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Rubella Infection and Maternal Immunity in Pregnant Women in Urban Areas of the Congo

Roch Bredin Bissala Nkounkou[1,2*], Paola Candyse Tsimba Lemba[1,3], Raphaëlle Francia Moyen[1,4], Dorcas Mouyama[1], Esther Nina Ontsira Ngoyi[1,5], Luc Magloire Anicet Boumba[1,6,7], Gickelle Bintsene-Mpicka[1,4], Henri Essome[8,9], Carole Else Eboumbou Moukoko[8,10]

[1]Faculty of Health Sciences, Marien Ngouabi University, Brazzaville, Republic of Congo
[2]Medical Biology Laboratory, Djiri General Hospital, Brazzaville, Republic of Congo
[3]Laboratory Department, Talangai Referral Hospital, Brazzaville, Republic of Congo
[4]Department of Gynecology and Obstetrics, University Hospital Center of Brazzaville, Brazzaville, Republic of Congo
[5]Bacteriology and Virology Laboratory, Brazzaville University Hospital Center, Brazzaville, Republic of Congo
[6]Microbiology and Molecular Biology Department, Loandjili General Hospital, Pointe-Noire, Republic of Congo
[7]National Institute of Biology and Health Surveillance, Pointe-Noire, Republic of Congo
[8]Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Republic of Cameroon
[9]Department of Gynecology and Obstetrics of Laquintinie Douala Hospital, Douala, Republic of Cameroon
[10]Yaoundé Pasteur Center, Yaoundé, Republic of Cameroon
Email: *bredin.bissalankounkou@umng.cg

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Abstract

This cross-sectional study investigated the presence of anti-rubella IgG and IgM antibodies in 124 pregnant women receiving prenatal care in Brazzaville. It reports positivity rates of 76.61% for IgG and 1.61% for IgM, yet interprets these results as evidence of a broader scope of infection than the test results alone suggest. Samples were analyzed using rapid diagnostic tests, and positive cases were confirmed via indirect ELISA. The mean age of the participants was 28 ± 5.96 years. None of the women had previously been vaccinated against rubella. The overall prevalence of rubella was estimated at 78.22%, comprising 76.61% (IgG) and 1.61% (IgM). Gestational age (specifically the first trimester) was associated with the presence of the virus; women in the first trimester faced a higher risk of contracting rubella than those in the second trimester (OR = 0.35; CI: 0.13 - 0.91; p = 0.028) or the third trimester (OR = 0.22; CI: 0.05 - 0.87; p = 0.023).

Keywords

Rubella Infection, Maternal Immunity, Pregnant Women, Congo

1. Introduction

Rubella in children and adults is a mild disease that rarely causes complications: purpura, arthralgia, perivenous encephalitis, and, very rarely, PESS unrelated to the measles virus [1]. However, it should be noted that many primary rubella infections do not present with clinical signs and may go unnoticed, particularly in pregnant women, hence the importance of diagnosis [2]. During pregnancy, congenital rubella corresponds to fetal damage during a maternal primary infection in the first 20 weeks of pregnancy; the earlier it occurs, the more severe it is. This infection can lead to serious fetal complications, collectively referred to as congenital rubella syndrome (CRS). This syndrome can affect the heart (patent ductus arteriosus), the ear (deafness), and the eye (cataracts). In addition to the effects on embryogenesis, there is also fetopathy, which is a consequence of the virus multiplying in the tissues: hepatitis encephalitis, thrombocytopenic purpura, bone lesions [1] [3] [4]. The rubella virus is a teratogenic pathogen, responsible for 2% to 3% of congenital malformations in fetuses of infected mothers [5]. By January 2024, 175 out of 194 countries had introduced the rubella vaccine, and global coverage was estimated at 69%. Reported cases of rubella have fallen by 97%, from 670,894 cases in 102 countries in 2000 to 17,865 cases in 78 countries in 2022 [6]. In Africa, more than 100,000 children are born with congenital rubella syndrome (CRS) each year, particularly in resource-limited countries, and the continued circulation of the virus still exposes many non-immune pregnant women to a high risk of infection [7].

In the Republic of the Congo, although serological screening for rubella is routinely prescribed during prenatal visits, epidemiological data on rubella and its risk factors among pregnant women remain limited or even outdated, particularly in urban areas, where population density and mobility facilitate the transmission of infectious diseases [8] [9]. In light of this observation, the present study was conducted to determine the prevalence and risk factors for rubella among women attending prenatal checkups at hospitals in the city of Brazzaville.

2. Materials and Methods

2.1. Type and Period of Study

This was a descriptive, cross-sectional study with an analytical component, conducted from July 3 to December 5, 2025—a duration of six months.

2.2. Study Population

The study population consisted of pregnant women attending prenatal consultations at health centers Integrated Health Centers (CSI) in Brazzaville—particularly those in Bissita, Kombo Matari, and Jeanne—as well as the Plateau Medical-Social Center who agreed to participate in the study after providing informed consent. ho visited the.

2.3. Inclusion Criteria

Pregnant women who attended prenatal consultations and consented to partici-

pate in the study.

2.4. Exclusion Criteria

Pregnant women whose samples could not be analyzed or utilized were not included in our study.

2.5. Study Sample

This was a random probability sample, as these patients were eligible on an ongoing basis after providing informed consent. We worked with a total of 124 patients.

2.6. Methodology

After obtaining the opinion of the Ethics Committee of the Health Facilities Administration, we informed the patients of the benefits of this study and then proceeded to collect the samples.

2.6.1. Data Collection

Data collection was carried out using a survey form designed for this purpose. Information on age, parity, trimester of pregnancy, level of education, marital status, history of STIs, presence of skin rashes, and lymphadenopathy was collected.

2.6.2. Variables Studied

The socio-demographic variables were age, parity, trimester of pregnancy (gestational age), level of education, marital status, presence of a skin rash, lymphadenopathy, etc.

Biological variables included immunoglobulins G and M.

2.6.3. Biological Samples

We collected blood samples from the participants in this study. The samples were drawn from the antecubital fossa and collected in EDTA-containing tubes. At the end of each day of sampling, the samples were placed in a cooler containing ice packs and then transported to the laboratory department at Djiri General Hospital. They were then centrifuged at 3000 rpm for 5 minutes. After centrifugation, the plasma was collected in Eppendorf tubes and stored at −20˚C.

2.6.4. Biological Analysis

Laboratory results were obtained using rapid diagnostic tests for the detection of anti-rubella IgG and IgM antibodies (Testsealabs®, reference 101044, lot RVGM25080601) and the indirect ELISA method for the detection of anti-rubella IgG and IgM antibodies (Calbiotech® Rubella IgG ELISA, reference RB025G, lot RBG243, and Calbiotech® Rubella IgM ELISA, reference RB026M, lot RBM6790). Only positive rapid test results were subjected to ELISA analysis for confirmation. For the ELISA method, once the procedure was complete and the colorimetric result obtained, the microtiter plate was read on a plate reader (HumanReader Single Plus automated reader) at 450 nm. Results were interpreted in accordance with the manufacturer's instructions, and IgG and IgM results were expressed in IU/mL.

2.6.5. Statistical Analysis

Statistical analysis was performed using Excel spreadsheets and Stata 13 softwares. 95% confidence intervals (CI) were used to identify the strength of the association. We assessed the risk (odds ratio: OR) with the association of each explanatory variable together with virus carriage using a logistic regression model to take risk factors into account. Associations were considered statistically significant for $p < 0.05$.

3. Results

3.1. Socio-Demographic Description of the Study Population

This study was conducted on 124 pregnant women who attended prenatal consultations at the Bissita, Jeanne Vialle, and Kombo Matari health centers and the Plateau Medical-Social Center in Brazzaville. The average age was 28 ± 5.96 years (Min-Max: 15 - 41 years). The majority of the study population was between 21 and 30 years old (50.81%). Most of the women were cohabiting (58.87%) and had a secondary school education (68.55%). Fifty-five pregnant women, or 44.35%, were in their second trimester of pregnancy, followed by those in their first trimester (42%, or 33.87%). The study population had never been vaccinated against rubella virus, as shown in Table 1.

Table 1. Socio-demographic characteristics of pregnant women.

Features	Population (N = 124)	Proportions (%)	
	n	%	IC à 95%
Age group (year)			
15 à 20	18	14.52	8.84 - 21.97
21 à 30	63	50.81	41.68 - 59.89
31 à 41	43	34.68	26.36 - 43.75
Marital status			
Single	30	24.19	16.96 - 32.70
Common-law marriage	73	58.87	49.68 - 67.63
Married	21	16.94	10.80 - 24.72
Level of education			
Primary	10	8.06	3.94 - 14.33
No education	1	0.81	0.02 - 4.41
Secondary	85	68.55	59.60 - 76.59
Higher	28	22.58	15.56 - 30.96

Continued

Pregnancy trimester			
1st trimester	42	33.87	25.62 - 42.91
2nd trimester	55	44.35	35.44 - 53.55
3rd trimester	27	21.77	14.87 - 30.08
Rubella vaccine			
Yes	00	00	
No	124	100	
Social status			
Hairdresser	8	6.45	2.83 - 12.32
Shopkeeper	45	36.29	27.85 - 45.40
Accountant	3	2.42	0.50 - 6.91
Seamstress	7	5.65	2.30 - 11.29
Pupil	13	10.48	5.70 - 17.26
Teacher	2	1.61	0.20 - 5.70
Student	14	11.29	6.31 - 18.22
Hotel worker	4	3.23	0.89 - 8.05
Receptionist	1	0.81	0.02 - 4.41
Bailiff	1	0.81	0.02 - 4.41
Nurse	2	1.61	0.20 - 5.70
Housewife	21	16.94	10.80 - 24.72
Midwife	1	0.81	0.02 - 4.41
Secretary	2	1.61	0.20 - 5.70
Integrated Health Center (IHC)			
Bissita	48	38.71	28.80 - 51.93
Jeanne vialle	25	20.16	13.49 - 28.31
Kombo	21	16.94	10.80 - 24.72
Plateau	30	24.19	16.96 - 32.70

Note. N = total number; 95% CI = 95% confidence interval.

3.2. Prevalence of Rubella and Immunoglobulins in the Study Population

Figure 1 shows that the majority of women had IgG when the samples were analyzed, representing a prevalence of 76.61%, which indicates that these women were well immunized against the rubella virus. However, we noted the presence of immunoglobulin M in two patients, representing a percentage of 1.61%. This brings the overall prevalence to 78.22% (95% CI).

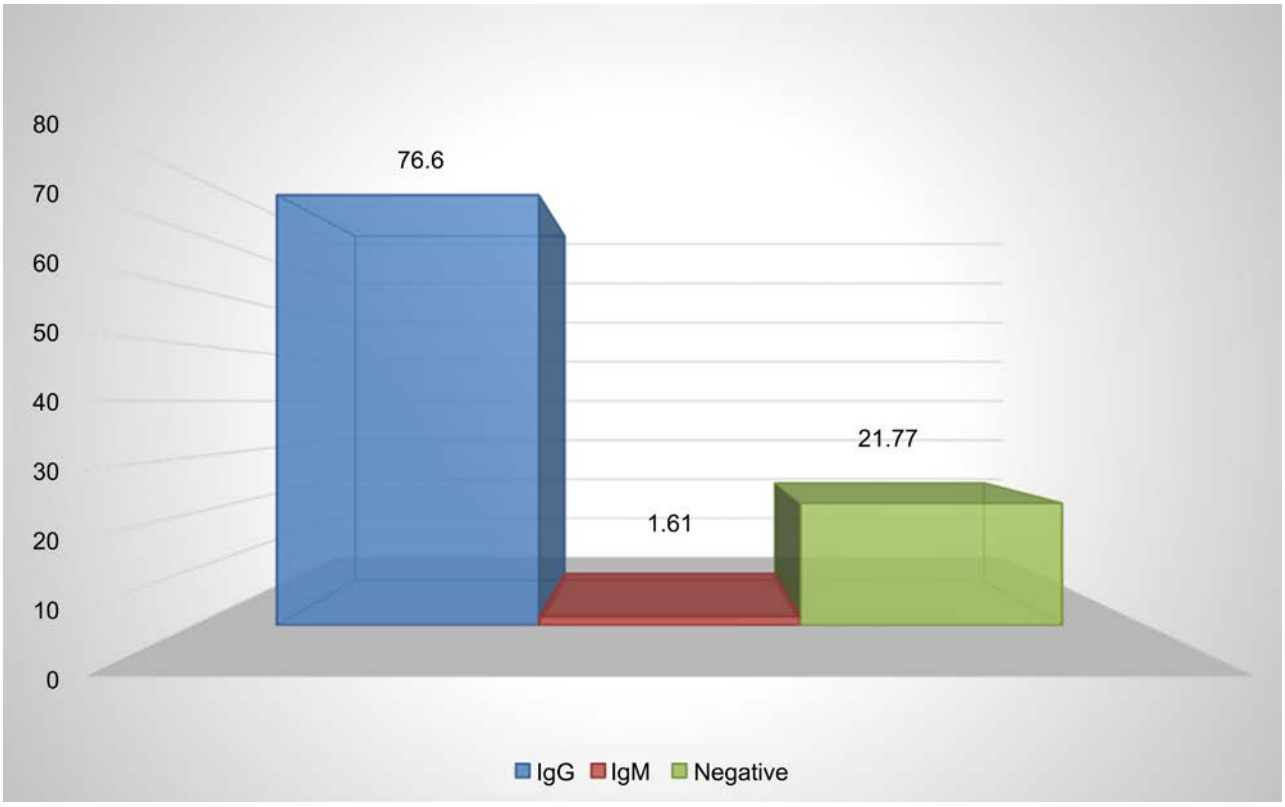


Figure 1. Distribution of IgG and IgM immunoglobulins in the study population.

3.3. Distribution of Rubella According to Socio-Demographic Characteristics

Table 2 shows rubella carriage according to socio-demographic characteristics. There was no significant association ($p > 5\%$) between rubella and age group, marital status, or educational level. However, rubella carriage was associated with the trimester of pregnancy ($p = 0.023$).

3.4. Risk Factors Independently Associated with Rubella Carriage

Table 3 shows the potential risk factors for rubella infection during each trimester of pregnancy in the study population. Women in their first trimester of pregnancy were at greater risk of contracting rubella infection than those who were already in their second trimester (OR = 0.35; CI: 0.13 - 0.91; $p = 0.028$) and third trimester of pregnancy (OR = 0.22; CI: 0.05 - 0.87; $p = 0.023$).

Table 2. Rubella carriage according to socio-demographic characteristics.

Features	Rubella				N	%	P
	Positive		Negative				
	n	%	n	%			
Age group (year)							
15 à 20	15	15.46	3	11.11	18	14.52	
21 à 30	47	48.45	16	59.26	63	50.80	**0.602**
31 à 41	35	36.09	8	29.63	43	34.68	
Marital status							
Single	24	24.74	6	22.22	30	24.19	
Common-law marriage	57	58.76	16	59.26	73	58.87	**0.948**
Married	16	16.49	5	18.52	21	16.94	
Level of education							
Primary	9	9.28	2	7.41	11	8.87	
Secondary	64	65.98	21	77.78	85	68.55	**0.488**
Higher	24	24.74	4	14.81	28	22.58	
Pregnancy trimester							
1st trimester	27	27.84	15	55.56	42	33.87	
2nd trimester	46	47.42	9	33.33	55	44.35	**0.023**
3rd trimester	24	24.74	3	11.11	27	21.77	

Table 3. Univariate analysis.

Pregnancy trimester	N = 124	Rubella				OR_C (IC à 95%)	P
		Positive		Negative			
		n	%	n	%		
1st trimester	42	27	64.29	15	35.71	**1**	
2nd trimester	55	46	83.64	9	16.36	**0.35 (0.13; 0.91)**	**0.028**
3rd trimester	27	24	88.89	3	11.11	**0.22 (0.05; 0.87)**	**0.023**

4. Discussion

The rubella virus is a significant public health problem and is primarily responsible for congenital infections, which cause serious birth defects. Humans are the only known hosts. Transmission requires close contact between individuals [2] [6].

Our study focused on rubella infection and immunity in pregnant women attending prenatal consultations at three integrated health centers in Brazzaville, namely Bissita, Nkombo Matari, Jeanne Vialle, and the Plateau Medical-Social Center.

The methodology used consisted of analyzing plasma samples by TROD and ELISA for all women to determine prevalence in order to confirm the diagnosis.

This study was conducted among 124 pregnant women. The results revealed that the average age of these women was 28 ± 5.96 years (Min-Max: 15 - 41 years). This average was relatively close to that obtained by Makemgue *et al.* in Chad and Nadesh *et al.* in Cameroon in a population of pregnant women attending consultations [5] [10]. A study in Nigeria conducted by Olajide *et al.* also reported an average age close to ours [11]. However, in a study of pregnant women in Nigeria, the average age was 30.5 ± 7.9 years [12]. This difference may be due to the variability in the size of their sample and the study population, which consisted of women of childbearing age who may or may not have attended prenatal consultations.

We found that the population in our study was aged between 15 and 41 years. Numerous studies have reported the same age range [5] [7]. The similarity with these studies can be explained by the fact that women in this age group are sexually active. The majority of pregnant women had a secondary education level, but some studies, such as those conducted in Nigeria by Bola *et al.* and Olajide *et al.*, had a study population with a higher education level [11] [13]. These results, when compared with those studies, confirm that women's education in the Republic of Congo is declining, as reported in the sectoral education strategy [14]. In this study, we observed that the age of pregnancy was in the second trimester, as reported in several studies [5] [10]-[12]. However, a few studies reported the age of pregnancy in the first and third trimesters [13] [15].

The point prevalence of detectable rubella virus infection in our study was 78.22%, or 76.61% for IgG and 1.61% for IgM. We therefore found that the majority of women in this study were immune to the rubella virus, while only 1.61% were not. Some studies have reported higher prevalences of IgM than ours, ranging from 3% to 38.5% in Africa and Asia [10] [11] [13] [15] [16]. Comparing our results with those of these authors, this difference may be explained by poor hygiene or ventilation conditions and overcrowding. In addition, the 1.61% were women in their first trimester, indicating a recent infection prior to prenatal care. What is positive in this study is the fact that the majority of pregnant women had IgG carriage of the infection, which indicates good immunization. This high rate is reported in several studies conducted on pregnant women around the world, in Africa and in Congo (see study by Mieret *et al.*), showing good immunization [8]

[10] [17] [18]. Our prevalence is below the World Health Organization's recommendation that at least 90% - 95% of women of childbearing age be immunized in order to eliminate rubella. In fact, our prevalence is between 70 and 85% for IgG, which, according to the WHO, translates into low to moderate immunity that is insufficient to prevent chains of transmission [6]. While some studies have established a link between rubella infection and age, environment, and marital status, the present study has highlighted an association between rubella carrier status and the first trimester of pregnancy [5] [12] [19]. Our results are consistent with those reported by Bola *et al.* and Makemgue *et al.* regarding gestational age [5] [13]. In fact, women in the first trimester of pregnancy had a higher risk of rubella infection than those in the second trimester (ORc: 0.35 [0.13, 0.91]; p = 0.028) and the third trimester (ORc: 0.22 [0.05, 0.87]; p = 0.023).

5. Conclusion

This study revealed that the rubella virus is indeed present in the population of pregnant women in our country and that low IgM levels—indicating a recent infection—pose a risk to the fetus or child. The significant association between the first trimester of pregnancy and viral shedding—which indicates an increased risk of infection—should enable us to strengthen preventive measures among women of childbearing age, particularly through vaccination before pregnancy.

Ethical Approval and Consent to Participate

This study was conducted in accordance with the ethical guidelines governing research involving human subjects in the Congo and the Declaration of Helsinki. Administrative approvals were obtained from the administration of Djiri General Hospital (No. 216-1/MSP/DGHGD), the integrated health centers, and the Ethics Committee for Health Sciences Research (CERSSA) (No. 033-40/MESRSIT/DGRST/CERSSA/-25). All parents or guardians of minors, as well as the participants, provided their informed consent by signing a consent form. The confidentiality and anonymity of the information provided were guaranteed.

Artificial Intelligence

The authors declare that no generative AI technology such as large language models (ChatGPT, COPILOT, etc.) and text-to-image generators were used in the writing of this manuscript.

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Declaration of Consent to Publication

Not applicable. However, all authors have given their consent for the publication of this manuscript through their respective emails.

Author Contributions

Conceptualization: Roch Bredin Bissala Nkounkou; Methodology: Roch Bredin Bissala Nkounkou, Paola Candyse Tsimba Lemba, and Raphaëlle Francia Moyen; Statistical analysis: Dorcas Mouyama; Data entry: Esther Nina Ontsira Ngoyi and Luc Magloire Anicet Boumba; Review and editing: Gickelle Mpika Bintsene and Henri Essome; Supervision: Carole Else Eboumbou Moukoko; Fieldwork: Roch Bredin Bissala Nkounkou and Dorcas Mouyama.

Conflicts of Interest

The authors have declared that they have no known financial or non-financial conflicts of interest or personal relationships that could have influenced the work presented in this article.

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