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Investigation of Cytomegalovirus Carriage among Blood Donors at the General Hospital of Yaoundé

Ahouga Voufo Roger[1,2], Abdouraman Bouba[1], Yimga Wanda Grace[1,3], Maboulu Emvoutou Valerie[1,4], Cherifa Ngoupatoum[5], Calixte Didier Mbakop[1], Ngonde Essome Marie Chantal[1,2]

[1]Institute of Medical Research and Medicinal Plant Studies, Yaounde, Cameroon
[2]Faculty of Medicine and Biomedical Sciences, University of Yaounde 1, Yaounde, Cameroon
[3]Faculty of Sciences, University of Dschang, Dschang, Cameroon
[4]Faculty of Sciences, University of Yaounde 1, Yaounde, Cameroon
[5]Foundation Virginia Henderson, Yaounde, Cameroon
Email: rogerahouga@gmail.com

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Abstract

Introduction: Cytomegalovirus is a pervasive virus present within the population, transmitted through multiple pathways. This condition is often asymptomatic, leading carriers to remain unaware of their status, which may result in their inclusion among blood donors. This scenario can have significant implications for both the health of the carriers and the recipients. **Methods:** To investigate the prevalence of cytomegalovirus among blood donors, a prospective, cross-sectional study was conducted over a three-week period from June 12 to June 30, 2023, at the General Hospital of Yaoundé. The study involved 100 donors who met all the criteria for blood donation and provided their free and informed consent. Venous blood samples were drawn from each participant into a dry tube, following strict aseptic, hygiene, and laboratory safety protocols. These samples were then centrifuged at 3000 revolutions per minute for 5 minutes. The resulting serum was utilized to detect IgG antibodies against cytomegalovirus using immuno-chromatography. Data entry was performed using Microsoft Word 2016, and the analysis of results was conducted with Microsoft Excel and IBM SPSS 23, applying a significance level of 0.05. **Results:** Out of the 100 eligible donors we enlisted, 88% were male and 12% were female, leading to a sex ratio of 7.33. The age cohort of 18 to 28 years was the most prevalent, comprising 69%, with a mean age of 25.36 years ± 5.5 years, and a range from 18 to 53 years. On average, 95% of donors had no knowledge concerning cytomegalovirus. The age range of [18 to 28] years displayed a peak

carriage of this virus, with 56% of positive cases, according to the search for anti-cytomegalovirus antibodies. Two categories of donors were found: family members (71%) who carried this antibody 50% of the time, and volunteers (29%), of whom 17% carried this antibody. The occurrence of cytomegalovirus was found to be 67% among blood donors. The number of sexual partners (RR = 1.41), being single (RR = 1.53), and having the virus in the family (RR = 1.50) are some of the risk variables that we found to be associated with the spread of this virus. **Conclusion:** According to the study's findings, a considerable amount of cytomegalovirus is carried by General Hospital of Yaoundé (GHY) blood donors, most of whom are not aware of their virological status prior to giving blood. To ensure transfusion safety, we plan to conduct a similar study looking for IgM to propose to public authorities the elimination of blood bags positive for anti-cytomegalovirus IgM.

Keywords

Cytomegalovirus, Blood Donors, Carriage

1. Introduction

A member of the Herpesviridae family, which comprises over 100 species, Cytomegalovirus (CMV) is categorized into three subfamilies: *Alphaherpesvirinae, Gammaherpesvirinae*, and *Betaherpesvirinae*. CMV frequently causes endemic human infections [1]. Human CMV is a delicate encapsulated virus that deactivates rapidly in the environment. Approximately 150×10^6 daltons in size, CMV is a DNA virus that has a viral DNA polymerase and is more genetically sophisticated and rich than other herpesviridae. It is exclusively susceptible to antiviral drugs that do not require activation by viral thymidine kinase because it does not seem to possess its own thymidine kinase [2].

CMV infection is often asymptomatic, but in some cases, symptoms such as fever, chills and prenatal blindness in newborns can be observed. Moreover, it remains in a latent state in tissues throughout life. Latent CMV can be reactivated by a variety of triggers, which can lead to the virus growing and occasionally resulting in disease. Infections can occur in the eyes, spinal cord, lungs, and digestive system. Urine from infected people may occasionally contain CMV. The virus can spread through both sexual and non-sexual channels because it is also found in cervical secretions, semen, faeces, breast milk, and blood. A CMV infection can develop in individuals who have received a transfusion of infected blood, who may develop a fever, and may develop liver inflammation two to four weeks later [2]. Transfused individuals, HIV-positive individuals, pregnant women, neonates, and premature infants are among the most at risk [3]. After initial contact with the human body, CMV remains in a latent state and may reactivate during immunosuppression [4]. This reactivation can lead to many severe manifestations: pneumonia, neurological damage, retinitis, digestive ulcers, and others. Recipi-

ents of blood transfusions run a significant chance of contracting CMV, which should be addressed carefully [5].

Significant medical concerns have focused on the hazards of blood transfusions, especially those that are infectious. For all donors, certain infections are subject to particular regulatory screening procedures. However, CMV screening is still disregarded in our setting even though the virus is widespread in the population. In their investigation of the incidence of CMV in France, Jeddi and associates discovered a 50% seroprevalence in the general population [6]. This prevalence is between 50 and 60 percent in North America [7]. In a blood donor population in the Paris region, Hoang and colleagues discovered a CMV prevalence of 47% [8]; in Africa, specifically in Mali, Burkina Faso, and Nigeria, research carried out within blood donor communities revealed prevalences of 89%, 92.2%, and 95.8%, respectively [9]. However, many nations do nothing for CMV and only perform the standard tests (HIV, HBV, HCV, and Syphilis) that the World Health Organization (WHO) recommends.

A study carried out in 2015 in Douala, Cameroon, by Essomba and associates found that 80% of blood donors have CMV [10]. In 90% of cases, the primary CMV infection in immunocompetent adults and children does not cause any symptoms. It would be prudent to carry out a study on the virus's carriage among our donors in order to evaluate the virus's circulation at the General Hospital of Yaoundé, since this virus is not routinely screened in blood banks and its prevalence is still high among blood donors.

The general objective of this research is to ascertain the prevalence and contributing variables of cytomegalovirus (CMV) carriage among GHY blood donors.

2. Methodology

2.1. Study Design

Study type, site, and duration: This is a prospective and cross-sectional study carried out Over a period of three weeks from June 12 to June 30, 2023, at the General Hospital of Yaoundé.

Target population: Individuals who came to donate blood at the blood bank of the General Hospital of Yaoundé.

Sampling*:* We conducted a non-probabilistic convenience sampling. The study included individuals coming to donate blood at the General Hospital of Yaoundé who were eligible and freely consented to participate in our study. Excluded from our study were any individuals coming to donate blood at GHY who were eligible and refused to participate in the research. Moreover, any donor who had previously consented to our research and withdrew their consent during the study were excluded from our research.

2.2. Methods

2.2.1. Participant Enrollment

The Yaoundé General Hospital served as the recruitment site. The participants

were warmly welcomed, and a pre-donation questionnaire was provided to collect information. Concerning our study, the information sheet was read and explained to the participants. Following the participants' signatures on the informed permission forms, a questionnaire comprising sociodemographic and clinical information was used to gather a variety of data.

2.2.2. Medical Selection

A follow-up interview with serological tests was conducted on each participant to ensure they were in compliance with the blood donation contraindications. Participants who qualified to donate blood were subsequently given an information sheet. An informed consent form was read and signed by individuals who accepted to participate in this study. To protect the anonymity of the results, the participant's code was noted on the form. They were asked a variety of study-related questions. The participants were then directed to the collection site.

2.2.3. Collection of the Blood Bag

The collection was carried out following the completion of a single form that contained all of the collection's data, including the donor's identification and the amount given. The tubing was successfully sealed at various segments that were 10 to 15 cm apart. Three segments were required at minimum. Following the final sealing, a dry tube straight from the tubing's end was taken and marked with the donor and donation numbers, the date, and the collecting time.

2.2.4. Sample Transportation and Storage

Once the collection was completed, the samples were directly transported to the handling room where they were centrifuged at 3000 rpm for 5 minutes, then aliquoted into cryotubes for storage in the freezer at −20˚C.

2.2.5. Sample Analysis

The different samples were recorded on the bench sheet with each of the codes and analyzed using the CMV rapid test device. The CMV rapid test device (serum) is a rapid immuno-chromatographic assay that allows for the qualitative detection of antibodies against CMV in serum, thus facilitating the screening of cytomegalovirus infections.

❖ **Principle of the anti-CMV antibody test**

The CMV rapid test device (serum) is a qualitative immunological assay on the membrane that allows for the detection of anti-CMV antibodies in serum. Its principle is based on the immuno-chromatographic migration along the body of the device of the CMV Ab-Ag mixture from the test device.

On one end of a nitrocellulose membrane, the examined sample is deposited. Certain antigens tagged with colloidal gold bind to the target antibody if it is present. The antigen-antibody complexes migrate by capillarity when exposed to a migration lysis buffer, and capture antibodies that are adhered to the membrane trap them. A coloured line appears to imply a successful outcome. The antigen-colloid combination passes through the reading region without generating

a signal when particular antibodies are absent [11].

❖ **Preparation of CMV rapid test device (IgG)**

The test device, the buffer, the sample and/or the controls were allowed to return to room temperature (between 15˚ and 30˚) before carrying out the test.

❖ **Operating procedure with the CMV rapid test kit**

After placing the device on a clean, flat surface, 10 µl (microliter) of serum was pipetted and placed in the sample well, without letting it dry. Then, 90 µl (microliter) of diluent was added to the same well by a pipette, and the reading was taken ten to fifteen minutes later.

The kit's quality was confirmed using both a positive and negative control.

❖ **Reading and interpretation of results**

The result is said to be:

- **Positive:** when two lines appear. One colored line is located in the control zone (C) and the other in the test zone (T). The intensity of the color in the test zone (T) depends on the concentration of anti-CMV antibodies in the sample. Therefore, the appearance of a colored line, no matter how faint in the test zone (T), must always be interpreted as a positive result.

- **Negative:** only one colored line appears in the control area (C). No line is visible in the test area (T).

- **Invalid:** no control line appears. Check the procedure and repeat the test using a new test device.

❖ **Test kit storage and stability**

Store the test in its sealed pouch, at room temperature or in a refrigerated compartment (between 2˚C and 30˚C). The test remains stable until the expiration date printed on the sealed pouch. The test device must remain in the sealed pouch until use. Do not freeze.

❖ **Test limitations**

- It is a qualitative test that does not determine the quantity of anti-CMV antibodies or the rate of increase in their concentration.

- A positive test does not differentiate between CMV healing and a current infection.

2.2.6. Data Statistical Analysis

The variables to be studied were recorded, processed, and analyzed using Excel 2016 and SPSS software. The results obtained are presented in the form of tables, histograms, and sectors.

2.3. Ethical Considerations and Administrative Authorization

To conduct this study ethically, we obtained: Administrative authorization from the Director of the General Hospital of Yaoundé; a research authorization issued by the Virginia Henderson Foundation; an ethical clearance issued by the authorities of the General Hospital of Yaoundé (N/Ref:569-23/HGY/DG/DPM/APM-TR of June 30, 2023); an information notice about the study to all participants, explaining our study, its advantages, and disadvantages; a signed informed and vol-

untary consent form from the participants; the questionnaire was provided following the respect for the participants' privacy; the data was processed using unique identification numbers to ensure the confidentiality of the participants; the benefits of participation were equitable: free implementation and delivery of the screening test results.

3. Results

3.1. Sociodemographic Data

Distribution of the population based on sociodemographic data and knowledge about CMV

Our study population consisted of 100 participants aged between 18 and 56 years, with an average age of 25.36 years ± 5.5 years. The most represented age group was [18 - 28] years, accounting for 78% (78). 88% (88) were male, compared to 12% [12] female, resulting in a gender ratio of 7.33. Family donors were the most represented at 71% (71), compared to 29% (29) volunteer donors.

In this distribution, subjects who had never donated blood were the most represented, accounting for 55%, and 95% were unaware of cytomegalovirus while 5% were aware. Singles were the most represented with a percentage of 89% compared to 11% of married individuals. This information is illustrated in Table 1.

Table 1. Distribution of the population based on sociodemographic data and knowledge about CMV.

	Modalities	Frequencies
Age groups	[18 - 28[	78%
	[28 - 38[	15%
	[38 - 48[	4%
	[48 - 58[	3%
Gender	Male	88%
	Female	12%
Number of donation	None	55%
	Once	16%
	More than once	29%
Type of donation	Family	71%
	Volunteer	29%
Knowledge about the virus	Yes	5%
	No	95%
Marital status	Single	89%
	Married	11%

3.2. Biological Data

Frequency of carriers of IgG antibodies against cytomegalovirus

Out of the 100 blood samples analyzed by immunochromatography, it appears that 67 donors carried IgG-type antibodies against cytomegalovirus, which is 67%, compared to 33 (33%) donors negative for these antibodies, as illustrated in Figure 1.

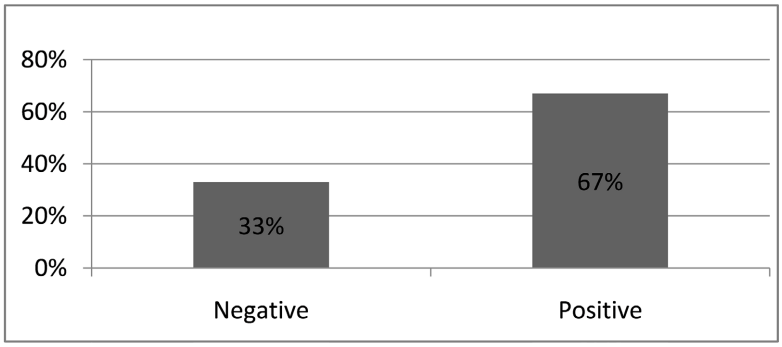

Figure 1. Frequency of cytomegalovirus carriage.

Frequency of CMV carriage based on sociodemographic data

The distribution shows that 67 participants carried anti-CMV antibodies, with the age group [18 - 28[representing the majority of cases at 56%. Men, who are the most represented, are more affected by this virus with a frequency of 60%, in contrast to women who present a frequency of 7%. Family donors are more affected by this virus (50%), compared to voluntary donors (17%). Based on the number of donations, we obtained 31 (31%) donors who have never donated blood and who carried the antibody against CMV, against 24 (24%) who did not carry this antibody. This information is illustrated in Table 2.

Table 2. Frequency of CMV carriage based on sociodemographic data.

	Positive	Negative	Total
Age			
[18 - 28[	56%	22%	78%
[28 - 38[	7%	8%	15%
[38 - 48[	2%	2%	4%
[48 - 58[	2%	1%	3%
Total	67%	33%	100%
Sex			
Female	7%	5%	12%
Male	60%	28%	88%
Total	67%	33%	100%

Continued

Type of donation			
Volunteer	17%	12%	29%
Family	50%	21%	71%
Total	67%	33%	100%
Number of blood donation			
None	31%	24%	55%
Once	14%	2%	16%
More than once	22%	7%	29%

3.3. Risk Factors

Some elements that could be associated with the presence of CMV in our population were identified and tested. After calculating the relative risk, being single (RR = 1.53), having more than one sexual partner (RR = 1.41), and the presence of the virus in the family (RR = 1.50) are risk factors associated with the occurrence of CMV in our participants. Meanwhile, the number of donations made has no impact (RR = 1). These results are recorded in Table 3 opposite.

Table 3. Risk factors for CMV.

Risk factors		CMV IgG		RR	P
		Positive	Negative		
Marital status	Married	5%	6%	1.53	0.02
	Single	62%	27 %		
Number of sexual partners	One	31%	24%	1.41	0.022
	More than one	36%	9%		
Number of blood donation	Once	20%	10%	1.00	0.04
	More than once	47%	23%		
Presence of the virus in the family	Present	2%	0 %	1.50	0.03
	Absent	65%	33 %		

4. Discussion

To ascertain the prevalence of cytomegalovirus carriage among blood donors at the General Hospital of Yaoundé, a cohort of 100 individuals was recruited, with a mean age of 25.36 ± 5.5 years, spanning from 18 to 56 years. These findings align with those reported by Essomba *et al.* in Cameroon in 2015 and Ojidel *et al.* in Nigeria in 2016, who documented mean ages of 31.1 and 30.1 years, respectively, in populations of 110 and 101 blood donors [12]. Within this cohort, the predom-

inant age group was 18 to 28 years, attributable to the availability and dynamic nature of younger individuals for blood donation. The majority of participants were male (88%), compared to 12% female, resulting in a male-to-female sex ratio of 7.33. This ratio, while low, is comparable to that reported by Samuel *et al*. in Cameroon in 2015, which was 11.5 in a sample of 150 donors [12]. These findings may be partially explained by blood donation criteria that restrict female participation, such as menstruation, pregnancy, and breastfeeding, as well as by social and cultural factors in Africa that often place women in a secondary role concerning the type of intervention required [10]. A similar male predominance (70%) was observed in the study by Namululi *et al*. in the Democratic Republic of Congo [13].

In this study, family donors constituted the majority (71%), consistent with the findings of Eboumbou *et al*. (2014) in Douala, which reported a predominance of family donors at 89.5%. This prevalence may be attributed to the deeply ingrained cultural practices, as the population remains largely uninformed about the issue. The regular implementation of awareness campaigns and the establishment of new associations for volunteer donors could ultimately decrease the reliance on family donors, thereby enhancing the quality of blood donations [14].

Within our population, 95% lacked knowledge regarding cytomegalovirus, a situation attributable to the limited awareness of this virus and the scarcity of available literature on the subject. This finding aligns with the study by Essomba *et al*. (2015) in Cameroon, where 100% of the participants were unaware of the virus. The discrepancy observed, where 5% of our population were informed about the virus, can be explained by the fact that these individuals were healthcare personnel.

The present study identifies a seroprevalence of anti-CMV IgG antibodies at 67%, indicating a substantial rate of prior exposure to the virus among the blood donors sampled. This prevalence is consistent with the 60% reported by Mabilangan *et al*. in Canada in 2020 [15] and is comparable to the 80% prevalence found by Essomba *et al*. in Cameroon in 2015. This finding may be attributed to a lack of awareness regarding the virus and its transmission methods within the population. Notably, the frequency of anti-CMV antibody carriers was higher among family donors at 50%, compared to 17% among voluntary donors. This discrepancy may be due to the increased risk of horizontal transmission of the virus among family members [12]. This observation is corroborated by a study conducted by Yacouba in Bamako, which also reported a higher frequency among family donors. Furthermore, the study reveals that anti-CMV antibodies were more prevalent among single individuals, with a rate of 62%, compared to 5% among married individuals. This difference may be explained by the lifestyle of singles, which often involves multiple sexual partners. Additionally, 36% of individuals with more than one sexual partner carried the antibody, compared to 31% of those with fewer partners. The diversity and number of partners in both men and women appear to be significant factors in the transmission of CMV, given

that sexual contact is the primary mode of transmission for this virus. Moreover, within the study population, all individuals with circulating antibodies in the family also possessed the antibody, suggesting horizontal transmission among family members. This study successfully identifies several factors contributing to the occurrence of cytomegalovirus. Among the factors examined, marital status was associated with a relative risk of 1.53. Additionally, the number of sexual partners was found to have a significant relative risk of 1.50, and it strongly contributes to the occurrence of this virus, with a relative risk of 1.43.

5. Conclusion

Our findings indicate that a significant 95% of the population surveyed were unaware of cytomegalovirus (CMV), including its transmission mechanisms and treatment options, which likely contributes to the widespread prevalence of the virus. Among 100 eligible blood donors, 67% were found to possess anti-CMV antibodies, while 33% did not. The age group most represented was 18 to 28 years, which also exhibited a notable peak in the presence of anti-IgG antibodies against CMV. Factors such as the number of sexual partners, marital status, and familial presence of the virus were identified as significant risk factors for the disease, with relative risks (RR) of 1.53, 1.41, and 1.50, respectively. Consequently, it is imperative to organize awareness campaigns about CMV targeting both blood donors and the general population.

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Conflicts of Interest

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

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