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Research Article

Seroprevalence of Cytomegalovirus among Blood Donors in Brazzaville, Republic of Congo

Séroprévalence du Cytomégalovirus parmi les Donneurs de Sang à Brazzaville

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RÉSUMÉ

Introduction. Cytomegalovirus (CMV) is widely distributed globally and can be transmitted from person to person via blood transfusion resulting in a severe infection or death among immune-compromised blood recipients. The aim of this study was to determine the prevalence of CMV antibodies among blood donors in Brazzaville, Republic of Congo. **Methodology.** This was a cross-sectional study performed among blood donors in National Blood Transfusion Center of Brazzaville from July 2022 to January 2023. Samples were analyzed for anti-CMV immunoglobulin M (IgM) and IgG antibodies using ELISA assay. **Results.** A total of 90 blood donors were recruited for this study comprising of 79 males and 11 females. The age of the donors ranges from 18 to 60 years old. The prevalence of CMV IgG was found to be 83.33%, and that of CMV IgM was 21.11%. The prevalence of anti-CMV IgM and anti-CMV IgG were higher in the age range of 18-30 years old, male, and family/replacement donors. There were no statistically significant associations between the presence of CMV antibodies and the socioeconomic characteristics of the donors (p>0.05). **Conclusion.** The prevalence of CMV is high among blood donors in Brazzaville, emphasizing the importance of rigorous screening in order to prevent transfusion-transmitted CMV and potential related complications in blood recipients.

ABSTRACT

Introduction. Le cytomegalovirus (CMV) est largement répandu dans le monde et peut être transmis d'une personne à une autre via une transfusion sanguine, entraînant une infection grave ou la mort chez les receveurs de sang immunodéprimés. L'objectif de cette étude était de déterminer la prévalence des anticorps anti-CMV chez les donneurs de sang à Brazzaville, en République du Congo. **Méthodologie.** Il s'agit d'une étude transversale réalisée chez les donneurs de sang du Centre national de transfusion sanguine de Brazzaville de juillet 2022 à janvier 2023. Les échantillons ont été analysés pour la recherche d'anticorps anti-CMV immunoglobuline M (IgM) et IgG à l'aide du test ELISA. **Résultats.** Au total, 90 donneurs de sang ont été recrutés pour cette étude, dont 79 hommes et 11 femmes. L'âge des donneurs variait de 18 à 60 ans. La prévalence des anticorps anti-CMV IgG était de 83,33 % et celle des anticorps anti-CMV IgM de 21,11 %. La prévalence des anticorps anti-CMV IgM et IgG était plus élevée chez les donneurs âgés de 18 à 30 ans, de sexe masculin et des donneurs dits familiaux ou de remplacement. Aucune association statistiquement significative n'a été observée entre la présence d'anticorps anti-CMV et les caractéristiques socio-économiques des donneurs (p>0,05). **Conclusion.** La prévalence du CMV est élevée chez les donneurs de sang à Brazzaville, soulignant l'importance d'un dépistage rigoureux afin de prévenir la transmission du CMV par transfusion sanguine et les complications potentielles chez les receveurs de sang.

KEY RESULTS

What this study addresses

Seroprevalence of cytomegalovirus among blood donors in Brazzaville, republic of Congo

Key Results

1. The prevalence of CMV IgG was 83.33%, and that of CMV IgM was 21.11%.
2. The prevalence of anti-CMV IgM and anti-CMV IgG were higher in the age range of 18-30 years old, male, and family/replacement donors.
3. There were no statistically significant associations between the presence of CMV antibodies and the socioeconomic characteristics of the donors.

INTRODUCTION

Cytomegalovirus (CMV) is a double-stranded enveloped DNA virus of the *Herpesviridae* family and is one of the most common herpes viruses to infect humans **[1,2]**. It is transmitted by direct contact with body fluids such as saliva, breast milk, urine, sperm, blood and vertically from mother to fetus through the placenta **[2]**. In healthy individuals, infection is often asymptomatic or results in mild, self-limiting viral illness. However, in immunocompetent individuals such as CMV-negative infants, infection can lead to severe CMV disease **[3]**. Clinical indices for the CMV infection include the parenchymal damage, such as pneumonitis, retinitis, gastroenteritis and encephalitis, lymphocytosis in immunocompromised patients and can lead to significant mortality **[4,5].** The reported global CMV prevalence varies widely among geographical regions, with a rate of 66% in the European region, 75% in South and North America, 86% in the Southeast Asian region, 88% in Africa and the Western Pacific, and 90% in the Eastern Mediterranean region **[6].** Blood transfusion is a lifesaving component of many therapeutic interventions **[1,7].** The risks associated with CMV transmission through blood products have been demonstrated in several studies **[8].** Blood transfusion is considered to be a significant source of CMV infection, and transfusion-transmitted CMV (TT-CMV) in CMV-seronegative immunocompromised patients can result in fatal CMV disease **[9,10]**. The incidence of TT-CMV in immunocompromised patients ranges from 13% to 37%, and its prevention has become an important priority, especially in high-risk groups **[11]**. The risk of TT-CMV can be limited by improved selection of donors **[8]**. However, the high prevalence of CMV seropositivity in the donor populations of many countries, including the growing demand for CMV-free blood products, may be difficult to meet if CMV-seropositive donors are excluded **[12]**. In our country, screening for cytomegalovirus is not carried out routinely and no study has yet been performed among blood donors. Thus, in the present study, we investigated the prevalence of CMV among blood donors in Brazzaville, Republic of Congo.

PATIENTS AND METHODS

This was a cross-sectional observational study and was conducted from July 2022 to January 2023. Written informed consent was obtained from all subjects after they were fully informed about the study objectives and procedures. To ensure confidentiality, all samples were coded, and access to the data was limited to the research team. All blood donors who presented to the National Blood Transfusion Center of Brazzaville within the study period were consecutively recruited. Only those with normal blood pressure, pulse rate, and body temperature were enrolled. The individuals with a history of chronic illness as well as intravenous drug users are not accepted as blood donors. They were therefore excluded from the study. An interviewer administered questionnaire was used to obtain information on demographic characteristics and the donation habits. Five milliliters of whole blood were collected from each subject in tubes. After the samples were coagulated, the serum was separated by centrifugation at 3000 × g for five minutes. Samples were stored at −20 °C until they were assayed. All samples were tested for anti-CMV IgM and IgG antibodies using enzyme-linked immunosorbent assay (ELISA, anti-CMV IgG and IgM, Calbiotech) according to the manufacturer's instructions.We used Statistical Package for Social Sciences (SPSS-21) (SPSS Inc, Chicago, IL, USA) software for all statistical analysis. The Fisher's test was used to determine the association between anti-CMV IgM and IgG antibodies and sociodemographic determinants and we considered $p < 0.05$ to be a significant threshold.

RESULTS

A total of 90 blood donors were recruited to participate in the study. **Table 1** shows the sociodemographic characteristics of the participants. Majority of the blood donors were males constituting 87.8% of the sample (79), only 12,2% (11) of the respondents were females. The average age of the participants was 35.12 ± 10.85 years old. There were 57 (63.3%) married participants and 60 (66.7%) have primary education level.

Table 1. Socio-demographic characteristics of blood donors

Characteristics	N	%
Gender		
Male	79	87.8
Female	11	12.2
Age group (years)		
18-30	34	37.8
31-45	39	43.3
46-60	17	18.9
Education		
Primary	60	66.7
Secondary	21	23.3
Post-graduate	9	10.0
Occupation		
Student	11	12.2
Traders	14	15.6
Civil servant	22	24.4
Military	31	34.4
Unemployed	12	13.3
Blood donor type		
Family/replacement	43	47.8
Voluntary	29	32.2
Regular	18	20.0
Marital status		
Married	33	36.7
Single	57	63.3

Table 2 shows the prevalence of anti-CMV IgG and anti-CMV IgM as detected by ELISA. The prevalence of anti-CMV IgG was found to be 83.33%, and that of CMV IgM was 21.11%. We examined the association between anti-CMV antibody positivity and different parameters. Any significant difference was found between anti-CMV IgG and anti-CMV IgM antibody positivity rates and age (p-value>0.05) **(Table 2).**

Despite the fact that the prevalence of anti-CMV IgM and anti-CMV IgG were higher in age groups 18-30 years, followed by 31-45 years, and the age group 46-60 had the least prevalence, the difference was not statistically significant. There was no significant difference in anti-CMV antibody seropositivity between males and females. The prevalence of anti-CMV IgM was higher in males (94.7%) than their females (5.3%). Similarly, the prevalence of anti-CMV IgG was also higher in males (88%) than females (12%), as shown in Table 3. Also from Table 3, it can be observed that there was no significant difference (p-value>0.05) in the seropositivity of anti-CMV antibodies among types of donors **(Table 3).**

However, the prevalence of anti-CMV IgM was higher in family/replacement (57.9%), in married (63.2%) and unemployed (31.6%). Similarly, the prevalence of anti-CMV IgG was also higher in family/replacement donors (48%), in single (64%), in low level education (68%) and unemployed subjects (37.3%) as shown in **Table 3.** Furthermore, no significant difference was found in the carriage of anti-CMV antibodies (p>0.05).

Table 2. Prevalence of anti-CMV IgM and IgG antibodies among blood donors in Brazzaville.

Status	anti-CMV IgM		anti-CMV IgG	
	n (%)	95% CI	n (%)	95% CI
Positive	19(21.11)	12.68-29.54	75(83.33)	75.63-91.03
Negative	71(78.89)	70.46-87.32	15(16.67)	8.97-24.37

CI: confidence interval

Table 3. Distribution of anti-CMV IgM and IgG antibodies with socio-demographics characteristics among blood donors in Brazzaville.

Characteristics	Anti-CMV IgM		*P*-value	Anti-CMV IgG		*P*-value
	Positive(%)	OR(95% CI)		Positive (%)	OR(95% CI)	
Gender						
Male	18(94.7)	2.95(0.35-24.63)	0.317	66(88)	1.13(0.22-5.84)	0.886
Female	1(5.3)	1		9(12)	1	
Age group (years)						
18-30	9(47.4)	2.75(0.51-14.21)	0.241	31(41.3)	2.21(0.39-12.37)	0.365
31-45	8(42.1)	1.94(0.36-10.26)	0.438	30(40)	0.71(0.16-3.05)	0.649
46-60	2(10.5)	1		14(18.7)	1	
Education						
Primary	13(68.4)	2.21(0.25-19.34)	0.473	51(68)	1.62(0.29-9.08)	0.584
Secondary	5(26.3)	2.50(0.24-25.15)	0.437	17(22.7)	1.21(0.18-8.22)	0.842
Post-graduate	1(5.3)	1		7(9.3)	1	
Occupation						
Student	4(21.1)	5.71(0.85-38.33)	0.073	7(9.3)	1	
Traders	5(26.3)	5.56(0.90-34.24)	0.065	11(14.7)	2.09(0.36-12.32)	0.413
Civil servant	2(10.5)	1		19(25.3)	3.62(0.64-20.41)	0.145
Military	2(10.5)	2.00(0.24-16.36)	0.518	10(13.3)	2.86(0.40-20.14)	0.292
Unemployed	6(31.6)	2.40(0.44-13.20)	0.314	28(37.3)	5.33(0.96-29.51)	0.055
Marital status						
Married	12(63.2)	0.24(0.08-0.71)	0.009	27(36)	0.84(0.27-2.62)	0.769
Single	7(36.8)	1		48(64)	1	
Blood donor type						
Family/replacement	11(57.9)	1.72(0.42-7.08)	0.454	36(48)	1.02(0.23-4.52)	0.970
Voluntary	5(26.3)	1.04(0.22-5.01)	0.959	24(32)	0.96(0.19-4.61)	0.959
Regular	3(15.8)	1		15(20)	1	

DISCUSSION

Cytomegalovirus is an ubiquitous agent that commonly infects individuals from diverse geographical and socio-economic backgrounds. In the current study, the positivity rate for anti-CMV IgG was 83.33% among blood donors in Brazzaville, indicating a high prevalence of previous viral exposure. Our results are in agreement with some studies, which reported high frequencies of anti-CMV IgG positivity among blood donors, 97.3% in Sudan **[13]**, 87.9% in India **[14]** and 94.4% in Ethiopia **[15]**. In contrast with our results and those of other studies, low frequencies of anti-CMV IgG positivity were reported among blood donors in Iraq (46.6%); in Nigeria (25.8%) and the Sudan (77%) **[16–18].** Anti-CMV IgM detection indicates a recent infection, and our study showed that 21.11% of donors were found to be positive. Our result is lower to those reported in other

studies, such as 39% in Lybia **[19],** 52.6% in Nigeria **[20]** and 85% in Iran **[21]**. On the contrary, our result is higher than those of other countries, 3% in Iraq [22], 3.6% in Kenya **[23]**, 4% in Ethiopia **[15]** and 5.5% in Yemen **[24]**. Anti-CMV IgM positivity indicates a recent infection (primary, reactivation, or reinfection), and anti-CMV IgG has been detected in secondary (reactivation) CMV infections in some CMV-infected individuals **[25]**. The detection of anti-CMV IgM alone cannot be used to diagnose primary infections because IgM antibodies can also be detected in secondary infections **[26]**. The presence of IgM-positive donors indicates a risk of transmission through blood transfusions to susceptible populations, such as immunosuppressed recipients, which is known as a transfusion-transmitted infection (TTI) **[27].** The prevalence of anti-CMV antibodies (IgM and IgG) was higher in males (94.7% vs 88%) than in females (5.3% vs 12%), but was not statistically significant ($p>0.05$). Njeru et *al.*, also did not find any association between CMV seropositivity and gender **[23]**. However, studies by Matos et *al.*, **[28]** and Gargouri et *al.*, **[29]** revealed a significantly higher prevalence in women than in men. The likely explanation is that infected infants and children, particularly those under 30 months of age, excrete the virus in their saliva and urine. Women therefore have more frequent contact with children, resulting in higher CMV prevalence in women **[30]**. Our study showed that the prevalence of anti-CMV antibodies varied according to age, with a high rate in the 18-25 year age group, followed by the 31-45 year age group. However, difference in positivity of CMV based on distribution of age did not reach statistical significance. Studies by Njeru et *al.*, **[23]** and Matos et *al.*, **[28]** also did not find any relationship of CMV antibody prevalence and age group. On the other hand, Hecker et *al.*, in Germany and Agbodeka et *al.*, in Togo, observed a significantly higher positivity with increasing age of blood donors **[31,32].** This may be due to earlier acquisition of CMV infection, leading to higher seroprevalence even in younger adults. In this study, frequency of anti-CMV antibodies positivity was high among married, unemployed and donors with low-education level. Indeed, singles may have fewer long-term intimate relationships, reducing the likelihood of frequent close contact that promotes CMV transmission [33,34]. Donors with higher levels of education might be more likely to work in environments with lower CMV exposure, contributing to lower prevalence **[35].** Our study showed that the family donors have a higher rate of anti-CMV antibodies than voluntary donors and regular donors. This finding is consistent with several previous studies, including those by Bawa et *al.*, 2014 **[33]**; Bolarinwa et *al.*, 2014 **[20];** Essomba et *al.*, 2015 **[36];** Gwarzo et *al.*, 2017 **[34]**, which highlight the role of close contact and household interactions in CMV transmission, particularly within families. This can lead to a higher positivity rate among this group.

CONCLUSION

This study provides crucial insights into the frequency of CMV among blood donors. The high prevalence of anti-CMV antibodies observed in our study emphasises the need of safeguarding transfusion to prevent blood recipients from potential CMV-related complications. Strategies such as systematic CMV screening, pathogen inactivation, or leukocyte reduction could be considered to enhance blood safety. Further research and collaborative efforts are warranted to optimize transfusion protocols and ensure the well-being of vulnerable individuals.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest concerning this research.

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AUTHOR'S CONTRIBUTIONS

BMA: Study design,Data collection, analysis and interpretation, Manuscript drafting. SOM:Study conceptionand design, Supervision of data collection, Critical revision of the manuscript. FKK:Data analysis and interpretation, Critical revision of the manuscript. BF: Data collection, Critical revision of manuscript. BSB:Supervision of data collection, Critical revision of the manuscript. GBB:Supervision of data collection, Critical revision of the manuscript. FRN:Supervision of data analysis, Critical revision of the manuscript. AV: Study conception, Critical revision of the manuscript. All authors have read and approve of the final manuscript.

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