

Seroprevalence of Human Cytomegalovirus and Its Association with Hepatic and Renal Function Markers among Pregnant Women in Dutse, Jigawa State

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ABSTRACT

Human cytomegalovirus (CMV) is a common viral infection and a leading cause of congenital infections. This study determined the sero-prevalence of CMV and assessed its association with hepato-renal functions among pregnant women attending antenatal care at General Hospital Dutse, Jigawa State. A cross-sectional study was conducted among 81 pregnant women. Serum samples were analyzed for CMV IgG and IgM antibodies using ELISA. Liver and kidney function parameters were determined using standard methods. Data were analyzed using descriptive statistics, chi-square tests, analysis of variance (ANOVA), and binary logistic regression. Statistical significance was set at $p < 0.05$. The result showed that CMV sero-prevalence was 61.7%. CMV IgG was positive in 60.5% of participants, (i.e. the sum of 45.7% and 14.8%), 16.0% were IgM positive (i.e. the sum of 1.2% and 14.8%) and 14.8% had both IgG and IgM. CMV sero-status was not significantly associated with trimester of pregnancy ($p = 0.53$). Significant differences were observed in liver enzyme levels across CMV sero-status groups, for ALT ($p < 0.001$), AST ($p < 0.001$), and ALP ($p = 0.027$). Parity was a significant predictor of CMV sero-positivity, with nulliparous women having higher odds of CMV infection (OR = 12.7, $p = 0.031$). CMV infection is highly prevalent among pregnant women in Dutse and is associated with altered liver enzyme profiles. Parity appears to be an important risk factor associated with CMV seropositivity.

Keywords: Cytomegalovirus, pregnancy, sero-prevalence, liver function, renal function, Nigeria.

1.0 INTRODUCTION

Human cytomegalovirus (HCMV) is a β human herpes virus with sero-prevalence rates ranging from 60-90% (Lawrence, 2024). It is the second most common cause of congenital viral infections in the developing countries, after HIV (Payne *et al.*, 2024). Congenital CMV (cCMV) occurs when there is transmission of CMV from the mother to the fetus in utero or perinatally. It is diagnosed by the detection of CMV DNA in any of the neonate's body fluids within the first 21 days of life (Salomè *et al.*, 2023). Although many infected infants are asymptomatic at birth, congenital CMV can lead to various outcomes, including mild hepatomegaly, sensorineural hearing loss, and, in severe cases, fetal or neonatal death. As there is no vaccine alternative measure to prevent congenital infection (Boscarino *et al.*, 2024).

Pregnancy has been described as an immunological condition which presents multiple challenges in diagnosis, prevention and management of infectious diseases (Beltrami *et al.*, 2023). Maternal immunity acquired against CMV prior to conception does not confer complete protection to the developing fetus, as is the case with the other antenatal and perinatal congenital infections such as toxoplasmosis and rubella (Auriti *et al.*, 2022). As a result, vertical transmission of CMV can occur in both primary and non-primary maternal infections with rates of 30% and 2%, respectively (Choodinatha *et al.* 2023).

In the USA, an estimated 40,000 pregnant women acquire a primary CMV infection (seroconvert) during pregnancy. Of the 40,000 women who seroconvert approximately 6,000 to 8,000 of their infants will develop severe and permanent neurologic damage from this infection (Gowda *et al.*, 2021 Ornoy *et al.*, 2025). High level screening of CMV in Belgium has yielded data on maternal-fetal transmission rates at gestation (Périllaud-Dubois *et al.*, 2021). The Italians used national serologic screening to develop and evaluate methods to diagnose maternal and fetal CMV infections including the CMV IgG avidity assay and to test CMV immunoglobulin interventions (Fowler *et al.*, 2022; Muntean *et al.*, 2025). While the French used serologic screening to evaluate the role of maternal education on CMV and the role of hygienic intervention to prevent maternal acquisition during pregnancy (Hussami *et al.*, 2025). However, the Nigerian situation may be worse, as there are either no screening for CMV during pregnancy due to inadequate funding in the health sector or no proper documentation as regards the health status on CMV in the various health care centers are available.

In recent times, there is a growing awareness of the possible importance of human cytomegalovirus (CMV) as a cause or contributory factor in a range of disease conditions in Africa and other developing regions globally. In children, the outcomes of CMV congenital infection are largely undefined in African populations (Diogo *et al.*, 2020). CMV is also a cause of pneumonia and meningitis (Schattner, 2024; Jabbehdari *et al.*, 2022), and an important

co-infection in HIV infected adult patient groups which is associated with increased morbidity and mortality (de Melo *et al.*, 2025). However, there is limited research studies on the associated risk factors and status of this infection among pregnant women in Jigawa State, thereby making appropriate control measures more difficult since such information is crucial to identify and implement effective control measures. This study was aimed at determining the seroprevalence of Cytomegalovirus, association with hepatorenal functions and its associated risk factors among pregnant women attending antenatal care clinic at General Hospital Dutse, Jigawa State with a view to guiding policy makers and educating pregnant women on ways of preventing infection to reduce birth of children with various disabilities.

2.0 MATERIALS AND METHODS

2.1 Ethical approval

Ethical approval was obtained from the Jigawa State Ministry of Health Research Ethics Committee (JGHREC/2023/100) prior to the commencement of the study.

2.2 Study Design and Population

A cross-sectional study was conducted among pregnant women attending the antenatal clinic of General Hospital Dutse, Jigawa State, Nigeria. Women who gave informed consent were recruited into the study using consecutive sampling technique.

2.3. Inclusion and exclusion criteria

The inclusion criterion was a confirmed pregnancy that was registered for antenatal care at General Hospital Dutse. Non-pregnant women and pregnant women who did not give their informed consent were excluded from the study.

2.4 Sample Size Determination

The sample size was determined using the formula by Cochran, (1977) for sample size determination.

$$N = Z^2 pq / d^2$$

Where;

N = sample size

Z = the normal standard (Z=1.96)

p = the frequency of occurrence of CMV infection (50%)

q = 1-p

d = level of precision (0.05%)

Assuming a prevalence of CMV of 50%, a 95% confidence interval and a margin of error of 5%, a minimum sample size of 384 was obtained. After applying the finite population correction for a total population of 81 pregnant women, the adjusted sample size was 66. However, all 81 eligible pregnant women were recruited, thereby increasing the power of the study.

2.5 Structured Questionnaires

Structured questionnaires were given to study participants who gave their informed consent to obtain sociodemographic and other relevant information

2.6 Sample Collection and Processing

Five milliliters of venous blood was collected from each of the pregnant women, whose consent has been obtained using a 23-gauge needle and syringe. The blood was transferred into a plain sample bottle specific for each pregnant woman. Each sample bottle was appropriately labelled to match the ID number for each patient as written on the questionnaire containing individual demographic data. The blood sample was centrifuged at 3,000g for 5 minutes using a benchtop centrifuge. The serum obtained was transferred into a clean cryovials using a Pasteur pipette and stored at -20°C until all required samples were collected and ready for laboratory analysis.

2.7 Serological testing

The serological testing was carried out in the laboratory of the Dutse General Hospital, Jigawa State. Qualitative determination of CMV IgG and IgM antibodies was carried out using Enzyme Linked Immunosorbent Assay (ELISA) technique, using CMV IgG and IgM kit (Dia lab®, Austria). Samples, reagents and calibrators were brought to room temperature before the test was conducted.

Microwell plate were labeled for sample, control and blank appropriately. Samples were diluted 1:100 with the sample diluents. Afterwards 100 µl of each sample, positive and negative controls were dispensed into wells, leaving a well empty (blank). This was covered with adhesive foil and incubated at 37°C for 60 minutes using an incubator. The adhesive foil was gently detached and the plate washed seven times with 300 µl diluted wash buffer according to manufacturer's instructions. After that, 100 µl of enzyme conjugate was introduced into all wells, covered again and incubated at 37°C for another 60 minutes. This was washed again seven times with 300 µl diluted wash buffer. Then 100µl of the substrate was dispensed into all the wells including the blank. The plate was covered with a new adhesive and then incubated at room temperature for 20 min, protected from light. After which 100µl of stop solution was finally introduced into all the wells. The absorbance of each sample, control and blank was read using plate reader at a wavelength of 450 nm. The cut off of IgG was set at 0.5 World Health Organization (WHO) IU/m (Kofahi *et al.*, 2025). Samples with a concentration ≥ 0.5 WHO IU/mL was considered positive for CMV IgG, while samples with a concentration below the cut off were considered as negative results.

2.8 Liver and Kidney Function Tests

All the liver function indices; Alanine Amino transferase (ALT), Aspartate Aminotransferase (AST), Alkaline Phosphatase (ALP) as well as indices for kidney function; Urea, Creatinine, and electrolytes were determined using the RANDOX kit by following the IFCC Manual RX MONZA according to the manufacturer's instructions. Tests were carried out at the laboratory of the Dutse General Hospital, Jigawa State, Nigeria.

2.9 Data Analysis

Data collected from this study was analyzed using Python (Python 3) with pandas, SciPy and statsmodels libraries

within a Jupyter Notebook environment. Descriptive statistics was used to summarize the demographic and clinical variables. Chi square test was done to assess the association between categorical variables. Differences in biochemical parameters across CMV serostatus groups

were evaluated using one-way ANOVA followed by Tukey Post-hoc test. Binary logistic regression was performed to identify factors associated with CMV seropositivity. The normality of the data was assessed using Shapiro-Wilk test. The statistical significance was set at $p < 0.05$.

3.0 RESULTS

3.1 Characteristics of study population

Table 1: Socio-Demographic and Obstetric Characteristics of Study Population (N=81)

| Variable | Category | Frequency (n) | Percentage (%) |
|----------------|---------------|----------------|----------------|
| Age (years) | Mean \pm SD | 23.9 \pm 6.1 | — |
| | Range | 17–45 | — |
| Marital status | Married | 79 | 97.5 |
| | Single | 1 | 1.2 |
| | Divorced | 1 | 1.2 |
| Occupation | Housewife | 75 | 92.6 |
| | Housemaid | 4 | 4.9 |
| | Student | 2 | 2.5 |
| Gravidity | Primigravida | 48 | 59.3 |
| | Multigravida | 33 | 40.7 |
| Parity | Nulliparous | 33 | 40.7 |
| | Primiparous | 39 | 48.1 |
| Trimester | Multiparous | 9 | 11.1 |
| | First | 43 | 53.1 |
| | Second | 28 | 34.6 |
| | Third | 10 | 12.3 |

A total of 81 pregnant women were recruited for the study. The mean age of the study participants was 23.9 \pm 6.1 years (range: 17–45 years). Majority 79(97.5%) of the study participants were married, 75(92.6%) were housewives, and

48(59.3%) were primigravida. Study participants were distributed across all three trimesters of pregnancy with 43(53.1%), 28(34.6%) and 10(12.3%) in the first, second and third trimesters respectively as shown in table 1.

3.2 CMV sero-prevalence in the study population

Distribution of CMV Status Among Pregnant Women

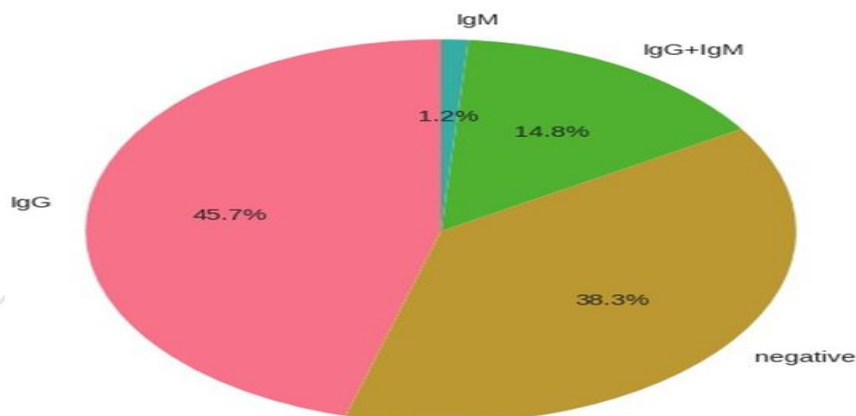


Figure 1: Sero-prevalence of cytomegalovirus antibodies among pregnant women

Results obtained from the study revealed that 61.7% of participants were seropositive for CMV antibodies as shown in figure 1. Specifically, 60.5% were positive for CMV IgG (i.e. the sum of 45.7% and 14.8%), indicating past exposure, while 16.0% were IgM positive (i.e. the sum

of 1.2% and 14.8%), indicating recent or active infection. Dual positivity for both IgG and IgM was observed in 14.8% of participants. Approximately 38.3% of the women were CMV sero-negative (figure 1)

3.3 Distribution of CMV status by trimester of pregnancy

Table 2: Distribution of CMV Serostatus by Trimester of pregnancy

| Trimester | CMV Positive n (%) | CMV Negative n (%) | Total |
|-----------|--------------------|--------------------|-------|
| First | 31 (72.1) | 12 (27.9) | 43 |
| Second | 15 (53.6) | 13 (46.4) | 28 |
| Third | 4 (40.0) | 6 (60.0) | 10 |

Chi-square test: $\chi^2 = 8.07$, $p = 0.53$

No statistically significant association was observed between CMV sero-status and trimester of pregnancy ($\chi^2 = 8.07$, $p = 0.53$), indicating that CMV exposure was evenly distributed across trimesters (Table 2).

3.4 Liver Function Tests and CMV Status

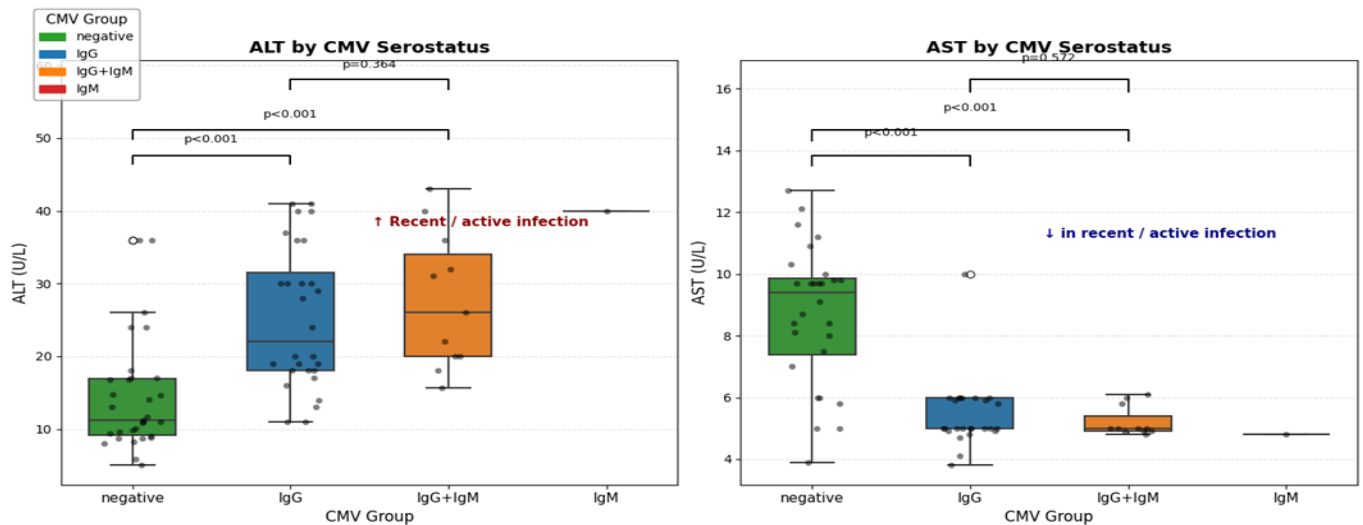


Figure 2: Liver function parameters by CMV sero-status

Significant differences were observed in liver enzyme levels across the CMV groups. Alanine aminotransferase (ALT) levels differed significantly by CMV status ($p < 0.001$) with CMV-positive women (IgG, IgM, or both) having higher mean ALT levels compared to CMV-negative women. Aspartate aminotransferase (AST) levels were also observed to be significantly different across CMV

groups ($p < 0.001$), with CMV-negative participants having higher mean AST levels than CMV-positive groups. In addition, significant differences were observed in ALP levels though no significant differences were observed among the groups. In all, CMV sero-positivity was associated with altered liver enzyme profiles, particularly elevated ALT levels (Figure 2).

3.5 Kidney Function Tests and CMV Status

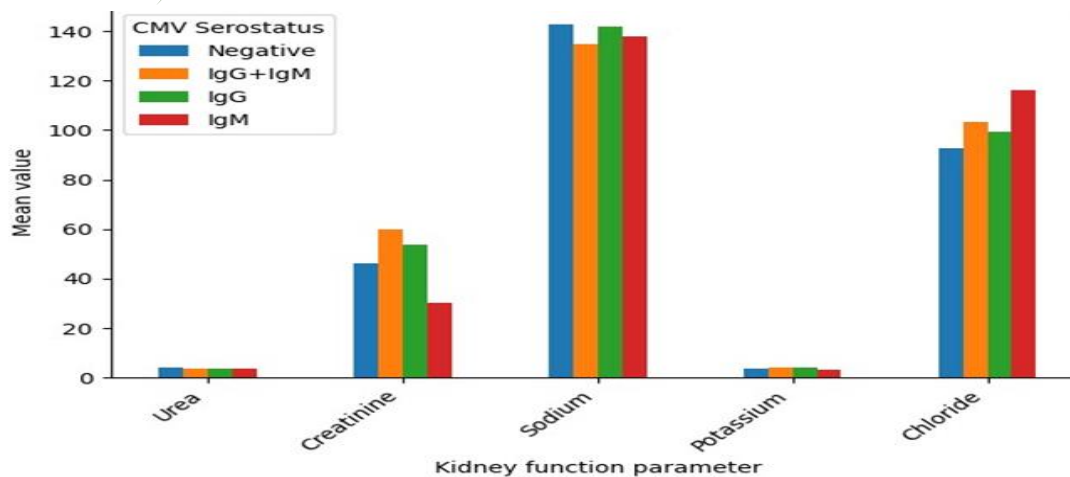


Figure 3: Kidney function parameters by CMV sero-status

As shown in Figure 3, no statistically significant differences were observed in serum urea or creatinine levels across CMV sero-status groups ($p > 0.05$ for both).

3.6 Risk Factor Analysis for CMV Seropositivity

Table 3: Logistic regression analysis of factors associated with CMV sero-positivity

| Variable | Odds Ratio (OR) | 95% CI | p-value |
|---------------------|-----------------|-------------|---------------|
| Age | 1.00 | 0.92–1.10 | 0.93 |
| Second trimester | 0.33 | 0.10–1.12 | 0.07 |
| Third trimester | 0.88 | 0.12–6.27 | 0.90 |
| Nulliparous | 12.72 | 1.27–127.57 | 0.031* |
| Primiparous | 8.30 | 0.99–69.60 | 0.051 |
| Primigravida | 0.99 | 0.32–3.08 | 0.98 |
| Secondary education | 1.87 | 0.54–6.47 | 0.33 |
| Tertiary education | 3.19 | 0.37–27.16 | 0.29 |

Binary logistic regression was performed to identify factors associated with CMV sero-positivity and parity emerged as a significant predictor as shown in table 4. Results obtained from the study revealed that nulliparous women had significantly higher odds of CMV sero-positivity compared with multiparous women (OR = 12.7, $p = 0.031$). Primiparous women also showed increased odds, approaching statistical significance (OR = 8.3, $p = 0.051$). On the other hand, age, trimester of pregnancy, gravidity, and educational level were not significantly associated with CMV sero-positivity (table 3). The model showed modest explanatory power (Pseudo $R^2 = 0.11$).

3.7 Influence of parity in CMV sero-positivity

Table 4: Seroprevalence of CMV by parity and trimester

| Parity | CMV Positive (%) | Total (n) |
|-------------|------------------|-----------|
| Nulliparous | 66.7 | 33 |
| Primiparous | 66.7 | 39 |
| Multiparous | 22.2 | 9 |

The prevalence of CMV sero-positivity was markedly higher among nulliparous (66.7%) and primiparous (66.7%) women compared with multiparous women (22.2%), supporting the findings from the regression analysis (Table 3).

4.0 DISCUSSION

This study assessed the sero-prevalence of human cytomegalovirus (CMV) and its association on hepato-renal functions among pregnant women attending antenatal care at General Hospital Dutse, Jigawa State. The findings provide important insight into the burden of CMV infection in pregnancy and its potential biochemical implications in a resource-limited setting where routine CMV screening is not currently practiced.

The CMV sero-prevalence observed in this study was high, with more than half of the participants testing positive for CMV IgG antibodies. This finding is consistent with reports that CMV is highly prevalent in developing countries, where sero-positivity rates commonly exceed 50% due to

early childhood exposure, overcrowding, and close interpersonal contact (Yusuf *et al.*, 2018; Huang *et al.*, 2022; Moglad *et al.*, 2023). The predominance of IgG positivity suggests widespread prior exposure and latent infection among women of reproductive age, which aligns with the established epidemiology of CMV in sub-Saharan Africa (Elikwu *et al.*, 2023). The presence of IgM antibodies, either alone or in combination with IgG, although less frequent, indicates recent infection or viral reactivation, both of which are clinically relevant during pregnancy because they carry a risk of vertical transmission (Rybak-Krzyszowska *et al.*, 2023).

Despite the variation in CMV positivity across trimesters, no statistically significant association was observed between CMV sero-status and trimester of pregnancy. This supports the concept that CMV infection or reactivation can occur at any stage of pregnancy, as previously reported (Rybak-Krzyszowska *et al.*, 2023; Lawrence, 2024). Pregnancy is characterized by complex immunological adaptations that may allow reactivation of latent CMV or reinfection with a different viral strain, irrespective of gestational age. The higher proportion of CMV-positive cases observed in early pregnancy, although not statistically significant, remains clinically important, as primary or reactivated infection in the first trimester is associated with a higher risk of congenital CMV and severe fetal outcomes (Nonou *et al.*, 2024).

A key finding of this study was the significant association between CMV sero-positivity and alterations in liver function indices. Elevated alanine aminotransferase (ALT) levels among CMV-positive participants suggest subclinical hepatic involvement. CMV is known to cause mild to moderate hepatocellular injury, even in immunocompetent individuals, and transient hepatitis has been well documented during primary infection or reactivation (Tziella *et al.*, 2025). The observed differences in AST and ALP further support the influence of CMV infection on hepatic function during pregnancy. Although these biochemical changes were largely asymptomatic, they may have clinical relevance in pregnancy, where liver dysfunction can complicate maternal health and pregnancy outcomes.

In contrast, renal function markers, including urea and creatinine, did not differ significantly across CMV sero-status groups. This suggests that CMV infection in this population did not exert a measurable effect on renal function. This finding is consistent with existing evidence indicating that CMV-related renal impairment is more commonly observed in immunocompromised individuals, such as transplant recipients or patients with advanced HIV infection (Fan *et al.*, 2016), rather than in otherwise healthy pregnant women.

Parity emerged as an important risk factor for CMV sero-positivity. Nulliparous and primiparous women had significantly higher odds of CMV infection compared with multiparous women. This may reflect differences in immunity acquired through repeated pregnancies or cumulative exposure over time. Multiparous women are more likely to have developed protective immunity from

earlier exposures, whereas women in their first or second pregnancies may be more susceptible to primary infection or reinfection. Similar observations have been reported in previous studies identifying parity as an important determinant of CMV sero-status during pregnancy (Zenebe *et al.*, 2021).

Age, gravidity, trimester, and educational status were not significantly associated with CMV sero-positivity in this study. This buttress the fact that CMV infection is widespread across demographic and socioeconomic groups in endemic settings, further highlighting the limitations of relying solely on risk-based screening approaches. The absence of strong demographic predictors suggesting the need for broader preventive strategies, including health education and consideration of routine antenatal screening.

The findings of this study have important public health implications. The high CMV sero-prevalence, combined with evidence of hepatic involvement, supports the need to integrate CMV awareness, screening, and preventive education into antenatal care services in Nigeria. Given that maternal immunity does not fully protect against vertical transmission, early identification of CMV infection during pregnancy could inform monitoring strategies and counseling aimed at reducing congenital CMV-related morbidity.

5.0 CONCLUSION

CMV infection is highly prevalent among pregnant women in Dutse and is associated with alterations in ALT and AST levels. Parity was found to be an important risk factor, indicating the need for increased CMV awareness and its consideration for inclusion in routine antenatal screening.

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CONFLICT OF INTEREST

We have no conflict of interest to declare.

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