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Vitamin D, Gamma-glutamyl Transferase, Total Protein, Albumin/Globulin Ratio, Urea and Creatinine Levels in Relation to Severity of SARS-CoV-2 Infection Among Patients in Lagos, Nigeria

[1]Toyosi Yekeen Raheem, [2]Kazeem Adewale Osuolale, [3]Samuel Kayode Akindele, [3]Emmanuel Olusesan Fasela, [3]Maureen N Aniedobe, [4]Babatunde Lawal Salako

[1]Molecular Biology and Biotechnology Department, Nigerian Institute of Medical Research, Yaba, Lagos. [2]Grant, Monitoring and Evaluation Unit (Biostatistics), Nigerian Institute of Medical Research, Yaba, Lagos, [3]Clinical Diagnostics Department, Nigerian Institute of Medical Research, Yaba, Lagos, [4]Clinical Sciences Department, Nigerian Institute of Medical Research, Yaba, Lagos.

Corresponding Author: Raheem T.Y; toyosiraheem55@gmail.com

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Toyosi Yekeen Raheem

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ABSTRACT

Background: Serum vitamin D has gained attention due to its potential role in immunity. The global impact of SARS-CoV-2 infections underscored the need to explore factors influencing disease severity especially vitamin D status and markers of liver and kidney functions. This study investigated relationship between serum vitamin D, liver and kidney function markers, and severity of SARS-CoV-2 infections among participants in Lagos, Nigeria.

Methods: This was a cross-sectional, case-control study on a cohort of 236 patients with varying COVID-19 statuses and 44 COVID-19 negative participants. Structured questionnaire was administered to collect socio-demographic and clinical data. Venous blood samples were collected and vitamin D measured using architect 1000 Chemiluminescent Microparticle Immuno Assay (CMIA). Gamma-glutamyl transferase (GGT), total protein, albumin/globulin ratio, urea and creatinine were determined using TC-Matrix Chemistry Analyzer (Teco Diagnostics USA). Descriptive and inferential statistics were performed.

Results: SARS-CoV-2-positive participants in the study had higher vitamin D levels compared to negative participants.
Overall, the analysis indicates that while there are some significant correlations (between vitamin D levels and albumin/globulin ratio in asymptomatic ($r = 0.23$, $p = 0.009$) and mild cases ($r = -0.20$, $p = 0.05$), and total protein in asymptomatic ($r = 0.17$, $p = 0.05$) and mild cases ($r = 0.22$, $p = 0.03$)), most correlations are weak and not statistically significant.

Conclusions: The study showed that while there are some significant correlations between vitamin D levels and albumin/globulin ratio in asymptomatic and mild cases and total protein in asymptomatic and mild cases, most correlations are weak and not statistically significant. This suggests that the relationship between vitamin D levels and these clinical parameters in COVID-19 participants may be limited or influenced by other factors not captured in this study. Further research with larger sample sizes and additional variables may help to clarify these relationships.

Key words: 25-OH vitamin D, Hepatic and renal function indicators, COVID-19, Severity, Nigeria

1. INTRODUCTION

Vitamin D is a fat-soluble vitamin from steroid (7-dehydrocholesterol), required for hormone production and immunity. It is mainly produced in the body when the skin is exposed to ultraviolet rays from sunlight which subsequently trigger vitamin D synthesis. The serum level is maintained in individuals in environment where exposure to sunlight is high (sun-rich environment), and vitamin D levels are optimum in persons who spend an above-average amount of time outdoors[1]. Most cells express the vitamin D receptor and about 3% of the human genome is directly or indirectly regulated by the vitamin D endocrine system[2,3]. The relationship between vitamin D and infectious diseases had been supported by genetic studies of polymorphisms in the VDR gene receptor for vitamin D. Study had found a significant link between single nucleotide polymorphisms of genes controlling innate immune function and VDR gene and genetic susceptibility to viral diseases such as respiratory syncyti-

al virus (RSV) bronchiolitis[2]. Vitamin D is converted to the active hormone 1,25-(OH)2-vitamin D (calcitriol) through two hydroxylation reactions. The first hydroxylation converts vitamin D into 25-OH vitamin D and occurs in the liver. The second hydroxylation converts 25-OH vitamin D into the biologically active 1,25-(OH)2-vitamin D and occurs in the kidneys as well as in many other body cells[3]. Two forms of vitamin D are biologically relevant - vitamin D3 (Cholecalciferol) and vitamin D2 (Ergocalciferol). Both vitamins D3 and D2 can be absorbed from food, but only an estimated 10-20% of vitamin D is supplied through nutritional intake[3]. The major storage form of vitamin D is 25-OH vitamin D and is present in the blood at up to 1,000-fold higher concentration compared to the active 1,25-(OH)2-vitamin D. However, 25-OH vitamin D has a half -life of 2-3 weeks compared to four (4) hours for 1,25-(OH)2-vitamin D. Therefore, 25-OH vitamin D is the analyte of choice for determination of the vitamin D status in individuals[1, 4,5, 6]. Globally, studies have shown high global prevalence of vitamin D insufficiency and deficiency[6] and the associated risk factors have been reported to include low sun exposure, malnutrition, some malabsorption syndromes, and liver or kidney diseases[7].

During the COVID-19 pandemic, SARS CoV-2 infection crossed many geographic boundaries making it to be declared first a global health emergency on January 30, 2020, and later, considered to be a pandemic on March 11, 2020. During the COVID-19 pandemic, Nigeria ranked as the fourth most affected country in Africa, with 4787 cases, 158 deaths, and a case fatality rate of 3.3%, as of May 12, 2020 and Lagos State was an epicentre8. SARS CoV-2 infection is characterized by high infectivity and rapid transmission as well as possibility of transmission during an asymptomatic period3. The severity of the disease seems to range from asymptomatic or acute or chronic respiratory tract illnesses to general organ failure and death[4]. It has been reported that SAR CoV-2 virus has receptor binding domain which binds to angiotensin converting enzyme -2 (ACE-2). Although SARS-CoV-2 infection is primary a disease of the respiratory system, it has been reported that cells of the kidney, liver, intestine and cardiovascular systems have abundant ACE-2 explaining why multiple organ damage in infected individuals is common[3]. Older people, and those with underlying medical problems like cardiovascular disease, asymptomatic kidney, liver, diseases, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness if infected with SARs-COV-2 virus[3]. There have been different reasons ascribed to susceptibility and severity among individuals infected with SARS COV 2. Some of the factors were reported to be due to biology and the age of individuals infected with the virus[9,10]. Studies have shown that SARS COV-2 is more common in persons with oldest age groups and healthcare workers[7,11]. Generally, older persons and those with underlying health conditions have been reported to be more vulnerable to SARS COV-2 infection and suffer severe outcome than the younger age group and those without any underlying conditions. The severity is higher in persons from 60-64 years old (3.41-4.55%) and highest in persons 70 years old and above (7.48-15.9%) but lower in younger ages 20-54 years old (0.0317-1.55%) [9,10].

Vitamin D has long been recognized as having Immunomodulatory actions and shown to be of significance in the normal human physiology[12]. Vitamin D insufficiency and its association with prevalent immune disorders have been reported and the increasing awareness of low circulating levels of precursor 25-hydroxyvitamin D in populations across the globe is one of the reasons contributing to epidemiological investigations of health problems associated with vitamin D insufficiency[12]. The major storage form of vitamin D is 25-OH Vitamin D and this is present in human blood in higher concentration when compared to 1, 25-(OH)2-Vitamind D. Therefore, the 25-OH vitamin D is the preferred choice for determination of vitamin D status in individuals[13,14]. The risk factors for vitamin D deficiency has been reported to be low-sun-exposure, malnutrition, malabsorption syndromes, liver and kidney diseases[15]. It has also been reported that vitamin D is a key factor linking innate and adaptive immunity, and both of these functions may be compromised under conditions of vitamin D insufficiency[12]. The source of vitamin D is mostly through the action of sunlight on the skin, with 7-dehydrocholesterol being converted to parental vitamin D in the epidermis after which the vitamin D produced in the skin undergoes sequential metabolic conversions. Firstly, in the liver to form 25-OHD the main circulating form of vitamin D12 . In temperate countries with limited or no access to natural sunlight, this lack of exposure may contribute to the severity of SARS-CoV-2 infections, leading to high morbidity and mortality rates in these regions..

The role of vitamin D and infections had been reported[16]. It had been reported that athletes with optimal vitamin D levels > 48.08 ng/mL present significantly less episodes of upper respiratory tract infections, their severity and frequency of illness were significantly lower than those with vitamin D deficiency (< 12.02 ng/mL)16. Studies had shown that most American adults have inadequate levels of vitamin D17. This may be the reason why COVID-19 severity was more pronounced in America, UK and other temperate regions of the world during the COVID-19 pandemic unlike in tropical and sub-tropical regions such as in Africa where access to natural sunlight and by extension, vitamin D, could be a factor why the severity of SARS-CoV-2 infections was low.

During the COVID-19 pandemic, Lagos State remains the epicentre of the outbreak in Nigeria with the highest number of cases followed by the Federal Capital Territory[18]. This shows that delaying the detection of infected cases will not only increase the probability of spreading the virus to other susceptible persons. Apart from the population density of Lagos State, the baseline laboratory assessment of liver, kidney and cardiovascular systems of people in Lagos needs to be assessed to possibly provide explanation for why the infection has a high prevalence and incidence in Lagos State.

The measurement of vitamin D status, and assays of liver and kidney function markers had not been significantly investigated to provide opportunities for possible preventive and therapeutic interventions in cases of SARS CoV-2 infections[9, 19]. Evidences have suggested that vitamin D deficiency, may be associated with increased risk of infection and disease severity. Also, levels of gamma-glutamyl transferase, total protein, albumin/globulin ratio, urea and creatinine can be determinants of disease severity. Studying these biochemical parameters in the participants can provide insights into their protective role or risks in SARS CoV-2 infections and disease severity. This study investigated relationship between serum vitamin D, gamma-glutamyl transferase, total protein, albumin/globulin ratio, urea and creatinine as determinants of severity of SARS CoV-2 infections and disease severity among participants in Lagos, Nigeria.

2. METHODOLOGY

2.1 Study Design, Sites and Participants

This was a case-control cross-sectional study conducted between September 2020 and August 2022 among SARS CoV-2 positive and negative participants in Lagos, Nigeria. Two hundred and thirty -six (236) Participants were intending travelers or those referred to Nigerian Institute of Medical Research, Yaba, Lagos and Federal Medical Centre, Ebute Metta, Lagos. These were those attended to at the centres within the study period. Forty-four (44) participants confirmed negative in the community survey of SARS CoV-2 infection in Lagos State[20] were purposely enrolled. Interviewer-administered questionnaires were used. The questionnaires consisted of sections for capturing biodata, socio-demographic and clinical information of the participants. Inclusion criteria were those confirmed positive or negative for SARS CoV-2 irrespective of their ages, while exclusion criteria included those on vitamin D supplements, hyperparathyroidism, osteoporosis and osteomalacia.

2.2 Specimen Collection and Processing

Exactly 5.0mL of venous blood were collected aseptically into each of lithium heparin and plain bottles. The plasma from lithium heparin specimens were separated into cryovials and frozen. Clean sera free of haemolysis were separated into different cryovials and frozen.

2.3 Laboratory Method

SARS CoV-2 infections were diagnosed as described in previous study[20]. Vitamin D level was determined using architect 25-OH Vitamin D Chemiluminescent Microparticle Immuno Assay (CMIA) for the quantitative determination of 25-hydroxy vitamin D (25-OH vitamin D) in human serum) as an aid to vitamin D sufficiency as described in the Package insert instructions[21]. Urea, creatinine, total proteins, SGOT, SGPT, alkaline phosphatase, albumin and globulin were assayed using TC-Matrix chemistry Analyzer and Biobase reagents.

2.4 Data Management:

Data management and analysis were conducted with meticulous attention to ensure the reliability and validity of the study findings. This section outlines the procedures employed in managing and analyzing the collected data.

2.5 Data Collection

Participants' demographic information, including age and gender were recorded, along with their COVID-19 status. Data from laboratory measurements of vitamin D levels and various markers of liver and kidney function such as gamma-glutamyl transferase (GGT), total protein, albumin/globulin ratio (A/G ratio), urea, and creatinine were collected. All data were anonymized to ensure participant confidentiality.

2.6 Data Entry

Collected data were entered into a Microsoft Excel spreadsheet with restricted access to authorized personnel only. Data entry was conducted with double-entry verification to minimize errors. Quality control measures, including range checks and consistency checks, were implemented to identify and resolve discrepancies.

2.7 Statistical Analysis

Statistical analysis was performed using STATA 16.0 to explore relationships between variables and assess associations. Descriptive statistics, such as means, standard deviations, and frequencies, were calculated to summarize demographic characteristics and variable distributions. Correlation coefficients were computed to examine the relationships between vitamin D levels, liver and kidney function markers, age, gender, and COVID-19 status. Bivariate analysis, including t-tests and F-test, was conducted to compare mean differences and assess statistical significance between groups based on COVID-19 status and severity. The p value < 0.05 was considered significant in the study.

2.8 Ethical Consideration

The study was approved by the Institutional Review Board (research ethics committee) of Nigerian Institute of Medical Research, Yaba, Lagos, Nigeria with project number IRB/21/078. Consent forms were made available, filled and signed by participants before enrolment into the study. No potential risk, harm, burden or discomfort was caused to any participant in this study. Confidentiality of the information obtained from the participants was maintained using only unique identification number.

2.9 Inclusion/Exclusion Criteria

Those confirmed SARS CoV-2 positive by polymerase chain reaction (PCR), gave voluntary informed consent and agreed to donate 5.0mL of blood were enrolled into the study while those with confounders such as history of hyperparathyroidism, vitamin D supplements utilization, bone disorders like rickets, osteoporosis and osteomalacia, and those who declined consents were excluded from the study.

2.10 Data Availability Statement

The data that support the findings of this study are openly available on the Zenodo repository at https://doi.org/10.5281/zenodo.13955942, reference number [13955942].

3. RESULTS

A total of 280 participants were included in the study comprising 107 with symptomatic COVID-19, 129 with asymptomatic COVID-19, and 44 controls (non-COVID-19). The mean age of the study participants was 38.4 years, with males slightly older at 39.6 years and females at 37 years (Table 1). The mean serum vitamin D level among participants was 22.77±9.71 ng/mL, with a median of 21.2 ng/mL. The mean vitamin D level exceeded the median, indicating a right-skewed distribution. Individual vitamin D levels ranged from 0.4 ng/mL to 54.1 ng/mL. Notably, 8 participants had vitamin D levels below the reference range (6.6 ng/mL), while 6 had levels above the reference range (50 ng/mL). A significant difference in mean vitamin D levels was observed between COVID-19 positive and negative groups (t-statistic = 5.0, p = 0.001), with an associated statistically significant association with COVID-19 severity (F-statistic = 18.8, p = 0.001) as shown in Table 1. One hundred and twenty nine (129) participants with asymptomatic COVID-19 disease exhibited a mean vitamin D level of 26.79±9.08 ng/mL , while those in the negative control group had a mean level of 16.68±2.46 ng/mL . Across all disease severity categories, the mean vitamin D level was 22.77 ± 9.71 ng/mL.

Table 2 illustrates the relationship between COVID-19 status and vitamin D levels. Positive COVID-19 status categories had a mean level of 23.91 ng/mL (SD = 10.13), while negative status categories had a mean level of 16.68 ng/mL (SD = 2.46). Overall, individuals with a positive COVID-19 status exhibited higher mean vitamin D levels compared to those with a negative status, with a higher

Table 1: Summary of Participant Characteristics, Vitamin D Levels, and COVID-19 Status and Disease Severity (COVID-19 Positive N= 236; COVID-19 Negative N= 44)

Variable	Categories	Values
Mean Age (years)	Male	39.6
	Female	37.0
	Overall	38.3
Vitamin-D Levels	Mean	22.77ng/mL
	Median	21.2 ng/mL
	Minimum	0.4 ng/mL
	Maximum	54.1 ng/Ml
COVID-19 Distribution	Positive	84.3%
	Negative	15.7%
Vitamin-D Levels Among COVID-19 Positive Participants	Participants with Vitamin D level below reference(6.6ng/mL)	8 (3.4%)
	Participants with Vitamin D level above reference (5ng/mL)	6 (2.5%)
	Participants with Vitamin D level within normal limit	222 (94.1%)

standard deviation observed in the positive group. It also showed that 222 (94.07%) respondents were COVID-19 positive and had moderate vitamin D level while 8(3.4%) had low vitamin D while 6 (2.5%) had high vitamin D level. All the 44 (100.0%) respondents that were COVID-19 negative had moderate vitamin D level.

Analysis of the correlation between vitamin D levels and various clinical parameters revealed generally weak or very weak correlations, most of which were not statistically significant across the different participant groups (Table 3). Specifically, there was no significant correlation between vitamin D and GGT, urea, creatinine, gender, or age in any of the groups. However, a statistically significant positive correlation was observed between vitamin D levels and the albumin/globulin (A/G) ratio in asymptomatic participants and in those with mild COVID-19. Similarly, a weak but statistically significant positive correlation was observed between vitamin D and total protein in both asymptomatic and mild COVID-19 cases. For other parameters, including AST and ALT, no statistically significant correlations were found across any of the groups (Table 3).

The relationship between disease severity and serum vitamin D levels (measured in ng/mL) is summarized in Table 1. Respondents with mild disease exhibited a mean vitamin D level of 20.47 ng/mL, with a standard deviation of 10.42. Conversely, respondents with severe disease had a mean vitamin D level of 16.83 ng/mL, with a standard deviation of 8.40. Those with very severe disease demonstrated a mean vitamin D level of 20.55 ng/mL, with a standard deviation of 3.61.

4. DISCUSSION

The mean age of the participants in the study was 38.4 years, with males averaging slightly higher at 39.6 years and females at 37 years, reflecting a diverse age range with a relatively balanced gender distribution. This observation was different from the participants' mean age 50.6 ± 11.1 years reported in a study on vitamin D in Lagos[22].The difference however can be explained to be due to the population studied. Our study focused on COVID-19 positive and negative participants whereas, the latter study was on women with epithelial ovarian cancer. which aligns with findings from among SARS-CoV-2 infected individuals. In our study population, the mean vitamin D level was 22.77 ng/mL, with a median of 21.2 ng/mL, indicating an average slightly higher than the median. This finding suggested there was no prevalence of Vitamin D deficiency defined as <20 ng/mL. This finding was contrary to the overall prevalence of vitamin D deficiency reported in Lagos[22, 23]which reported prevalence of Vitamin D deficiency (<20 ng/mL) in the mothers and newborns was 4.8% and 29.5% and 68.5% to 77.5% respectively. It was also different from earlier report which recorded a mean vitamin D concentration of 28.9 ng/mL24 and that a little less than a quarter of the population (22.4%) of the study population had vitamin D deficiency. Previous study had shown that Vitamin D deficiency is prevalent in subtropical areas such as northern Taiwan in healthy individuals who had no chronic kidney disease (CKD)[24]. However, the difference between our study and those previous studies could be ascribed to the fact that our study was among participants with or without COVID-19 irrespective of gender; whereas those other studies were conducted in women with or without epithelial ovarian cancer, mothers and newborns and normal healthy population respectively[22, 23, 24]. However, vitamin D insufficiency defined as 21–29 ng/mL was also observed in our study when bench-marked with previous report[23] though their study was among pregnant women and their newborns. The minimum recorded Vitamin D level was 0.4 ng/mL and eight (8) individuals had Vitamin D levels below the reference range (6.6 ng/mL) indicating that there were individuals with very low vitamin D levels in the study. The explanation for this could be that a portion of the study population had vitamin D levels below the recommended threshold and that could be because systemic inflammation lowers circulating vitamin D levels in humans which may contribute to the low circulating vitamin D levels observed in participants suffering from infectious diseases especially COVID-19. It had been reported that inflammatory response in COVID-19 patients may decrease vitamin D levels before hospitalization and vitamin D

Table 2: COVID-19 Status, Disease Severity, and Vitamin D Levels Among Participants

COVID-19 Status	Disease Severity	Mean Vitamin D (ng/mL)	Std. Deviation	Vitamin D Level Distribution			Total
				Below Reference	Within Normal	Above Reference	
Positive	-	23.91	10.13	8 (3.4%)	222 (94.1%)	6 (2.4%)	236
Negative	-	16.68	2.46	0	44 (100%)	0	44
Total	-	22.77	9.71	-			280
Positive	Mild	20.47	10.42	-			-
Positive	Severe	16.83	8.4	-			-
Positive	Very Severe	20.55	3.61	-			

Table 3: Bivariate Correlations Between Vitamin D Levels, Kidney and Liver Function Markers, Gender and Age by COVID-19 Grades.

Variables Compared	Asymptomatic (p-value)	Mild (p-value)	Severe (p-value)
Vitamin D Levels vs GGT	-0.07 (0.44)	0.13 (0.20)	-0.37 (0.54)
Vitamin D Levels vs A/G ratio	0.23 (0.009)	-0. 20 (0.05)	-0. 56 (0.33)
Vitamin D Levels vs Urea	-0. 07 (0.42)	0.02(0.83)	0.19 (0.76)
Vitamin D Levels vs Creatinine	-0. 06 (0.50)	0.06 (0.54)	0.40 (0.50)
Vitamin D Levels vs Age	-0. 04 (0.63)	-0. 07 (0.51)	0.72 (0.17)
Vitamin D Levels vs Total Protein	0.17 (0.05)	0.22 (0.03)	0.37 (0.54)
Vitamin D Levels vs AST	-0. 12 (0.17)	0.04 (0.68)	0.56 (0.32)
Vitamin D Levels vs ALT	0.06 (0.53)	-0. 14 (0.18)	0.74 (0.15)

measurements[25]. The maximum recorded vitamin D level was 54.1 ng/mL and six (6) individuals had levels above the reference range (5 ng/mL) indicating that there were also individuals with very high vitamin D levels possibly due to unreported vitamin D supplementation by them.

The t-statistic of 5.0 and a p-value of 0.001 suggest a statistically significant difference in mean vitamin D levels between the COVID -19 positive and negative groups. This indicates that there may be a relationship between vitamin D levels and COVID-19 infection status. The F-statistic of 18.8 and a p-value of 0.001 suggested a statistically significant association between vitamin D levels and COVID-19 severity. This indicated that vitamin D levels may play a role in determining the severity of COVID-19 infection in the study population.

The correlation analysis between vitamin D levels and GGT were weak and not statistically significant across all severity levels. This suggests that vitamin D levels might not have a meaningful impact on GGT levels in COVID-19 patients. A significant positive correlation was observed between vitamin D levels and albumin/globulin ratio in asymptomatic participants. This indicates that higher vitamin D levels are associated with a higher albumin/globulin ratio in asymptomatic cases. Mild and severe cases showed negative correlations, but these were not statistically significant. The correlation between vitamin D levels and Urea was very weak and not statistically significant for all severity levels, suggesting no meaningful relationship between these variables.

Similarly, the correlations between vitamin D levels and creatinine were very weak and not statistically significant, indicating a lack of substantial relationship across all severity levels. The correlations between vitamin D levels and Age were weak and not statistically significant for asymptomatic and mild cases. However, a strong positive correlation was observed in severe cases, although this was not statistically significant. This might suggest a potential trend that warrants further investigation with a larger sample size.

Significant weak positive correlations were found between vitamin D levels and total protein in both asymptomatic and mild cases, indicating that higher vitamin D levels might be associated with higher total protein levels in these groups. The correlation in severe cases was moderate but not statistically significant. The correlations between vitamin D levels and AST were weak and not statistically significant across all severity levels, suggesting no substantial relationship. There was also a very weak positive correlation between vitamin D levels and ALT in asymptomatic cases and a weak negative correlation in mild cases, both of which were not statistically significant. In severe cases, a strong positive correlation was observed, although this was not statistically significant, indicating a potential trend that could be explored further. The values of vitamin D levels obtained in this study is described generally as insufficient despite the study participants being from sun-exposed region of the world[25]. This finding is in agreement with previous report that systemic inflammation lowers circulating vitamin D levels in humans; hence, systemic inflammation which usually sets in patients suffering from infectious diseases, including COVID-19, could contribute to the low circulating vitamin D concentrations more so that visit to health facilities by patients were usually at least several days after onset of disease or inflammation and vitamin D levels could decrease within a short period of a systemic inflammatory response[25-27]. However, the finding in this study is different from the reports of the authors in 25, 26 and 27 as our study revealed that more than 95% of the participants with COVID-19 had vitamin D levels within and/or above normal reference values.

4.1 Conclusion

Our study investigated the relationship between serum vitamin D levels,, gamma-glutamyl transferase, total protein, albumin/ globulin ratio, urea and creatinine levels in relation to severity of SARS-CoV-2 Infection Among Patients in Lagos, Nigeria and the severity of SARS-CoV-2 infections among participants from selected health facilities in Lagos, Nigeria. Vitamin D levels and gender showed very weak and negative correlation in asymptomatic participants. In mild cases, the correlation was also very weak and negative and not statistically significant. Severe cases exhibited a weak negative correlation which is not statistically significant. The study also showed that while there are some significant correlations between vitamin D levels and albumin/g ratio in asymptomatic and mild cases and total protein in asymptomatic and mild cases most correlations are weak and not statistically significant. This suggests that the relationship between vitamin D levels and these clinical parameters in COVID-19 participants may be limited or influenced by other factors not captured in this study. Further research with larger sample sizes and additional variables may help to clarify these relationships.

Our findings provided valuable insights into the potential role of vitamin D in COVID-19 infection and disease severity. Additionally, a significant association was found between vitamin D levels and COVID-19 severity, indicating a possible role in determining disease outcomes. Correlation analysis revealed weak associations between vitamin D levels and various health markers, including gamma-glutamyl transferase (GGT), albumin/globulin (A/G) ratio, urea, creatinine, age, gender, and total protein. While these correlations were generally weak, they underscore the complex interplay between vitamin D status and physiological parameters, which may influence COVID-19 outcomes. Furthermore, our study highlighted the prevalence of vitamin D insufficiency among participants, despite residing in a sun-exposed region. This underscores the importance of public health interventions to address vitamin D deficiency and optimize immune function, particularly in the context of infectious diseases such as COVID-19.

Recommendations

The correlations observed in this study were generally weak, there is need for further investigation to understand their clinical implications. The results indicated that there are differences in vitamin D levels between genders, but further statistical analysis may be needed to explore this relationship. These findings underscore the importance of considering vitamin D status in the context of public health and COVID-19 management.

Vitamin D Supplementation:

Given the prevalence of vitamin D insufficiency observed in our study population, we recommend public health initiatives aimed at promoting vitamin D supplementation, particularly among individuals at risk of deficiency. This may include targeted supplementation programs for high-risk groups such as the elderly, individuals with infectious diseases and those with limited sun-light exposure.

Routine Screening for Vitamin D:

We recommend routine screening for vitamin D levels as part of comprehensive health assessments, especially in regions with high rates of vitamin D insufficiency. Early detection of deficiency or insufficiency can prompt timely interventions to optimize vitamin D status and potentially mitigate the risk of adverse health outcomes, including severe COVID-19 infections.

Clinical Management

Healthcare providers should consider monitoring vitamin D levels as part of the clinical management of COVID-19 patients, particularly those with risk factors for vitamin D deficiency. This may help identify individuals at increased risk of disease progression and guide therapeutic strategies, including personalized supplementation regimens.

Public Health Education

Public health campaigns should focus on raising awareness about the importance of maintaining adequate vitamin D levels for overall health and immune function. Educational initiatives targeting both healthcare professionals and the general public can help dispel misconceptions about vitamin D and promote evidence-based practices for optimizing vitamin D status.

Further Research

Future research should aim to elucidate the mechanistic links between vitamin D status, immune function, and COVID-19 outcomes through well-designed prospective studies and clinical trials. Additionally, investigations into the potential efficacy of vitamin D supplementation as an adjunctive therapy for COVID-19 management are warranted to inform evidence-based guidelines and clinical practice.

Policy Development

Policymakers should consider integrating recommendations for vitamin D supplementation into existing public health guidelines, particularly in regions with high rates of vitamin D insufficiency and vulnerability to infectious diseases like COVID-19. Collaborative efforts between healthcare professionals, researchers, and policymakers are essential for developing and implementing effective policies aimed at improving vitamin D status and enhancing resilience to infectious diseases.

Contributors' Roles and Taxonomy Statement:

Raheem, T.Y: Conceptualization, Coordination, Methodology, Literature search , writing of the original draft of the manuscript and reviews of the manuscript..

Kazeem, A.O: Risk of bias assessment, data entry and deposit on open data repository, validation, analysis, reviews and editing of the manuscript;

Akindele S.K: Perform laboratory assays and review of the manuscript.

Fasela, E.O: Blood sample collection, laboratory assays and review of the manuscript;

Aniedobe, M.N: Perform laboratory assays, quality assurance and review of the manuscript

Salako, B.L: General supervision, coordination and review of the manuscript.

Conflict of Interest:

The authors declare that they have no financial or personal interest which may have inappropriately influenced them in writing this paper.

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