be recognized in developing countries, and rubella-induced rashes are often misdiagnosed.<sup>17</sup>

In the current study, the median age of the people was not significantly associated with rubella infections. However, Bukbuk et al. have documented that increased maternal age, was significantly associated with rubella infection among Nigerian women.<sup>29</sup> Also,

in studies undertaken in Kenya, revealed that an increase in age was associated with an increase in rubella seropositivity.<sup>30</sup> The seroprevalence rate for rubella in this study did not differ between urban and rural areas, although a slight increase was observed in the urban region, which showed that a percentage of 92.07% versus 89.09% for IgG and 2.07% versus 1.82% for IgM. Similarly, there was no difference between the place of residence and rubella seroprevalence in a study conducted in Turkey.<sup>31</sup> Some studies that covered a wide range of factors that affect the prevalence rate of rubella in several groups indicated that the seroprevalence of rubella IgG is higher in urban areas with low susceptibility.<sup>32,33</sup> In Morocco, the seroprevalence rate of rubella IgG antibodies was also increased in urban areas.<sup>32</sup> Though, other studies did not find any localities dependency.<sup>34</sup>

Another study reported by Sallam et al., found the percentage of rural schoolgirls without rubella antibodies was significantly higher than of urban schoolgirls indicated that the level of rubella IgG antibody was significantly higher among urban pregnant women. This might be attributed to the crowding environment usually found in an urban location as the city that is in favor of the greater transmission for airborne infections as rubella in urban areas rather than in a rural location.<sup>35</sup>

On the other hand, in a WHO collaborative study about the seroepidemiology of rubella in several countries, the differences between urban and rural susceptibility were 43% versus, 51% in Jamaica, 38% versus, 65% in Panama, and 22% versus 40% in Peru<sup>36</sup> showed a much lower seroprevalence of rubella in urban areas rather than in rural once.

Because of the low facilities, this study has many limitations; one of these we did not use IgG avidity kits to differentiate between recent and remote rubella infection and polymerase chain reaction (PCR) technique. The other limitation is the lack of follow-up for these women to document seroconverting and to detect fetal infections.

## Conclusion

Rubella is endemic in Hodeidah city, western Yemen, with a high seroprevalence among pregnant women. There is a strong recommendation for rubella screening in pregnant women and postpartum vaccination for seronegative women. However, further studies on the susceptibility of women of childbearing age need to be carried out countrywide. Furthermore, studies to determine the prevalence of CRS is necessary to highlight the risk of Rubella.

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## Conflicts of interest

The authors declare no conflict of interest.

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