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Deficiency of Vitamin D in COVID-19 Patients

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Abstract

Background: Currently, the entire world is facing major health and economic crisis due to the novel coronavirus. At the moment, neither any medicines nor any vaccines are 100% efficacious; therefore, a healthy diet is essential for the normal function of the immune system.

Objective: The main objective of this study was to find out the prevalence of vitamin D in COVID-19 patients at the community level.

Patients and Methods: This is a descriptive cross-sectional study that was carried out in Kathmandu, Nepal. 122 patients were included in this study whose polymerase chain reaction (PCR) test was positive and was in home isolation with mild to moderate symptoms. Vitamin D level was analyzed by quantitative Chemiluminescent Immunoassay (CLIA) methods and Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) 16.0 software.

Results: Out of total patients, vitamin D deficiency was found in 65.34% male and 74.46% female.

Conclusions: Prevalence of Vitamin D deficiency is higher in coronavirus disease (COVID-19) patients; in addition, the prevalence of Vitamin D deficiency is higher in coronavirus disease (COVID-19) females compared to coronavirus disease (COVID-19) males.

Keywords

COVID-19; Vitamin D; Prevalence

Abbreviations

COVID-19: Coronavirus Disease-19; SARS CoV2: Severe Acute Respiratory Syndrome Coronavirus 2; RNA: Ribonucleic Acid; ARDS: Acute Respiratory Distress Syndrome; CBC: Complete Blood Count; RFT: Renal Function Test; LFT: Liver Function Test; URINE R/M/E: Urinary Routine and Microscopic Examination; RBS: Random Blood Sugar; ESR: Erythrocyte Sedimentation Rate; CRP: C - reactive protein; LDH: Lactate Dehydrogenase; HRCT: High-Resolution Computed Tomography

Introduction

Currently, the entire world is facing major health and economic crisis due to the novel coronavirus. The coronavirus disease-19 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS CoV2), is a single-stranded (+) RNA virus that has infected millions and killed hundreds of thousands of people all over the world [1]. The sign and symptoms of COVID-19 vary: some are asymptomatic while others may have mild flu-like symptoms to severe life-threatening Acute Respiratory Distress Syndrome (ARDS) [2].

Presently, few treatments are available for the prevention and treatment of COVID except few supportive cares like corticosteroids and vaccines, therefore, a healthy diet is essential for the normal function of the immune system; macronutrients and micronutrients can enhance the immune response by suppressing pro-inflammatory mediators [3,4]. Vitamin D is a group of fat-soluble vitamins that is present naturally in very few foods, that's why certain foods are substituted with vitamin D [5]. It is also produced endogenously when the body is exposed to the sunlight directly. Vitamin D received from the sun, meals, and supplements, on the other hand, is physiologically inactive and must be activated in the body through two processes of hydroxylation [6].

Initially, in the liver vitamin D is converted to calcidiol (25-hydroxyvitamin D [25(OH) D]), later in the kidney, calcidiol is further hydroxylated to form calcitriol, 25-dihydroxy vitamin D [1, 25(OH)₂D]. Although the major function of vitamin D is calcium homeostasis, it also has immunomodulatory functions, which may protect against respiratory infections [7]. Vitamin D deficiency is a global health problem, affecting more than 50% among one billion deficient populations [8].

The main objective of this study is to find out the prevalence of vitamin D in COVID-19 patients at the community level in Kathmandu. Vitamin D along with CBC, RFT, LFT, URINE R/M/E, RBS, ESR, CRP, LDH, D-DIMER and CHEST X-RAY or HRCT was done depending upon patient saturation and clinical conditions.

Patient and Methods

This study is a descriptive cross-sectional study that was carried out at Bio diagnostic laboratory, Kathmandu. Samples were collected from home, pharmacy, and multiple polyclinics, in Kathmandu, from 1st June 2020 to 1st June 2021. Before the study, consent was taken from patients themselves or their relatives and respective polyclinics. 122 patients were included in this study whose Polymerase Chain Reaction (PCR) test was positive and was in home isolation with mild to moderate symptoms and age above 18 years. Patients below 18 years and PCR negative were excluded.

Levels of vitamin D were analyzed by quantitative Chemiluminescent Immunoassay (CLIA) methods by using Vitros 5600 integrated system (Ortho clinical diagnostics, Raritan, New Jersey, USA). The value less than 20 ng/ml were considered as deficient, 20-29 ng/ml insufficient, 30-100 ng/ml sufficient, and above >100 potential toxicity [9].

Statistical analysis was performed using SPSS 16.0 software (IBM Corp., Armonk, NY, USA). Data are presented as means $\pm$ standard deviation, percentage, graphs and pie chart.

Result

A total of 122 patients are included in this study, among them 75 are male (Mean age $\pm$ SD: 51.11 $\pm$ 9.825) and 47 are female (Mean age $\pm$ SD:45.87 $\pm$ 10.163). Out of total male patients 49 (65.34%) were supplemented with Vitamin D, among them 38 (50.67%) were deficient, 11 (14.67%) were insufficient while, 26 (34.66%) patients had normal vitamin D level (Fig. 1 and 2).

Out of total female patients, 34 (74.46%) were found to have Vitamin D deficit, among them 27(57.44%) were deficient, 8(17.02%) were insufficient and 12(25.53%) patient had normal vitamin D level. The prevalence of vitamin D among COVID-19 patients is shown in Table 1. The frequency of vitamin D in male and female are shown in (Graph 1 and 2). The percentage of total vitamin D; Deficient (D), Insufficient (I) and Sufficient(S) in COVID-19 patients are shown in the pie chart. None of the value above 100 ng/ml was found, therefore, there was no potential toxicity (Fig, 3).

Figure 1: Pie chart presentation of prevalence of vitamin D in COVID-19 patients.

Figure 2: Frequency of vitamin D in male.

Figure 3: Frequency of vitamin D in female.

Prevalence of Vitamin D deficiency in COVID-19 PATIENTS				
GENDER	DEFICIENT(D)	INSUFFICIENT(I)	SUFFICIENT(S)	TOTAL n (%)
MALE (n=75)				
D=38	50.67%	14.67%	34.66%	D+I=65.34%
I=11				S=34.66%
S=26				
FEMALE (n=47)				
D=27	57.44%	17.02%	25.53%	D+I=74.46%
I=8				S=25.53%
S=12				
TOTAL (121)				
D=64	53.28%	15.57%	31.15%	
I=19				D+I=68.85%
S=38				S=31.14%

Table 1: Prevalence of vitamin D deficiency in COVID-19 patients.

Discussion

The global COVID-19 pandemic outbreak in such a short time, that compelled doctors to treat COVID with whatever resources were available. Since the beginning of the pandemic sales of immune-boosting products were increased globally [10]. A present study on the status of Vitamin D in COVID patients was done at the community level, considering the association between Vitamin D deficiency and the severity of COVID [11]. Lately, studies have shown deficiency of vitamin D in COVID infection, which is similar to our study [12,13].

Several processes are elucidating the relationships between vitamin D deficiency and COVID-19 severity and outcomes. Vitamin D enhances the cellular immunity and plasma levels of anti-inflammatory markers, in addition, it suppresses the plasma levels of pro-inflammatory markers (TNF- α , IFN- γ), which has been produced COVID-19 [14]. Furthermore, it can improve adaptive immunity by enhancing concentrations of cytokine by Th2 and T-regulatory cells and decreasing the concentrations of the T-helper (Th) cell type 1 (Th1) [15-17].

Vitamin D can also alter immune system function because of the high expression of Vitamin D Receptors (VDRs) in B- and T-lymphocytes [18]. VDR is a transcription factor that belongs to the Nuclear Hormone Receptor (NHR) family, it is found in both T and B immune cells and regulates a range of metabolic pathways related to immune response and cancer [19,20]. A high level of transforming growth factor β (TGF- β) is seen in the initial stage of COVID-19, which is reduced by VDR through genomic competition between mothers and decapentaplegic homolog 3 (Smad3), resulting in the stable physiologic situation [21].

Another possible mechanism is that vitamin D can boost cellular innate immunity and limit virus multiplication by inducing antimicrobial peptides such as cathelicidin, IL-37, and defensins [22-24].

There has also been a link found between COVID-19 prevalence and mortality and DBP gene polymorphism and vitamin D metabolism and DBP polymorphism increases the risk of COVID-19 infection and mortality [25].

The result from this investigation shows that there is an association between COVID-19 severity and vitamin D deficiency. As a result, supplementation with vitamin D in COVID-19 patients will help to boost immunity, In addition, it will also help to reduce the prevalence of vitamin D deficiency [26].

The limitation of the study is that it was carried out in small sample size and the duration of recovery or the outcome was not followed. The research would have been more effective, had the duration of recovery or the outcomes were included.

Conclusion

The prevalence of Vitamin D deficiency is higher in COVID-19 patients; in addition, the prevalence of Vitamin D deficiency is higher in COVID-19 females compared to COVID-19 males. If the deficiency can be detected early, prompt management can be carried out then complications can be prevented in COVID-19 patients.

Conflict of Interest

The author declares no conflict of interest.

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