**Original Research Article**

**Sero-Prevalence and Immunological Profile of SARS-CoV-2 Antibodies in Nigerian Sickle Cell Disease Patients during the COVID-19 Pandemic.**

**Abstract**

**Introduction**: Nigeria has the greatest prevalence of sickle cell disease (SCD) worldwide, making it a significant genetic illness in Africa. Due to their weakened immunological and hematological characteristics, SCD patients were at further danger during the COVID-19 pandemic.

**Aim/Objective**: The purpose of this study was to determine the sero-prevalence of SARS-CoV-2 IgG and IgM antibodies as well as the corresponding hematological and immunological profiles in SCD patients in Nigeria during the epidemic.

**Method**: At the University College Hospital (UCH), Ibadan, a case-control, cross-sectional study with 167 participants—122 SCD patients and 45 healthy controls—was carried out. Blood samples were examined for coagulation indicators (PT, APTT, D-dimer), hematological parameters (WBC, platelets, Hb, PCV), and SARS-CoV-2 antibodies (IgG/IgM). SPSS v23.0 was used for statistical analysis.

**Results**: WBC (11.37 vs. 5.64), platelet counts (351.62 vs. 233.04), PT (15.33 vs. 11.86), APTT (32.25 vs. 29.27), and D-dimer (3347.08 vs. 1438.13) were all substantially higher in SCD patients than in controls (p<0.05). SARS-CoV-2 IgG/IgM levels did not differ significantly between groups, while SCD patients had somewhat higher mean values. Age and IgM levels were shown to be negatively correlated (r=-0.223, p=0.014).

**Conclusion**:Significant coagulation and hematological abnormalities were seen in SCD patients, underscoring their susceptibility to thrombotic episodes during infections. For improved clinical care, serological testing and routine monitoring of these indicators are advised.

**Keywords**: Sero-prevalence, SARS-CoV-2, IgG, IgM, sickle cell disease, haematological parameters, D-dimer, Nigeria.

**1.0 Introduction**

Sickle cell disease (SCD) is a genetic disorder caused by a mutation in the β-globin gene (HBB), which results in the production of abnormal hemoglobin S (HbS) (1). In low oxygen environments, HbS tends to form polymers, causing red blood cells to become stiff and fragile. This leads to hemolysis, blockage of blood vessels, and complications like pain crises, strokes, and damage to several organs (2). SCD affects millions globally, with sub-Saharan Africa carrying the highest burden. In Nigeria, more than 150,000 babies are born with SCD every year, and over 1.8 million people live with the disease (3,4). Due to limited healthcare resources, especially access to treatments like hydroxyurea and blood transfusions, SCD remains a major cause of death in children in these regions (5).

The COVID-19 pandemic, which began in 2019, added new challenges for SCD patients, who are already vulnerable due to their weakened immune and blood systems (6). SARS-CoV-2, the virus responsible for COVID-19, causes several blood and clotting problems, including low platelet and lymphocyte counts, raised D-dimer levels, and prolonged clotting times (PT and APTT) (7,8). These issues resemble the existing inflammatory and clotting abnormalities in SCD, such as chronic inflammation, blood vessel damage, and activated platelets (9). This overlap has raised concerns about increased risk of blood clots and severe COVID-19 outcomes in people with SCD (10).

Studying the antibody response to SARS-CoV-2 in SCD patients is important for several reasons. Firstly, IgM and IgG antibodies help identify recent or past infections and provide insights into population exposure and immunity (11). Secondly, the immune response in SCD is not fully understood-some evidence suggests poor antibody production due to spleen damage, while other studies suggest chronic inflammation might enhance antiviral responses (12,13). Thirdly, in countries like Nigeria where testing and vaccination are limited, antibody data can guide targeted public health actions, such as vaccination programs for high-risk groups (3).

Despite the relevance, there has been limited research on SARS-CoV-2 antibody levels and immune profiles in African SCD patients. Most studies have focused on Western populations, where genetic traits and healthcare access differ significantly (4). Moreover, little is known about how markers like D-dimer and CRP relate to antibody levels in Nigerian SCD patients with COVID-19 (14). This study aimed to compare blood and clotting markers between SCD patients and healthy individuals, determine the presence of SARS-CoV-2 IgG and IgM antibodies in Nigerian SCD patients during the pandemic, and explore links between antibody levels and factors like age, sex, and disease severity (e.g., D-dimer).

### ****2.0 MATERIALS AND METHODS****

#### ****2.1 Study Design and Setting****

This study utilized a case-control, cross-sectional design to explore the sero-prevalence of SARS-CoV-2 antibodies and associated immunological markers in sickle cell disease (SCD) patients. The research was conducted at the Haematology Day Care Unit of the University College Hospital (UCH), Ibadan, Oyo State, Nigeria. One of the best tertiary hospitals in West Africa, UCH offers cutting-edge medical treatment and is a key hub for referrals for hematological illnesses, including sickle cell disease.

#### ****2.2 Study Design****

The study used a purposeful sample to compare laboratory parameters between SCD patients (cases) and healthy individuals (controls). A total of 167 people participated, comprising 122 confirmed SCD patients and 45 age- and sex-matched healthy controls with no past history of hematological issues.

#### ****2.3 Sample Size Determination****

A formula for case-control studies was used to calculate the sample size, taking into account power, confidence level, and anticipated variations in the means of coagulation parameters. To increase the study's statistical power, the computed minimum sample size was surpassed.

#### ****2.4 Study Subjects****

Participants were recruited based on medical records, history of SCD, and consent to participate in the study.

##### **2.4.1 Inclusion Criteria**

* Confirmed diagnosis of SCD (HbSS or HbSC)
* Age ≥5 years
* Attendance at UCH Haematology Day Care Unit
* Consent to participate in the study

##### **2.4.2 Exclusion Criteria**

* History of recent blood transfusion within three months
* Presence of other chronic diseases (e.g., HIV, TB, or cancer)
* Refusal to provide informed consent

#### ****2.5 Materials and Equipment****

The study utilized various laboratory tools and reagents including:

* EDTA and citrate blood collection tubes
* Automated hematology analyzers (Sysmex XN-series)
* ELISA kits for IgG, IgM, CRP, and FDP (validated for SARS-CoV-2 detection)
* Coagulation analyzers for PT, APTT, and D-dimer analysis
* Spectrophotometers and microplate readers
* Personal protective equipment (PPE) for biosafety

#### ****2.6 Ethical Consideration****

Ethical approval for this study was obtained from the UCH Institutional Review Board. All participants or their legal guardians signed informed consent forms. Confidentiality and anonymity of participant information were strictly maintained throughout the research process in accordance with the Declaration of Helsinki.

#### ****2.6 Clinical Laboratory Investigation****

##### **2.6.1 Sample Collection and Analysis**

Venous blood samples were collected under aseptic conditions. Blood in EDTA tubes was used for full blood count and haematological profiling. Citrated blood samples were used for coagulation studies including PT, APTT, INR, and D-dimer. Plasma was separated and stored at -20°C for ELISA-based serological testing. IgG and IgM antibody levels were quantified to assess SARS-CoV-2 exposure, and CRP and FDP levels were measured as markers of inflammation and fibrinolysis respectively.

#### ****2.7 Statistical Analysis****

Data were analyzed using SPSS version 23.0. Descriptive statistics such as means and standard deviations were used to summarize the data. Inferential statistics including independent samples t-tests, chi-square tests, and Pearson’s correlation coefficient were applied to examine differences and relationships between variables. A p-value of less than 0.05 was considered statistically significant.

**3.0 RESULTS**

**TABLE 1: COMPARISON OF MEAN±SD SARS-COV-2 (COVID-19 INFECTION) ANTIBODIES OF STUDY SUBJECTS (TEST/CASES AND CONTROL)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **SICKLE CELL PATIENTS (n=122)** | **NORMAL PEOPLE/CONTROL (n=45)** | **t-test** | **p-value** | **Remark** |
| **Other important parameters** | **Mean**±SD | **Mean**±SD |  |  |  |
| IgM | 0.28 ± 0.20 | 0.24 ± 0.10 | 1.330 | 0.185 | Not Significant |
| IgG | 0.17 ± 0.03 | 0.16 ± 0.03 | 1.118 | 0.265 | Not Significant |

\*p<0.05 (i.e. Significant).

**TABLE 2: CORRELATION OF AGE WITH SARS-COV-2 (COVID-19 INFECTION) ANTIBODIES OF TEST SUBJECTS (n=122)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables (r values**  **(p values)** | **Age (Years)** | **IgM** | **IgG** |
| Age (Years) | 1 |  |  |
| IgM | **-0.223 (0.014\*)** | 1 |  |
| IgG | 0.128 (0.159) | -0.036 (0.692) | 1 |

\*p<0.05 (i.e. Significant).

The table below showed a strong significant negative correlations between Age and IgM (r= -0.223, p=0.014) of test subjects. The table also showed no significant correlation between age and IgG (r= 0.128, p=0.159) of test subjects respectively.

**TABLE 3: RELATIONSHIP BETWEEN SEX AND SARS-COV-2 (COVID-19 INFECTION) ANTIBODIES OF TEST SUBJECTS (n=122)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SARS-COV-2 ANTIBODIES** | **SEX** | | **t-test** | **p-value** | **Remark** |
|  | Male (n=64) | Female (n=58) |  |  |  |
|  | Mean (±SD) | Mean (±SD) |  |  |  |
| IgM | 0.28 ± 0.20 | 0.28 ± 0.21 | 0.152 | 0.879 | Not Significant |
| IgG | 0.17 ± 0.02 | 0.16 ± 0.03 | 0.259 | 0.796 | Not Significant |

\*p<0.05 (i.e. Significant).

The table below showed that there were no significant differences between the SARS-COV-2 (COVID-19 INFECTION) ANTIBODIES (IgM and IgG) of sickle cell patients in relation to their sexes (p>0.05) as shown in table 3.

**4.0 Discussion**

The results provide insight into the blood and immune characteristics of SCD patients in Nigeria during COVID-19. Although there were no significant differences in SARS-CoV-2 antibody levels between SCD patients and healthy controls, SCD patients showed more severe blood and clotting changes (15). These findings improve our understanding of how viral infections interact with chronic blood disorders like SCD, especially in settings with limited healthcare access (3).

The commonly seen high white blood cell and platelet counts in SCD patients (11.37 ± 3.86 vs. 5.64 ± 1.88 and 351.62 ± 91.62 vs. 233.04 ± 64.75, respectively) reflect the chronic inflammation in the disease (16). These changes result from repeated episodes of blocked blood vessels and red cell breakdown (17). The longer clotting times (PT: 15.33 ± 1.93 vs. 11.86 ± 1.43 sec; APTT: 32.25 ± 3.72 vs. 29.27 ± 3.38 sec) and much higher D-dimer levels (3347.08 ± 1272.15 ng/mL vs. 1438.13 ± 869.23 ng/mL) further support the hypercoagulable state seen in SCD, which may worsen during infections like COVID-19 (18,7).

These results are especially important because both SCD and severe COVID-19 share similar blood clotting issues (10). This may mean that SCD patients are at increased risk of complications from COVID-19, such as dangerous clots (19).

The lack of significant differences in antibody levels between the groups (IgM: 0.28 ± 0.20 vs. 0.24 ± 0.10; IgG: 0.17 ± 0.03 vs. 0.16 ± 0.03) is interesting (20). Even though SCD can affect immune responses due to spleen damage and chronic inflammation (6), the antibody responses in these patients appeared similar to those in healthy individuals (21). The slightly higher average antibody levels in SCD patients might suggest more exposure to the virus or minor differences in immune activity (22).

There is also a need for more research into how age affects antibody production in SCD patients. The observed negative correlation between age and IgM levels (r = -0.223) may reflect differences in exposure or age-related immune changes (23,24).

However, some limitations must be considered. Because this was a cross-sectional study, it could not assess how long antibodies lasted or when infections occurred (25). Also, being a single-center study limits how widely the results can be applied (26). Data on previous COVID-19 infections and vaccination status were incomplete (27). Future research should examine how different treatments for SCD affect immune responses, include cellular immunity tests, and use long-term studies to track antibody levels over time (14). Studies from multiple centers and different regions are needed to confirm these findings (8).

The blood and clotting abnormalities found in this study support the need for close monitoring of SCD patients, especially during health emergencies like the COVID-19 pandemic (28). Even though the antibody response seems generally preserved (12), the individual differences in immune function suggest that personalized care and vaccination strategies are needed for this high-risk group (2). These results highlight the importance of including SCD patients in pandemic response plans and point to areas where more research is needed to improve care for this vulnerable group (4,9).

**5.0 Conclusion**

This study shows that sickle cell disease (SCD) patients have severe coagulation and hematological abnormalities, such as higher platelet levels, white blood cell counts, and hypercoagulability markers, when compared to healthy persons. The results indicate that SCD patients may face increased risks during viral infections because of their underlying inflammatory and prothrombotic state, even if SARS-CoV-2 antibody levels did not differ significantly across groups. The results indicate the specific sensitivity of SCD patients to infection-related consequences and highlight the necessity for specialized surveillance and management.

**6.0 Recommendations**

We firmly believe that routine coagulation monitoring, such as D-dimer, PT, and APTT testing, should be incorporated into standard clinical care protocols for sickle cell disease patients, especially during infectious disease outbreaks, in order to enable early detection and treatment of thrombotic complications. In order to increase the identification of infection symptoms and thrombotic warning signs, healthcare practitioners should prioritize this susceptible population for targeted immunization initiatives and improved preventive care measures. At the same time, they should undertake extensive patient education programs. Furthermore, we advise that specific clinical guidelines be created that integrate these hematological monitoring techniques into the frameworks now in place for the management of sickle cell disease.

Additionally, there is a critical need for longitudinal research to evaluate long-term immune responses and optimize protective interventions for this high-risk group, with the ultimate goal of improving health outcomes during public health emergencies.

**Conflict of Interest:** Authors declare that they have no conflict of interest.

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**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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