International Journal of Biological and Pharmaceutical Sciences Archive

ISSN: 0799-6616 (Online)

Journal homepage: https://ijbpsa.com/

(RESEARCH ARTICLE)

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Immunoglobulin-M (IgM) antibody against cytomegalovirus among females of reproductive age in Buguma, Rivers State, Nigeria

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International Journal of Biological and Pharmaceutical Sciences Archive, 2023, 05(01), 041–050

Publication history: Received on 01 January 2023; revised on 27 February 2023; accepted on 01 March 2023

Article DOI: https://doi.org/10.53771/ijbpsa.2023.5.1.0016

Abstract

Infection with the human cytomegalovirus (HCMV), particularly in pregnant women, can result in congenital abnormalities and is frequently linked to significant side effects such as microcephaly, mental retardation, deafness, and spastic paralysis. In the Buguma city of Rivers State, a cross-sectional study was conducted to ascertain the seroprevalence of HCMV infection and related risk factors among females of reproductive age. A structured questionnaire was given to 93 females in Buguma of reproductive age and matched for socio-demographic traits between December 2021 and January 2023. By venous puncture, five millilitres (5 ml) of blood were obtained, centrifuged, and plasma was collected. Using an enzyme-linked immunosorbent test, plasma was analyzed for the presence of HCMV immunoglobulin M (IgM) antibodies (ELISA). SPSS Version 17 was used to analyze the data. There were 93 participants in all. The findings indicated that the highest proportions of participants were found in the age range of 31 to 40 years, the married (59.1%), those with tertiary education (64.5%), and business/traders (38.0%). Nineteen females (20.4%) tested positive for HCMV IgM antibodies. Compared to other age groups, the HCMV IgM age-specific seroprevalence was highest in people under 20 (25.0%) and closely followed by those in the 21–30 age range (23.3%). As people get older, HCMV infection rates decline. The frequency of HCMV IgM was higher in married people (21.8%) than in single people (18.4%). Compared to women with secondary education (12.1%), those with university education (25.0%) had a higher prevalence. Compared to other occupational groups, teachers had a higher frequency (33.3%). None of the patient demographic traits revealed a statistically significant correlation with HCMV serostatus. In the Nigerian town of Buguma, Rivers State, the investigation verified the existence of HCMV infections among females of reproductive age. The significant seroprevalence of anti-HCMV IgM antibodies in these females suggested recent virus exposure. This observation suggests that the virus is widespread in the research region. It is advised that routine CMV infection screening be adopted for all females of reproductive age across the state and the nation.

Keywords: Anti-HCMV; IgM antibody; Females; Reproductive age; Nigeria

1. Introduction

Human Cytomegalovirus (HCMV) is a significant global public health issue (Yeroh et al., 2015). According to Ndako et al. (2016), it is the primary cause of congenital infections globally, causing neurological impairments in children with severe aftereffects such as sensor neural hearing loss, neuro-developmental delay, and blindness (Yeroh et al., 2015).

The typical human cytomegalovirus (HCMV) virus can spread vertically and horizontally (Hamid et al., 2014). People can readily contract HCMV through interpersonal contact (Almaghrabi et al., 2019). Additionally, it can spread by an

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initial infection, a subsequent infection, or reactivation (Mocarski et al., 2007). Congenital abnormalities in children born to infected mothers were linked to HCMV (Deborah et al., 2015).

The incidence of congenital CMV infection and the seroprevalence of HCMV in adults are both highest (1 to 5% of births) in developing nations. Ninety per cent of newborns with HCMV infection are asymptomatic at birth and are not considered at risk for infection with the virus (Ndako et al., 2016). It has been suggested that women who contract CMV for the first time while pregnant are more likely to pass it on to their unborn children, which increases the risk of premature birth (Ndako et al., 2016).

The most frequent avoidable congenital illness, including deafness and intellectual disability, is HCMV, which is vertically transmitted (Ogbaini-Emovon et al., 2013). Seropositivity rates for past infections among pregnant women globally range from 50% in highly developed countries to 100% in underdeveloped countries, according to studies on seroprevalence (Taechowisan et al., 1997; Gratacap-Cavallier et al., 1998; Ogbaini-Emovon et al., 2013). Standard prenatal screening has no global agreement (Ogbaini-Emovon et al., 2013).

In Nigeria, serological testing for human Cytomegalovirus (HCMV) is not a standard procedure among women of reproductive this study aims to discover how common human cytomegalovirus (HCMV) IgM antibodies are among females of reproductive age in the Buguma Community in Rivers State, Nigeria.

2. Material and methods

2.1. Study Area

The study was conducted among women (females) of reproductive age from Buguma Community. The samples were collected from women at Buguma Community, Rivers State, Nigeria.

2.2. Study Design

The study involved the serological prevalence of HCMV among women of reproductive age in Buguma Community, Rivers State, Nigeria. Data was collected from consenting volunteers after obtaining due ethical permits from the relevant bodies. The study was a cross-sectional study which lasted for 12 months.

2.3. Study Population

There was a 93-female cross-sectional study involved. Only females 15 years and older of reproductive age participated in the study. In the Rivers State, Nigerian town of Buguma, 93 women of reproductive age gave blood samples. While pregnant women were not allowed to participate in the study, these were the inclusion criteria. Ninety-three (93) women of reproductive age, aged 15 to 45, made up the study's sample.

2.4. Sample collection and processing

The pregnant women who underwent screening provided biographical information and answers to a carefully constructed questionnaire. According to the procedure described by Cheesebrough (2009) and Ndako et al. (2016), five (5ml) of blood were aseptically drawn by venipuncture from the volunteer subjects. When the time came for the test, the collected sera were divided, placed in a clean container, and kept at -20 °C.

2.5. Serological Analysis

PRO Diagnostic Bioprobes, Milan, Italy, sera samples were examined for HCMV IgM antibodies. They were using an Enzyme-Linked Immunosorbent Assay (ELISA) Diagnostic Antigen kit produced by DIA. The tests were conducted according to the manufacturer's instructions, and the results were analyzed.

2.6. Data Analysis

Data were analyzed using Microsoft Excel 2016. The seroprevalence of CMV IgM was expressed in percentage.

3. Results

3.1. Total Population Study Analysis

The total number of females of reproductive age included in this study was 93. The socio-demographic data for these samples were stratified and shown in Table 1. The highest proportions of participants were observed in the age group 21-30 years, the married (59.1%), tertiary education (64.5%) and business/traders (38.0%).

3.2. Overall Prevalence of HCMV among females of reproductive age

Of the 93 females of reproductive age under the study, 19(20.4%) had HCMV, as indicated by IgM antibody, as shown in Table 1.

3.3. Prevalence of HCMV among females of reproductive age with their age

A higher prevalence of HCMV infection occurred in the age group <20 years (25.0%) compared to another age group. This value was closely followed by age groups 21-30 (23.3%) and 31-40 (16.0%), and the least prevalence occurred in 41 years and above (15.4%). HCMV infection decreases with increasing age (Table 1).

3.4. Prevalence of HCMV among females of reproductive age with their marital status

A higher prevalence of HCMV IgM occurred among the married (21.8%) than the singles (18.4%), as shown in Table 1.

3.5. Prevalence of HCMV among females of reproductive age with their educational status

Females with tertiary education (25.0%) had a higher prevalence than their counterparts with secondary education (12.1%), as shown in Table 1.

3.6. Prevalence of HCMV among females of reproductive age with their occupational status

Regarding occupations, a higher prevalence occurred among teachers (33.3%) than in other occupational groups (Table 1). This value was followed by business /traders (25.7%), unemployed (19.1%), and healthcare workers (7.7%) and the least prevalence (6.7%) occurred among civil and public servants (Table 1).

3.7. Associations between HCMV infections and the socio-demographic variables among females of reproductive age

Table 1 Prevalence of HCMV IgM with the socio-demographic characteristics of study participants

Variables	No. Tested (%)	No. Positive for HCMV IgM (%)	Chi-square Analysis
Age groups (years)			
<20	12 (13.0)	3 (25.0)	P= 0.83
21-30	43 (46.2)	10 (23.3)	
31-40	25 (26.9)	4 (16.0)	
41 & above	13 (14.0)	2 (15.4)	
Marital Status			
Singles	38 (40.9)	7 (18.4)	P= 0.69
Married	55 (59.1)	12 (21.8)	
Educational Background			
Secondary	33 (35.5)	4 (12.1)	P = 0.14
Tertiary	60 (64.5)	15 (25.0)	
Occupational Status			
Business/ Trader	35 (38.0)	9 (25.7)	P = 0.61

Health worker	13 (14.0)	1 (7.7)	
Civil and public servants	18 (19.3)	3 (6.7)	
Teachers	6 (6.5)	2 (33.3)	
Unemployed	21 (22.3)	4 (19.1)	
Total	93(100.0)	19 (20.4)	

None of the demographic characteristics of the patients showed a statistically significant association ($p < 0.05$) with HCMV serostatus (Table 1).

4. Discussion

Immunocompromised individuals and pregnant women continue at risk of morbidity and mortality from human cytomegalovirus (HCMV) (Bawa et al., 2019). The fetus faces a frequent and substantial hazard from primary HCMV infection throughout pregnancy. Alternative approaches are required because no vaccine prevents congenital HCMV infection (Hamid et al., 2014). In order to evaluate the safety of women and to ascertain the prevalence and contributing variables of HCMV infection among females of reproductive age in Port Harcourt, Nigeria, we conducted a cross-sectional study. Nineteen (20.4%) of the 93 females of reproductive age had HCMV, as shown by IgM antibodies. According to studies, HCMV can be found everywhere and affects between 50.0% and 80.0% of individuals in the United States, as shown by the prevalence of antibodies in most general populations (Staras et al., 2006). In Nigeria, a 2008 study found that breastfeeding women and infants had prevalence rates of IgM antibodies of 45.0% and 33.0%, respectively (Kassim et al., 1987).

According to the findings of this investigation, the prevalence rate revealed that 20.4% of the examined females had HCMV IgM antibodies. This result is analogous to the findings of Odebisi-Omokanye et al. (2017), who reported that 24.9% of the women tested in their study in Ilorin, Nigeria, were seropositive to HCMV IgM antibody. Additionally, it was compared to the 25.6% in our earlier study in Port Harcourt, Nigeria (Okonko et al., 2022) and the 19.5% of the women tested by Akinbami et al. (2009) in Lagos, Nigeria. It was also compared to Ndako et al. (2016), who noted that more than 18.0% of the women examined in their study in Gombe, Nigeria, were seropositive for HCMV (IgM) antibodies. In contrast to Bawa et al. (2019), who found a 2.6% prevalence of HCMV IgM in Minna, Nigeria, the results of this investigation were different. Additionally, it is different from that of Munro et al. (2005), who found that pregnant women in Australia had a low prevalence rate of 5.5%. In an Iranian study, Arakpour et al. (2008) found a low prevalence rate of 5.4% among women of reproductive age. In contrast, Kassim et al. (1987) found that moms in Nigeria had a higher frequency of 45.0%. In Luanda, Angola, Vueba et al. (2022) recorded 1.2%, while Adane and Getawa (2021) recorded 13.77% prevalence among blood donors.

The prevalence of 20.4% reported in this study differs from previous estimates of 1- 14% in pregnant women in the US and UK and 7.8% in Chandigarh (Reynalds et al., 1980). Iran has a prevalence of 5.4% among women of childbearing age compared to Australia's 5.5% among pregnant women (Munro et al., 2005; Singh et al., 2009). (Arbpour et al., 2008). The variations in geographic location, social-economic position, cultural characteristics, and childbearing behaviours in various locations could be the cause of the disparities in prevalence (Ho, 1990; Hengel et al., 1998; Deborah et al., 2015). The virus's significant prevalence in both industrialized and developing countries is the most crucial factor in the epidemiology of the disease (Mustakangas et al., 2003; Deborah et al., 2015).

Studies with unmatched anti-HCMV IgM antibody frequencies include those conducted in Pakistan (4.5%) by Ibrahim et al. (2016), Sudan (2.5%) by Hamdan et al. (2011) and Brazil (2.3%) by Souza et al. (2010). The 20.4% found in this study is higher than the 5.5% found in Albania (Bawa et al., 2019), the 10.5% found in Kafanchan, Kaduna State (Deborah et al., 2015), the 3.5% found in Makurdi, Nigeria (Umeh et al., 2015), the 4.0% found in Benin, Nigeria (Ogbaini-Emovon et al., 2013), and the 3.1% found in Benin (Ojide et al., 2012). Adeiza et al. (2016) conducted a comparative study but found a lower frequency of 13.2% in Zaria, Kaduna State, Nigeria. Additionally, Edward et al. (2015) reported a prevalence of 10.5% in Kaduna State, which is lower than the results of this study.

Previous investigations in West Africa found rates of 0.0% in Accra, Ghana, by Adjei et al. (2006) and 3.1% in Benin by Ojide et al. (2012). While Mujtaba et al. (2003) reported a prevalence of 10.3% in AIDS patients and Olatunji and Oluwajana (2017) reported 3.1% positive HCMV IgM in Ilorin, Nigeria, Kothari et al. (2002) and Kumar et al. (2008) found an HCMV IgM prevalence of 0.0% and 0.07%, respectively, in healthy blood donors. Only a few countries have reported variable IgM positivity, including 8.1% in Thika, Kenya (Maing & Nyamache, 2014), 1.6% in the Madinah

Region, Saudi Arabia, 2.5% in Iran (Bagheri et al., 2012), 6.0% in Sudan (Khairi et al., 2013), 1.7% in Korea (Seo et al., 2009), and 1.0% in Turkey (Uyar et al., 2008). (Mahallawi et al., 2022). Our results did not fall within the 0.4–10.0% rate range reported for other nations, including Switzerland, Tanzania, and China (Souza et al., 2010; Tebuka et al., 2019; Kowalzik et al., 2020). The frequency of HCMV IgM reflects the proportion of people with a reactive or chronic CMV infection that is contagious: This illustrates how HCMV functions as a transfusion-transmitted infection. [TTI] (Akinbami et al., 2009; Bawa et al., 2019). Differences in geographic regions, socioeconomic position, and strata of the women in various sites where the studies/research were conducted may be responsible for the disparity in prevalence rates (Jawetz et al., 2008).

An HCMV IgM response is linked to reactivation infection. People who experience reactivation have already mounted an IgG response to HCMV. For epidemiologic purposes, anti-HCMV IgG prevalence rates are thought to reflect overall prevalence since HCMV IgG indicates a chronic infection (Chakravarti et al., 2007; Akinbami et al., 2009; Alao et al., 2009; Bawa et al., 2019). Pregnant women in wealthy nations are probably better aware of good hygiene habits like hand washing, which accounts for a lower risk of contracting HCMV infection (Ogbaini-Emovon et al., 2013). The low hygiene standards and cultural practices that promote disease transmission in underdeveloped nations may cause disparities in the prevalence of maternal HCMV infection between developed and developing countries (Ogbaini-Emovon et al., 2013).

Age-dependent deferral of HCMV seroprevalence was seen in the HCMV IgM seropositivity distribution (Bawa et al., 2019). A high incidence was seen across all age groups based on this finding. Compared to other age groups, the age group under 20 years had a higher prevalence of HCMV infection (25.0%). Age groups 21–30 (23.3%), 31–40 (16.0%), and 41–plus (15.4%) had the highest prevalence rates close to this. This study's findings that age was not substantially correlated with HCMV infection are consistent with those of Umeh et al. (2015). The HCMV IgM age-specific seroprevalence was highest in the 16–25-year and 26–35-year age groups in research in Zaria, Kaduna State, Nigeria (Adeiza et al., 2016). Although they studied a population distinct from ours, Adjei et al. (2008) found a similar pattern in Ghana. Contrary to other research findings, HCMV infection declines with age. The seroprevalence rate did not change in any straightforward way or trend with age in the study by Ojide et al. (2012) in Benin City, Nigeria, and supported by Adjei et al. (2008) in Ghana. The pattern observed in prior studies conducted in affluent nations like the US, where seroprevalence rates increased with age and peaked around 80 years, contrasts the clustering of higher HCMV IgM seroprevalence in the younger age groups in this study (Staras et al., 2006). Additionally, Umeh et al. (2015) showed an increase in seroprevalence with ageing, ascribed to the immune system weakening with advancing age, as proposed by (Redwan & Ahmedi, 2001).

Despite being the second and third highest in terms of HCMV prevalence, people in the age range of 21 to 40 constitute sexually active, mature adults who have a propensity for promiscuity and are therefore more prone to contract the virus (Esumeh et al., 2003; Deborah et al., 2015). However, the low prevalence rates among those over 41 are consistent with the finding that HCMV (IgM) prevalence rates decline with age (Chandler et al., 1985). In contrast to our study, Deborah et al. (2015) found that the age range of 41–45 years in Kafanchan, Kaduna State, Nigeria, had the highest prevalence. The risk of infection rises as sexual activity increases from adolescence through childbearing age, according to Zhong and Ma (1999) and Nieves (2006). This observation cannot account for the low prevalence in the age range of 41 years and older that this study reported.

Similar to previous research, Ndako et al. (2016) found that pregnant women between the ages of 20 and 34 had the highest prevalence of age variation. This finding is remarkably similar to that of Alao et al. (2009), who found that the second peak age for HCMV seroprevalence was between 25 and 29. Our results also differ from those of another study, which revealed that the age range of 31 to 39 years was associated with the third-highest HCMV seroprevalence (Ojide et al., 2012; Bawa et al., 2019). In this investigation, the age group with the highest HCMV seroprevalence was under 20. In contrast, Bawa et al. (2019) and Alao et al. (2009) found that the lowest levels were among individuals between the ages of 15 and 19. However, our study, which found the lowest frequency in those over 41, compared favourably with theirs because they, too, found the lowest prevalence in people over 50. (Alao et al., 2009; Bawa et al., 2019). Our results support Wujcicka et al. (2014)'s observation that HCMV seropositivity is substantially correlated with advancing age. It contrasts, nevertheless, with a study from Bawa et al. (2019), which suggested a reverse case. Age-related increases in HCMV seroprevalence are anticipated because HCMV often results in lifetime seroconversion (Bawa et al., 2019).

The increased prevalence rates among persons between the ages of 20 and 30 could be explained by the fact that these individuals are sexually active and, therefore, more likely to contract the disease through sexual contact (Hollier & Grisso, 2005). This observation concurs with Duff's findings from 2005, which found that adolescents who engage in sexual activity and women who visit clinics for STDs have more excellent rates of HCMV infection. Additionally, there was no age-related variation in HCMV IgM antibody levels. This observation is in line with some earlier reports from a

city in Italy and India, but it contrasts with other investigations from Nigeria, Singapore, and other places (Wong et al., 2000; Rubina et al., 2004; Galia et al., 2007; Akinbami et al., 2011), where age-related increases in seroprevalence (Ogbaini-Emovon et al., 2013). More specifically, the fact that most women had previously been exposed to and recovered from primary infection by the time they reached childbearing age accounts for the increase in seroprevalence with age, as reported in earlier research (Ogbaini-Emovon et al., 2013).

Married people (21.8%) had a higher prevalence of HCMV IgM than single people (18.4%). In contrast to our study, Deborah et al. (2015) found that single people in Kafanchan, Kaduna State, Nigeria, had the highest prevalence of the condition. Our finding also conflicts with prior research that indicated that exposure to children is the leading risk factor for HCMV infection (Karen & Robert, 2006; de Vries et al., 2011; CDC, 2013; Wujcicka et al., 2014). It does, however, support a previous study of a similar nature conducted in Ilorin, Nigeria (Odebisi-Omokanye et al., 2017), in which married participants had the greatest seropositivity for HCMV IgM antibodies.

Our results support a study by Bawa et al. (2019) that found a strong correlation between HCMV seropositivity and higher education. Females with tertiary education were more prevalent than their counterparts with secondary education (12.1%), at 25.0%. Additionally, tertiary-educated participants in a related study in Ilorin, Nigeria (Odebisi-Omokanye et al., 2017) showed the greatest seropositivity for CMV IgM antibodies.

Teachers (33.3%) and business/traders (25.7%) had more excellent occupation prevalence rates than other occupational groupings. Our results support a study by Bawa et al. (2019), according to which seropositivity to HCMV substantially correlates with employment. According to the individuals' occupational distribution, there was no relationship between HCMV IgM and socioeconomic class. Although none of the prevalence rates was statistically significant (P>0.05), instructors and business/traders had the highest percentages. In contrast, Ndako et al. (2016) identified more significant numbers of farmers, the unemployed, and self-employed people. They suggested that this might be because HCMV infection is most often acquired among those in lower socioeconomic strata in developing nations (Jawetz et al., 2007). Our study disputes Deborah et al. (2015) analysis, which found that farmers had the most significant prevalence among all occupational groups in Kafanchan, Kaduna State, Nigeria. Moreover, of Odebisi-Omokanye et al. (2017) in Ilorin, Nigeria, discovered that businesswomen had higher seropositivity for HCMV IgM antibodies than those in other occupations. This result is consistent with earlier research showing that HCMV infection was more prevalent in lower socioeconomic groups (Conboy et al., 1986; Sheevani & Aggarwal, 2005; Ndako et al., 2016). The HCMV IgM antibody did not correlate with social class. While this result concurs with a prior investigation, it differs from several other studies showing that HCMV infection was more prevalent in lower socioeconomic groups (Sheevani et al., 2005; Colugnati et al., 2007; Ogbaini-Emovon et al., 2013).

Additionally, 20.4% of the women of reproductive age were found to be HCMV vulnerable in this investigation. If this group contracts the virus while pregnant, there is a great danger of the virus spreading to the fetus (Fowler et al., 1992; Ogbaini-Emovon et al., 2013). There was no statistically significant correlation between patient demographic factors and HCMV serostatus. This observation supports a study by Maingi and Nyamache (2014) conducted in Thika, Kenya, which found no evidence of a significant relationship between geographic location and occupation and HCMV infection. In the study by Bawa et al. (2019), other characteristics such as age, sex, marital status, type of marriage, educational attainment, and occupation showed varying degrees of connection. However, they were not significant ($p > 0.05$).

Age, parity, gestational age, and socioeconomic class have been linked in studies from other locations (Gratacap-Cavallier et al., 1998; Galia et al., 2007; Odebisi-Omokanye et al., 2017). However, this association was not examined in the few available studies (Ogbaini-Emovon et al., 2013). According to Maingi and Nyamache (2014), age, blood transfusion history, high parity, marital status, and age were all significant risk factors for HCMV infection.

This study's use of HCMV-specific IgM as a marker for initial infection had certain drawbacks (Ogbaini-Emovon et al., 2013). A primary HCMV infection may still occur despite a negative IgM result because samples taken too early during primary infection may not contain detectable levels of IgM (Ogbaini-Emovon et al., 2013). Furthermore, after reactivation of the HCMV infection, HCMV-specific IgM may return. It was impossible to distinguish between initial infection and reactivation in this investigation. It would be better to use an IgG avidity assay if one was available because it has been demonstrated that low IgG avidity is a more distinctive and trustworthy serologic sign of primary HCMV infection (Bodéus et al., 1998; Ogbaini-Emovon et al., 2013).

5. Conclusion

The study proved that there were HCMV infections among females in the reproductive age range in the Buguma community of Rivers State, Nigeria. The HCMV IgM seropositivity in these females was not observed to be correlated

with any of the parameters. A significant seroprevalence of anti-HCMV IgM antibodies in Buguma's female population of reproductive age suggests recent virus exposure. Because of the high frequency of HCMV infection found in this study, it is recommended that routine HCMV infection screening be introduced for all females of reproductive ages throughout the state and the nation.

Compliance with ethical standards

Acknowledgements

The authors would like to acknowledge the support obtained from the management and staff of Primary Health Centre, Buguma, Rivers State, Nigeria during the enrollment and collection of samples used in this study. The authors are grateful to the participants for their willingness to be part of the study.

Disclosure of conflict of interest

The authors have declared that no competing interests exist.

Statement of ethical approval

All authors declare that all experiments have been examined and approved by the University of Port Harcourt and Rivers State University Teaching Hospital Research Ethics committees. Therefore, the study is performed following the ethical standards laid down in the 1964 Declaration of Helsinki.

Statement of informed consent

All authors declare that informed consent was obtained from all individual participants included in the study.

References

[1] Adane, T., & Getawa, S. (2021). Cytomegalovirus seroprevalence among blood donors: a systematic review and meta-analysis. *The Journal of international medical research*, *49*(8), 3000605211034656. https://doi.org/10.1177/03000605211034656

[2] Adeiza MA, Dalhat M M, Musa B, Muktar H M, Garko S B, Habib A G. Seroepidemiology of cytomegalovirus antibodies in Hiv-positive and Hiv-negative adults in Nigeria. Sub-Saharan Afr J Med 2016;3:142-2

[3] Adjei A, Armah H, Narter-Olaga E. (2006). Seroprevalence of cytomegalovirus among some voluntary blood donors at the 37 military hospital, Accra, Ghana. Ghana Med J.;40:99-104

[4] Akinbami AA, Rabiu KA, Adewunmi AA, et al. (2011). Seroprevalence of CMV antibodies among normal pregnant women in Nigeria. Int J Women Health, 3:423-428.

[5] Akinbami, A A, Akanmu, A S, Adeyemo, T A, Wright, K O, Dada, M O, & Dosunmu, A O. (2009). Cytomegalovirus antibodies among healthy blood donors at Lagos University Teaching Hospital. *SAMJ: South African Medical Journal*, *99*(7), 528-530.

[6] Alao OO, Joseph DE, Mamman A, Banwat EB. The seroprevalence of cytomegalovirus antibodies among prospective blood donors in Jos. *Niger J Med Natl Assoc Resid Dr Niger.* 2009;17(2):200–2.

[7] Almaghrabi, M. K., Alwadei, A. D., Alyahya, N. M., Alotaibi, F. M., Alqahtani, A. H., Alahmari, K. A., Alqahtani, M. S., Alayed, A. S., Moosa, R., & Ali, A. S. (2019). Seroprevalence of Human Cytomegalovirus in Pregnant Women in the Asir Region, Kingdom of Saudi Arabia. *Intervirology*, *62*(5-6), 205–209. https://doi.org/10.1159/000506051

[8] Arabpour M, Kaviyanee K, Jankhah A, Yaghobi R; Human Cytomegalovirus Infection in Women of Child Bearing Age, Fars Province: A Population Based Cohort Study. Iranian Red Crescent Medical Journal, 2008; 10(2): 100 – 106.

[9] Arbpour M, Kaviyance K, Jankha A, Yagbobi R. Human Cytomegalovirus infection in women of Childbearing age, fars province: a population-based cohort study, Iranian Red Crescent Medical Journal. 2008;10(2):100-106.

[10] Bagheri L., Mokhtarian H., Sarshar N. & Ghahramani, M. (2012). Seroepidemiology of cytomegalovirus infection during pregnancy in Gonabad, east of Iran: a cross-sectional study. Journal of Research in Health Sciences.12 (1), 38–44.

[11] Bawa, M. K., Mamman, A., Olayinka, A., Gidado, S., Waziri, N. E., Balogun, M. S., Getso, K. I., Dalhat, M. M., Nsubuga, P., Aliyu, N., Bala, H., Muhammad, H., Haladu, S., Shehu, U. L., & Nguku, P. M. (2019). Blood donor safety, prevalence and associated factors for cytomegalovirus infection among blood donors in Minna-Nigeria, 2014. *The Pan African medical journal*, *32*(Suppl 1), 6. https://doi.org/10.11604/pamj.supp.2019.32.1.13297

[12] Bawa, M. K., Mamman, A., Olayinka, A., Gidado, S., Waziri, N. E., Balogun, M. S., Getso, K. I., Dalhat, M. M., Nsubuga, P., Aliyu, N., Bala, H., Muhammad, H., Haladu, S., Shehu, U. L., & Nguku, P. M. (2019). Blood donor safety, prevalence and associated factors for cytomegalovirus infection among blood donors in Minna-Nigeria, 2014. *The Pan African medical journal*, *32*(Suppl 1), 6. https://doi.org/10.11604/pamj.supp.2019.32.1.13297

[13] Bodéus M, Feyder S, Goubau P. Avidity of IgG antibodies distinguishes primary from non-primary cytomegalovirus infection in pregnant women. Clin Diagn Virol 1998;9:9-16

[14] Chakravarti A, Kashyap B, Matlani M. Cytomegalovirus infection: an Indian perspective. *Indian J Med Microbiol.* 2007;27(1):3–11.

[15] Chandler S.H, Holmes K.K, Wentworth B.B; The Epidemiology of Cytomegalovirus Infection in Women Attending a Clinic for Sexually Transmitted Disease. Journal of Infectious Diseases, 1985; 155: 655 – 660.

[16] Cheesebrough M; District Laboratory Practice in Tropical Countries, part 1. University Press, Cambridge, 2009; 239–258.

[17] Colugnati FA, Staras SA, Dollard SC, Cannon MJ. Incidence of cytomegalovirus infection among the general population and pregnant women in the United States. BMC Infect Dis 2007;7:71.

[18] Conboy T.J, Pass R.F, Stagno S, Britt W.J, Alford C.A, McFarland C.E *et al.;* Intellectual development in school-aged children with asymptomatic congenital cytomegalovirus infection. Pediatrics, 1986; 77(6):801–806.

[19] de Vries JJ, Korver AM, Verkerk PH, Rusman L, Claas EC, Loeber JG, Kroes AC, Vossen AC. Congenital cytomegalovirus infection in the Netherlands: birth prevalence and risk factors. *J Med Virol.* 2011;83(10):1777–1782.

[20] Duff P; Immunotherapy for congenital Cytomegalovirus infection (Editorial) New England Journal of Medicine. 2005; 353(13):1402-1404.

[21] Edward Deborah S, Edward Isaac U, Nwankiti O, Shallangwa Ishaku B, Abdullahi Musa M; Seroprevalence of cytomegalovirus (IgM) antibodies among pregnant women attending ante-natal clinic at the general hospital Kafanchan, Kaduna State Nigeria. British Microbiology Research Journal 2015; 9(5): 1–6.

[22] Esumeh FD, Ugbomoiko, Isiobor JO. Seroprevalence of human Immunodeficiency virus (HIV) and Hepatitis B surface antigen (HBsAg) among blood donor in central Benin city, Nigeria Journal of Medical Science. 2003; 12(2):52-55.

[23] Fowler KB, Stagno S, Pass RF. The outcome of congenital cytomegalovirus infection in relation to maternal antibody status. N Engl J Med 1992;326:663-667

[24] Galia R, Rinat G, Asher O, et al. Primary versus nonprimary cytomegalovirus infection during pregnancy. Emerg Infect Dis 2007;13:1791-1793.

[25] Gratacap-Cavallier B, Bosson JL, Morand P, et al. Cytomegalovirus seroprevalence in French pregnant women. Parity and place of birth as major predictive factors. Eur J Epidemiol 1998;14:147- 152.

[26] Hamdan HZ, Abdelbagi IE, Nasser NM, Adam I. Seroprevalence of cytomegalovirus and rubella among pregnant women in western Sudan. *Virol J.* 2011 May 11;8:217.

[27] Hamid, K. M., Onoja, A. B., Tofa, U. A., & Garba, K. N. (2014). Seroprevalence of cytomegalovirus among pregnant women attending Murtala Mohammed Specialist Hospital Kano, Nigeria. *African health sciences*, *14*(1), 125–130. https://doi.org/10.4314/ahs.v14i1.19

[28] Hengel H, Brune W, Koszinowski UH. Immune evasion by Cytomegalovirus – survival strategies of a highly adapted opportunitist. In Jawetz, E. A., Melmick, J. I. and Adelberg, E. A. (Ed) Medical Microbiology 24th Edition 385.McGraw-Hill Education (Asia); 1998.

[29] Ho M. Epidemiology of Cytomegalovirus infection. Reviews of infectious Diseases, 1990;12(7):5701–10.

[30] Hollier L.M, Grisso H; Human herpes viruses in pregnancy Cytomegalovirus, Espterin- Barrvir and varicella-zoster virus. Clinics in Perinatology, 2005; 32: 671–696.

[31] Jawetz E, Melnick J.L, Adelberg E.A; Virology In: Brooks, G. F., Carrol, K. C., Butel., J. S., Morse, S. A. Review of Medical Microbiology, 24th edition, McGraw Hill/Lange Publication. 2007; 441– 445.

[32] Karen FB, Robert PF. Risk factors for congenital Cytomegalovirus infection in the offspring of young women: exposure to young children and recent onset of sexual activity. *Pediatrics.* 2006;118(2):286–92.

[33] Kassim OO, Afolabi O, Ako-Nai K.A, Torimiro S.E.A, Littleton G.K, Oke O.O *et al.;* Cytomegalovirus antibodies in breast milk and sera of mother-infant pairs. Journal of Tropical Paediatric, 1987; 33(2):75–77.

[34] Khairi S. I, Intisar K. S, Enan K. H, Ishag M. Y, Baraa A. M and Ali Y. H (2013). Seroprevalence of cytomegalovirus infection among pregnant women at Omdurman Maternity Hospital, Sudan. Journal of Medical Laboratory and Diagnosis. 4(4), 45-49.

[35] Kothari A, Ramachandran VG, Gupta P, Singh B, Talwar V. Seroprevalence of cytomegalovirus among voluntary blood donors in Delhi, India. J Health Popul Nutr 2002;20:348-51.

[36] Kowalzik, F., Hitzler, W., Runkel, S., & Marron, M. (2020). Seroprevalence and Seroconversion of Cytomegalovirus in a Large Group of Healthy, German Blood Donors: Potential Contribution to Transfusion Transmitted Infections. *Clinical laboratory*, *66*(4), 10.7754/Clin.Lab.2019.190901. https://doi.org/10.7754/Clin.Lab.2019.190901

[37] Kumar H, Gupta PK, Kumar S, Sarkar RS. Is seroprevalence of anti-IGM CMV among blood donors relevant in India? Indian J Pathol Microbiol 2008;51:351-2

[38] Mahallawi, W., Khabour, O. F., Al-Saedi, A., Almuzaini, Z., & Ibrahim, N. (2022). Human Cytomegalovirus Seroprevalence Among Blood Donors in the Madinah Region, Saudi Arabia. *Cureus*, *14*(2), e21860. https://doi.org/10.7759/cureus.21860

[39] Maingi, Z., Nyamache, A.K. Seroprevalence of Cytomegalo Virus (CMV) among pregnant women in Thika, Kenya. *BMC Res Notes* 7, 794 (2014). https://doi.org/10.1186/1756-0500-7-794

[40] Mocarski ES, Shenk T, Pass RF. Cytomegalovirus. In: Knipe DM, Howley PM, editors. *Fields Virology.* 5th Ed. Lippincot Williams and Wilkins; 2007. p. 2702.

[41] Mujtaba S, Varma S, Sehgal S. Cytomegalovirus co-infection in patients with HIV/AIDS in North India. Indian J Med Res 2003;117:99-103.

[42] Munro S.C, Hall B, Whybin L.R; Diagnosis of and screening for cytomegalovirus infection in pregnant women. Journal of Clinical Microbiology, 2005; 43: 4713–4718.

[43] Munro SC, Hall B, Whybin IR, Leader P, Robertson P, Maine GT, Rawlinson WD. Diagnosis of and screening for Cytomegalovirus infection in pregnant women. Journal of Clinical Microbiology. 2005;43(9):4713-4718.

[44] Mustakangas P, Sarna S, Ammala P, Muttilainen M, Loskela P, Koskiniemi M. Human Cytomegalovirus seroprevalence in three social – economically different urban area during the cohort study; International Journal of Epidemiology. 2000;29:587-591.

[45] Ndako JA, Olopade BK, Banda JM, Fajobi VO, Peter L, Ifeanyi I. 2016. Studies on the prevalence of cytomegalovirus (IgM) antibodies among pregnant women attending ante-natal clinic at a specialist hospital North Eastern Nigeria Scholars Journal of Applied Medical Sciences (SJAMS), 4(3F):1042-1048

[46] Nieves M. Cytomegalovirus, An article in pediatrics Bulleting of emadline; 2006

[47] Odebisi-Omokanye, M. B., Udeze, A. O., AbdulRaheem, A. A, AbdulRazaq, N. E., Afolabi, L. M. and Yusuf, A. A. (2017). High Seroprevalence of Cytomegalovirus Infection among Pregnant Women in Ilorin, Kwara State, Nigeria. Ilorin Journal of Science, 4(1): 77 – 91

[48] Ogbaini-Emovon, E., Oduyebo, O., Lofor, P. V., Onakewhor, J.U., Elikwu, C.J. (2013). Seroprevalence and risk factors for cytomegalovirus infection among pregnant women in southern Nigeria. Journal of Microbiology and Infectious Diseases, 3 (3): 123–127.

[49] Ojide CK, Ophori EA, Eghafona NO, Omoti C. Seroprevalence of Cytomegalovirus (CMV) amongst voluntary blood donors in University of Benin Teaching Hospital (UBTH), Edo State, Nigeria. *Br J Med Med Res.* 2012;2(1):15–20.

[50] Okonko IO, Jasper DE, Innocent-Adiele HC, Frank-Peterside N. (2022). Prevalence of Human Cytomegalovirus IgM antibodies in Pregnant Women in Port Harcourt, Rivers State, Nigeria. *Researcher,* 14(10): 36-42

[51] Olatunji, M. K. and Oluwajana, E. (2017). Prevalence and risk factors associated with human cytomegalovirus and human immunodeficiency virus coinfection in pregnant women in Ilorin, Nigeria. Covenant Journal of Physical and Life Sciences. 5(1), 27-36.

[52] Redwan NA, Ahmedi MM (2001). Prevalence study of cytomegalovirus infection among foreign manpower in Jeddah, Saudi Arabia. African Journal of Microbiology Research: 201.

[53] Reynalds DW, Stagno S, Mosty TS. Maternal cytomegalovirus excretion and perinatal infection. New Journal Medicine. 1980;302:1073-1076.

[54] Rubina L, Bashir AF, Manzoor T. Seroprevalence of cytomegalovirus in Kashmir valley- a preliminary study. JK-Practitioner 2004;11:261-262

[55] Seo, S., Cho, Y. & Park, J. (2009). Serologic screening of pregnant Korean women for primary human cytomegalovirus infection using IgG avidity test. Korean Journal of Laboratory Medicine. 29(6), 557–562.

[56] Sheevani J.N, Aggarwal A; A pilot of seroepidemiological study of cytomegalovirus infection in women of childbearing age. Indian Journal of Medical Microbiology, 2005; 23:34-36.

[57] Sheevani, Jindal N, Aggarwal A. A pilot of seroepidemiological study of cytomegalovirus infection in women of childbearing age. Indian J Med Microbiol 2005;23:34-36.

[58] Singh MP, Arora S, Das A, Mishra B, Ratho RK. Congenital rubella and Cytomegalovirus infections in and around Chandigarh. Indian Journal of Pathology and Microbiology. 2009;52:46-8.

[59] Souza MA, Passos AM, Treitinger A, Spada C. Seroprevalence of cytomegalovirus antibodies in blood donors in southern Brazil. *Rev Soc Bras Med Trop.* 2010 Jul-Aug;43(4):359–61.

[60] Souza, M. A., Passos, A. M., Treitinger, A., & Spada, C. (2010). Seroprevalence of cytomegalovirus antibodies in blood donors in southern Brazil. *Revista da Sociedade Brasileira de Medicina Tropical*, *43*(4), 359–361. https://doi.org/10.1590/s0037-86822010000400004

[61] Staras S.A, Dollard S.C, Rayford K.W, Flanders W.D, Pass R.F, Cannon M.J; Seroprevalence of Cytomegalovirus infection in the United States (1988-1994). Clinical Infectious Diseases. 2006; 43(9):1143-1151.

[62] Staras SA, Dollard SC, Radford KW, Flanders WD, Pass RF, Cannon MJ. Seroprevalence of cytomegalovirus infection in the United States, 1988-1994. Clin Infect Dis 2006;43:1143-51

[63] Taechowisan T, Sutthent R, Louisirirotchamakul S. Immune status in congenital infection by TORCH agents in pregnant Thais. Asian Pac J Allergy Immunol 1997;15:93-97

[64] Tebuka, E., Fulgence, R. D., Msemwa, B., Silago, V., Mshana, S. E., & Mirambo, M. M. (2019). Acute human cytomegalovirus infection among voluntary blood donors in the Lake Victoria zone blood transfusion centre: should it be considered in screening? *African health sciences*, *19*(3), 2351–2355. https://doi.org/10.4314/ahs.v19i3.7

[65] Umeh EU, Onoja TO, Aguoru CU, Umeh JC (2015). Seroprevalence of Cytomegalovirus Antibodies in Pregnant Women, Benue State, Nigeria. J Infect Dis Ther 3:242. doi:10.4172/2332-0877.1000242

[66] US Centers for Disease Control and Prevention Report (CDC) *Health, United States, 2013 with special feature on prescription drugs.* 2013. Accessed on 08/06/2022.

[67] Vueba, A., Faria, C., Almendra, R. *et al.* Seroepidemiology study of Cytomegalovirus and Rubella in pregnant women in Luanda, Angola: geospatial distribution and its association with socio-demographic and clinical-obstetric determinants. *BMC Infect Dis* 22, 124 (2022). https://doi.org/10.1186/s12879-022-07087-x

[68] Wong A, Tan KH, Tee CS. Seroprevalence of cytomegalovirus, Toxoplasmosis and parvovirus in pregnancy. Singapore Med J 2000;14:151-155.

[69] Wujcicka W, Gaj Z, Wilczynski J, Sobala W, Spiewak E, Nowakowska D. Impact of socioeconomic risk factors on the seroprevalence of cytomegalovirus infections in a cohort of pregnant Polish women between 2010 and 2011. *Eur J Clin Microbiol Infect Dis.* 2014;10(14):2170–3. Epub 2014 Jun 6.

[70] Yeroh, M., Aminu, M. & Musa, B.O.P. (2015). Seroprevalence Of Cytomegalovirus Infection Amongst Pregnant Women in Kaduna State, Nigeria. *African Journal of Clinical and Experimental Microbiology*, *16*(1), 37-44.

[71] Zhong XX, Ma TY. A clinical study of cytomegalovirus infection during pregnancy Journal of Yonggi Medical University. 1999;13:60-64.