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Cytomegalovirus Seroprevalence among Parturient Women at Panzi General Referral Hospital, Bukavu, Democratic Republic of the Congo

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Abstract

Introduction: Cytomegalovirus (CMV) is a ubiquitous herpesvirus that establishes lifelong latent infection, and its global seroprevalence among women of reproductive age is close to 86%. Yet very little is known about CMV seroprevalence among parturient women in the Democratic Republic of the Congo. **Objective:** To estimate the seroprevalence of anti-CMV antibodies (IgM and IgG) and to identify associated factors among parturient women at Panzi General Referral Hospital in Bukavu. **Methods:** We conducted a cross-sectional descriptive study with an analytical component, using convenience sampling, from 1 October 2024 to 30 September 2025. A total of 551 consecutive parturient women with conclusive IgG and IgM results were included in the analysis. Anti-CMV IgM and IgG antibodies were detected using a standardized ELISA. Bivariate analysis followed by multivariable logistic regression was performed in SPSS version 26 to identify associated factors, with statistical significance set at $p < 0.05$. **Results:** Seroprevalence was 63.5% for IgG and 36.8% for IgM. Educational level was significantly associated with both IgM and IgG positivity ($p = 0.001$), and employment status with IgG positivity ($p = 0.005$). Parity was associated with IgM ($p = 0.015$) and IgG ($p = 0.018$) seropositivity, and multivariable logistic regression confirmed that parity ($p = 0.018$) and educational level ($p < 0.001$) were linked to IgM positivity. Marital status was associated with IgM in bivariate analysis ($p = 0.005$), but not after adjustment.

No significant association was found with age, place of residence, or gestational age. **Conclusion:** CMV seroprevalence is high among parturient women in Bukavu; however, IgM positivity alone does not establish recent infection, and the IgM estimate requires confirmation with IgG avidity or molecular testing. These findings highlight the need for stronger prevention strategies, including awareness-raising among pregnant women. Integrating CMV screening into routine antenatal care could be considered, but would first require evidence on confirmatory testing pathways and on clinical benefit.

Keywords

Cytomegalovirus, Seroprevalence, Parturient Women, IgM, IgG, Bukavu, DR Congo

1. Introduction

Cytomegalovirus (CMV), also known as human herpesvirus 5 (HHV-5), is a double-stranded DNA virus of the family Herpesviridae [1]. Like the other members of this family, CMV establishes lifelong latent infection after primary infection, with possible episodes of reactivation, particularly in immunocompromised individuals [2]. In pregnant women, CMV infection is of particular concern because of the risk of mother-to-child transmission. Congenital CMV is the most common infectious cause of congenital infection worldwide and a major public health problem, notably because of its association with sensorineural hearing loss and long-term neurodevelopmental impairment [3].

CMV seroprevalence is closely shaped by socioeconomic factors and is generally higher in low-income, densely populated settings [4]. Worldwide, seroprevalence among women of reproductive age is estimated at about 86%, with wide regional variation, from under 70% in parts of Europe to over 90% in resource-limited countries [5]. These differences reflect variations in early exposure to the virus, hygiene, and living conditions.

In Europe, the highest CMV seroprevalence among women of reproductive age has been estimated in Türkiye, at an average of 96%, and the lowest in Ireland, at an average of 39% [4]; in northern Italy, it reaches 68.3% [6]. In the United Kingdom, seroprevalence is 49% [7]. In the United States, the overall age-adjusted CMV seroprevalence among persons aged 6 - 49 years was 50.4% in 1999-2004, and seropositivity was independently associated with low household income, high household crowding, and low household education [8].

In Asia, the overall CMV seroprevalence among pregnant women in Jiangsu Province, China, was 98.7% [9]. In southern India, prevalence was 75% [10], whereas in Japan it was 69.1% [11].

In the Middle East, high rates have also been reported in several Arab countries, notably Yemen [12] and Saudi Arabia, where prevalence ranges from 95.7% to 100% [13]. In eastern Iran, by contrast, it is reported to be around 72.1% [14].

In Africa, seroprevalence remains high and varies from one country to another [15]: 80.9% in Tunisia [16]; 100.0% among pregnant women in Egypt [17]; 72.2% in Sudan [18]; 73.9% in Mwanza, Tanzania [19]; 77.3% in Thika, Kenya [20]; and 86.4% in Johannesburg, South Africa [21].

In high-income countries, seroprevalence is generally lower and more heterogeneous, whereas in sub-Saharan Africa it remains high, approaching universal levels in some populations. In this context, CMV is recognized as a neglected yet important pathogen in Africa, where its clinical impact is probably underestimated because of limited access to diagnosis and surveillance [3].

HIV/CMV co-infection is also a particularly relevant issue in sub-Saharan Africa, where both infections are endemic. CMV acts as a cofactor in HIV infection and has been associated with increased transmission, faster disease progression, and higher mortality among infected patients [3].

In pregnant women and exposed children, this interaction is all the more worrying because it may increase the risk of congenital infection and affect neonatal outcomes, especially in resource-limited settings [3].

Despite this heavy burden, CMV remains largely underdiagnosed and undermonitored in resource-limited countries. Most African countries have no routine CMV screening program during pregnancy or at birth, which leads to an underestimation of the true burden of congenital CMV and its long-term complications [3].

Against this background, the lack of robust local data on CMV seroprevalence among parturient women in the Democratic Republic of the Congo is a significant gap, both for understanding the epidemiology of the infection and for designing appropriate prevention strategies. The aim of this study was therefore to estimate the seroprevalence of anti-CMV antibodies (IgM and IgG) and to identify associated factors among parturient women seen at Panzi General Referral Hospital in Bukavu.

2. Methods

The study was conducted at Panzi General Referral Hospital in Bukavu, a city in the eastern Democratic Republic of the Congo.

This was a descriptive cross-sectional study using convenience (consecutive) sampling, including 551 parturient women. The study ran for 12 months, from 1 October 2024 to 30 September 2025. All parturient women admitted to the maternity ward who gave their consent were included. Of the 723 parturient women admitted during the study period, 58 declined consent and 665 were enrolled; 114 were then excluded ([n] because of an equivocal IgG or IgM result and [n] because of insufficient data), leaving 551 women in the final analytical sample.

The dependent variable was IgM and IgG seropositivity or seronegativity. Explanatory variables were sociodemographic and clinical characteristics: age, place of residence, educational level, marital status, employment status, parity, and gestational age. Parity was categorized by the number of deliveries, including the current delivery, as primiparous, pauciparous, multiparous, or grand multiparous.

Samples consisted of 5 mL of venous blood collected in an anticoagulant (EDTA) tube during labor and sent to the laboratory, where plasma was separated by centrifugation at 3000 ×g for 15 min within 1 h of collection and stored below −20˚C until ELISA testing. Anti-CMV IgG and IgM antibodies were detected using the Cytomegalovirus IgG ELISA (catalogue no. E-CVG-K01) and Cytomegalovirus IgM μ-capture ELISA (catalogue no. E-CVM-K02) kits from RD-RatioDiagnostics (Frankfurt am Main, Germany), according to the manufacturer's instructions. According to their package inserts, both kits are intended for testing human serum or plasma; however, the specimen-handling instructions specify serum, no anticoagulant is named, and performance data are reported for serum samples only. EDTA plasma was not validated against paired serum samples in our laboratory, which is a limitation of this study. Each run included a substrate blank and the kit calibrators (IgG: calibrators 0 - 4, with calibrator 1 defining the cut-off) or controls (IgM: negative, cut-off, and positive controls). Samples, calibrators, and controls were tested in duplicate. After blank subtraction, a run was accepted only if the optical density of the cut-off calibrator or control was at least 0.2 and that of IgG calibrator 4 or the IgM positive control was at least 3 or 1.5 times, respectively, that of the cut-off.

CMV serology was interpreted using the ratio of the mean optical density of the sample to that of the calibrator, for both IgG and IgM. A ratio above 1.1 was considered positive and a ratio below 0.9 negative, as specified in both package inserts. Results falling between these two values were considered equivocal and excluded from the study without retesting.

Based on the combination of IgG and IgM results, participants were classified into four descriptive antibody profiles: IgG-negative/IgM-negative (no detectable anti-CMV antibodies); IgG-positive/IgM-negative (IgG only, consistent with past infection); IgG-negative/IgM-positive (isolated IgM); and IgG-positive/IgM-positive (dual positivity). These profiles were not used to assign infection stage: isolated IgM may reflect early primary infection, persistent IgM, or nonspecific or false-positive reactivity, and dual positivity may reflect recent primary infection, reactivation, or reinfection, which cannot be distinguished without IgG avidity testing or molecular methods.

Statistical analysis was performed using IBM SPSS Statistics version 26. Descriptive statistics were expressed as proportions. Associations between sociodemographic variables and IgM and IgG seropositivity were first assessed using Pearson's chi-square test; multivariable logistic regression was then performed to identify factors independently associated with IgM seropositivity. All explanatory variables were entered into the model, with age entered as the four age groups (≤20, 21 - 30, 31 - 40, and >40 years) coded 1 - 4 and treated as an ordinal (linear) term. Because all four widowed women were IgM-positive, maximum-likelihood estimation was affected by quasi-complete separation; the IgM model was therefore fitted using Firth's penalized-likelihood logistic regression [22] with profile penalized-likelihood confidence intervals. Statistical significance was set at $p < 0.05$.

All approvals required for this study were obtained from the Provincial Ethics Committee under reference number CNES 001/DPSK/223PP/2024.

3. Results

3.1. Prevalence

In this study, IgG serology was positive in 350 parturient women and negative in 201, giving a seroprevalence of 63.5%. IgM serology, on the other hand, was positive in 203 women and negative in 348, giving a seroprevalence of 36.8% (versus 63.2% seronegative) (Table 1).

Table 1. Distribution of CMV serology results.

CMV serology	N = 551	%
IgG		
Positive	350	63.5
Negative	201	36.5
IgM		
Positive	203	36.8
Negative	348	63.2

Overall, 63.5% of parturient women were CMV IgG-positive. IgG seroprevalence was highest among women aged 21 - 30 years (65.1%, p = 0.145), and IgM seroprevalence among those aged 20 years or younger (42.3%, p = 0.465) (Table 2).

Table 2. CMV seroprevalence (IgM and IgG) by sociodemographic characteristics.

Variables	IgM			IgG		
Age	**Positive n/N**	**Seroprevalence (%)**	**p**	**Positive n/N**	**Seroprevalence (%)**	**p**
≤20	22/52	42.3	0.465	31/52	59.6	0.145
21 - 30	101/298	33.9		194/298	65.1	
31 - 40	75/189	39.7		121/189	64.0	
>40	5/12	41.7		4/12	33.3	
Residence						
Urban	186/500	37.2	0.586	314/500	62.8	0.271
Rural	17/51	33.3		36/51	70.6	
Educational level						
None	9/14	64.3	0.001	12/14	85.7	**0.001**
Primary	43/153	28.1		80/153	52.3	
Secondary	103/289	35.6		188/289	65.1	
University	48/95	50.5		70/95	73.7	

Continued

Marital status						
Single	18/35	51.4		24/35	68.6	
Married	181/512	35.4	0.005	322/512	62.9	0.250
Widowed	4/4	100		4/4	100	
Employed						
No	196/524	37.4	0.228	326/524	62.2	**0.005**
Yes	7/27	25.9		24/27	88.9	
Parity						
Primiparous	57/138	41.3		97/138	70.3	
Pauciparous	31/83	37.3	**0.015**	53/83	63.9	**0.018**
Multiparous	52/186	28.0		102/186	54.8	
Grand multiparous	63/144	43.8		98/144	68.1	
Gestational age (weeks)						
28 - 36	31/87	35.6		63/87	72.4	
37 - 40	159/424	37.5	0.795	258/424	60.8	0.059
>40	13/40	32.5		29/40	72.5	

3.2. Sociodemographic Characteristics

As shown in Table 2, educational level and employment status were significantly associated with IgG positivity (p = 0.001 and p = 0.005, respectively). Parity was also significantly associated with both IgM seropositivity (p = 0.015) and IgG seropositivity (p = 0.018). Educational level (p = 0.001) and marital status (p = 0.005) were likewise associated with IgM positivity. In contrast, age, place of residence, and gestational age were associated with neither IgM nor IgG.

Table 3. Multivariable logistic regression: association between sociodemographic factors and maternal IgM serology.

Variables	B	df	p	Exp(B)	95% CI for Exp(B)	
					Lower	Upper
Constant	22.266	1	0.999	4676064139.0		
Gestational age (weeks)		2	0.756			
28 - 36	−0.018	1	0.966	0.982	0.426	2.263
37 - 40	0.156	1	0.666	1.169	0.574	2.381
Employed	−0.445	1	0.337	0.641	0.258	1.589
Educational level		3	0.000			
Primary	−1.549	1	0.013	0.212	0.062	0.726
Secondary	−1.064	1	0.090	0.345	0.101	1.182
University	−0.345	1	0.600	0.708	0.195	2.573

Continued

Parity		3	0.018			
Primiparous	−0.481	1	0.182	0.618	0.305	1.254
Pauciparous	−0.528	1	0.133	0.590	0.297	1.174
Multiparous	−0.871	1	0.002	0.419	0.240	0.729
Marital status		2	0.099			
Single	−20.445	1	0.999	0.000	0.000	.
Married	−21.464	1	0.999	0.000	0.000	.
Residence	−0.327	1	0.350	0.721	0.363	1.431
Age	0.008	1	0.969	1.008	0.668	1.521

Table 3 shows that, after adjustment, educational level ($p < 0.001$) and parity ($p = 0.018$) remained significantly associated with IgM positivity: women with primary education (OR = 0.212; 95% CI: 0.062 - 0.726) and multiparous women (OR = 0.419; 95% CI: 0.240 - 0.729) had a lower risk than women with no formal education and grand multiparous women, respectively.

4. Discussion

This study was conducted to determine the seroprevalence of CMV infection among parturient women at the maternity unit of Panzi General Referral Hospital in Bukavu, DR Congo. IgG seroprevalence was 63.5% and IgM seroprevalence 36.8%; this high IgM rate, which would point to recent infection or reactivation, should be interpreted with caution in the absence of avidity testing. To our knowledge, this is the first study of its kind in the region. Across the African continent, studies have reported high rates in East Africa (72% - 89%) and even higher rates in North, Southern, and West Africa (100%) [23]. In Kenya, for example, CMV seroprevalence was 77.3% [20], compared with 72.2% in western Sudan [18].

CMV seroprevalence in our population is lower than that reported in most developing countries, both African and non-African [4] [9] [10], and closer to that observed in some developed countries [5] [7] [8] [24]. Low educational and socioeconomic status, together with the higher prevalence of poor hygiene conditions in developing countries, may help explain the higher CMV prevalence in these settings [24].

IgM seroprevalence was highest among women aged 20 years or younger (42.3%), with no statistically significant difference by age ($p = 0.465$). This is consistent with the observation by Radoi *et al.* in south-western Romania, where active infection was more frequent among the youngest women [25], whereas Vilibić-Čavlek *et al.* in Croatia identified age as a significant determinant of both IgM and IgG positivity, with IgG seroprevalence rising steadily with age [26]. The predominance of infection among younger women—a period of intense reproductive activity and close contact with young children—is consistent with the main routes

of CMV transmission (saliva, urine, and cervicovaginal secretions).

Educational level was significantly associated with both IgM and IgG positivity ($p = 0.001$ for both), and employment status with IgG positivity ($p = 0.005$). Several authors have reported similar links between socioeconomic or educational status and CMV serology; Zhang *et al.*, in Jiangsu Province, identified low maternal education as a risk factor for adverse pregnancy outcomes in the context of CMV infection [9]. In our series, women with no formal education had the highest IgG seroprevalence (85.7%), which may reflect socioeconomic, hygiene, and crowding conditions that favor early and repeated exposure to the virus, although the relationship was not linear (52.3% among women with primary education versus 73.7% among those with university education). Employed women were more often IgG-seropositive (88.9% vs. 62.2%), possibly reflecting greater occupational exposure, particularly contact with young children.

Parity was also significantly associated with IgM ($p = 0.015$) and IgG ($p = 0.018$) seropositivity. Multivariable logistic regression confirmed a statistically significant association between parity and IgM positivity ($p = 0.018$), with only multiparous women having a significantly lower risk than the reference category of grand multiparous women (OR = 0.419; 95% CI: 0.240 - 0.729; $p = 0.002$). One possible explanation is repeated contact with young children—the main reservoirs and shedders of CMV—over successive pregnancies [27]; however, contact with children was not measured in this study, and IgM positivity did not vary monotonically with parity. Other studies, however, such as that by Mhandire *et al.* in Harare, found no significant association between CMV seropositivity and parity [28], which underscores how much this factor varies across study populations.

In contrast, no significant association was found between place of residence (urban or rural) or gestational age and CMV serology. Marital status was associated only with IgM ($p = 0.005$), an association that did not persist after adjustment ($p = 0.099$) and rested on very small numbers (4 widowed women). This contrasts with the findings of Vilibić-Čavlek *et al.* in Croatia, where region and place of residence were significant determinants of seropositivity [26], and of Radoi *et al.* in Romania, who observed variation in seroprevalence by area of residence [25]. The homogeneity of our population, which was overwhelmingly urban (500 of 551 parturient women), may explain why no difference was seen by place of residence.

5. Strengths and Limitations

This study has several strengths. As the first study of CMV seroprevalence among parturient women in DR Congo, it provides new data. The large sample (551 parturient women) and consecutive recruitment over twelve months strengthen the robustness of the estimates, while dual IgM/IgG serology, multivariable logistic regression analysis, and prior ethical approval add to its methodological rigor.

The main limitations of this study are its single-center design and the use of convenience sampling, which restrict the representativeness and generalizability of the findings. The cross-sectional design does not allow causal inference, and

diagnosis relied solely on ELISA serology (IgM/IgG), without avidity testing or PCR; primary infection therefore cannot be reliably distinguished from reactivation or a false-positive result. In addition, antibodies were measured in EDTA plasma, whereas the specimen-handling instructions of both kits specify serum; because EDTA plasma was not validated against paired serum samples in our laboratory, some misclassification of antibody status cannot be excluded. Finally, the small size of some subgroups (widowed women) reduces statistical power.

Larger multicenter prospective studies combining IgG avidity testing, PCR, and follow-up of newborns would help refine estimates of seroprevalence and its risk factors, and clarify the risk of congenital CMV infection.

6. Conclusion

This study shows a high CMV seroprevalence among parturient women at Panzi General Referral Hospital, with IgG positivity of 63.5% and IgM positivity of 36.8%. Because IgM positivity alone does not establish recent infection, the IgM estimate should be confirmed with IgG avidity testing or PCR. In multivariable analysis, educational level and parity remained independently associated with IgM seropositivity, and employment status was associated with IgG seropositivity in bivariate analysis. Together, these results suggest that sociodemographic factors are associated with CMV serostatus in this population; whether contact with young children, which was not measured in this study, contributes to these associations remains to be determined. They support stronger awareness and prevention of CMV infection in pregnant women, as well as further studies to assess the risk of congenital infection. Routine antenatal CMV screening may merit evaluation in this setting, but its introduction would first require evidence on confirmatory testing pathways, such as IgG avidity testing and PCR, and on clinical benefit.

Author Contributions

All authors made a significant contribution to the work reported, whether in the conception, study design, and execution or in all these areas, took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Data Availability Statement

The datasets utilized in this study can be obtained from the corresponding author upon request. Please contact Dr. Julien Bwama via email at jbwama@gmail.com.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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