

**LABORATORY EVALUATION OF VITAMIN D BEFORE AND DURING THE COVID-19 PANDEMIC IN INDIVIDUALS IN THE BRAZILIAN AMAZON**

 <https://doi.org/10.56238/sevened2024.042-002>

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During the pandemic, vitamin D was widely consumed as a prevention strategy against COVID-19 due to its role in immunity. However, this practice has increased cases of hypervitaminosis D and toxicity, especially in the elderly, who are more likely to use supplements to strengthen the immune system. This study analyzes vitamin D levels in individuals in the Brazilian Amazon before and during the COVID-19 pandemic, observing variation in levels due to increased supplementation or reduction by recommended isolation to reduce transmission of SARS-COV2. This is a retrospective study, based on a database of a laboratory medicine unit, in Belém-PA, in two periods: before the pandemic, data recorded until 2019, and during the pandemic data from 2020-2023. The research compared vitamin D levels between different age groups and sex, observing a significant increase in values above the safe limit in people aged 60 and over, a group that showed a greater tendency to toxicity. The results show the need for monitoring and medical guidance in the use of supplements, highlighting the potential adverse impact of self-medication.

**Keywords:** Hypervitaminosis. Vitamin D. COVID-19. Vulnerability.



## INTRODUCTION

Vitamin D is a secosteroid produced from its inactive form (Cholecalciferol, vitamin D<sub>3</sub>) which is formed in the skin by exposure to ultraviolet radiation emitted by the sun, and exogenously, being absorbed through dietary sources (Alswailmi *et al.*, 2021). In both forms, cholecalciferol undergoes two hydroxylations to reach its active form, first in the liver, where it is converted to 25-hydroxycholecalciferol and later in the kidneys to 1,25 dihydroxycholecalciferol, which is the most active form and the main intracellular vitamin D receptor (VDR) signaler (Hall, 2020; Saponaro, 2020).

Its clinical relevance has been highlighted in patients of different age groups and its multifaceted role in physiological regulation and maintenance of human health, especially in the cardiovascular, bone, and immune systems, in pre-diabetic patients, and in pregnant women (Skolnik, 2024). However, toxicity due to continuous and prolonged use of high doses may lead to increased calcium absorption by intestinal and bone resorption. For these reasons, the main conditions associated with hypervitaminosis D are hypercalcemia, hypercalciuria, and hyperphosphatemia (Jolfaie *et al.*, 2023).

During the COVID-19 pandemic, two situations occurred with possible impacts on the population's Vitamin D levels. The reduction of exposure to the sun, due to recommendations of social isolation, and the search for preventive solutions against COVID-19 that led groups of people to ingest high doses of Vitamin D without adequate medical monitoring, increasing the risk of adverse effects, demonstrating the lack of knowledge of many about the recommendations for its intake, which ranges from 600IU per day in adults up to 70 years old, 800IU in patients aged 71 years and older, with levels above 60ng/mL being considered excessive (LiverTox, 2021; Endocrine Society, 2024).

In this situation, vitamin D was used as a disease management strategy by stimulating the maturation of immune cells and regulating inflammatory processes. Experimental animal studies have suggested an elevated risk of acute viral infections with vitamin D depletion (Janousek *et al.*, 2022). However, excessive supplementation during the pandemic may have led to an increase in the doses of this vitamin, which consequently may aggravate and increase problems such as hypercalcemia and complications associated with the various systems (Durdei *et al.*, 2024).

In view of the above, the present study aimed to analyze blood levels of vitamin D during the pandemic period according to the age groups 0 to 18 years, 19 to 49 years, 50 to 59 years, and 60 years or older, compared to the levels measured in the pre-pandemic period.



## METHODOLOGY

This is a retrospective, cross-sectional study, with descriptive and exploratory analysis of data regarding vitamin D levels in the COVID-19 pandemic of individuals living in the Amazon area, which involves the description of numerical information from a computerized laboratory system, in compliance with the ethical precepts of data use. Bibliographic scientific support was carried out through the SCIELO, PUBMED, and VHL databases, using the following descriptors: vitamin D, hypervitaminosis, and COVID-19, including publications from the last 5 years.

The creation of two groups of individuals who underwent vitamin D measurement in the period before the pandemic (group I, data up to 2019) and during the course of the pandemic (group II, between 2020 and 2023) was considered.

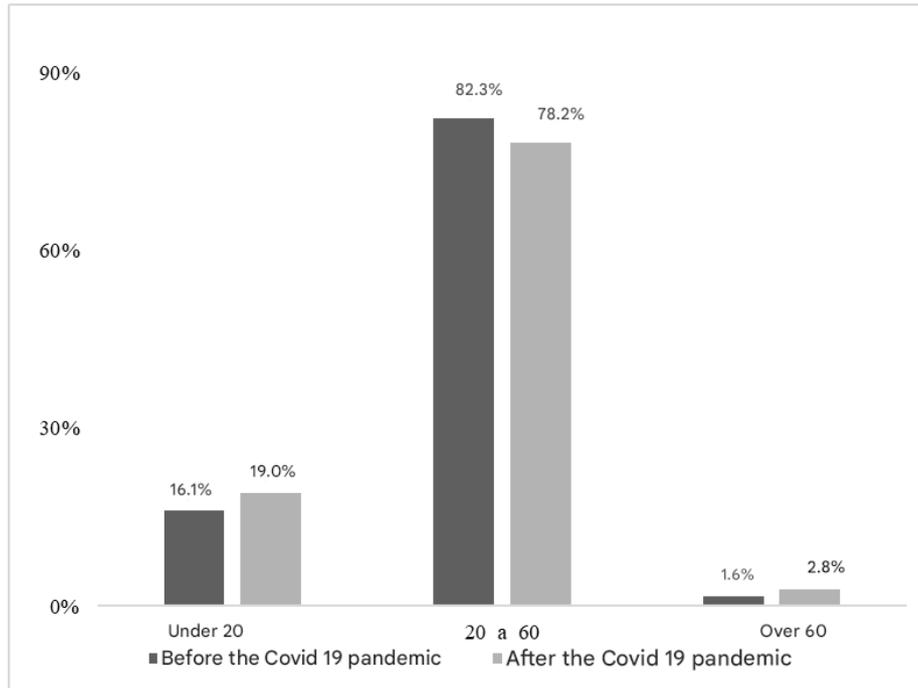
In order to highlight this issue, an average analysis of 50 thousand male and female patients was carried out, in the age group of 0 to 18 years, 19 to 49 years, 50 to 59 years and 60 years or older, divided into the two groups analyzed. The vitamin D levels that served as a reference were below 20 (low), between 20 to 60 (normal), and above 60 (high) (Antibodies, 2024).

The results are presented through tables and graphs, using *Microsoft Excel 2021* and *BioEstat® 5.4* software with the application of descriptive and analytical or inferential statistics, to evaluate the results of the sample variables through the Chi-Square Independence Tests for comparison between the sexes and Chi-Square Partition for comparison between age groups. For decision-making, the significance level  $\alpha=0.05$  or 5% was adopted, indicating the significant values with an asterisk (\*).

## RESULTS AND DISCUSSION

Vitamin D is essential for health in a multifactorial way, mainly due to the absorption of calcium and regulation of the various systems, especially the cardiovascular, bone and immune systems (Campbell; Bouillon, 2022). However, in order to help reduce morbidity and mortality due to viral infection during the COVID-19 pandemic period, in 2020, many individuals overdosed on this vitamin, thus resulting in a significant increase in these population groups in the region between 2020 and 2021 (Figure 1).

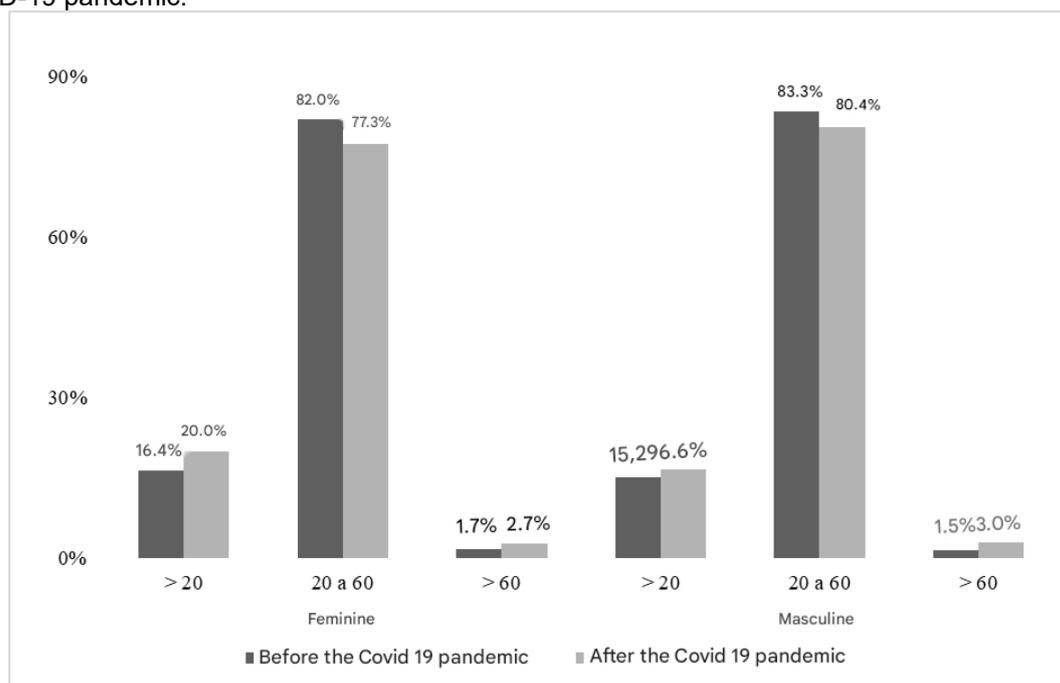
Figure 1. Mean vitamin D values in population groups in the Amazon, before and during the COVID-19 pandemic.



Source: Laboratory Medicine Service

In view of the vitamin D levels of both sexes, there were no significant differences in equal periods (Figure 2). However, it is possible to notice that both sexes have a portion of individuals who have a vitamin D level at the limit of toxicity, thus showing that when looking at the general picture, there is a population at risk of suffering the consequences of this level of toxicity.

Figure 2. Mean value of vitamin D according to gender, in population groups in the Amazon, before and during the COVID-19 pandemic.

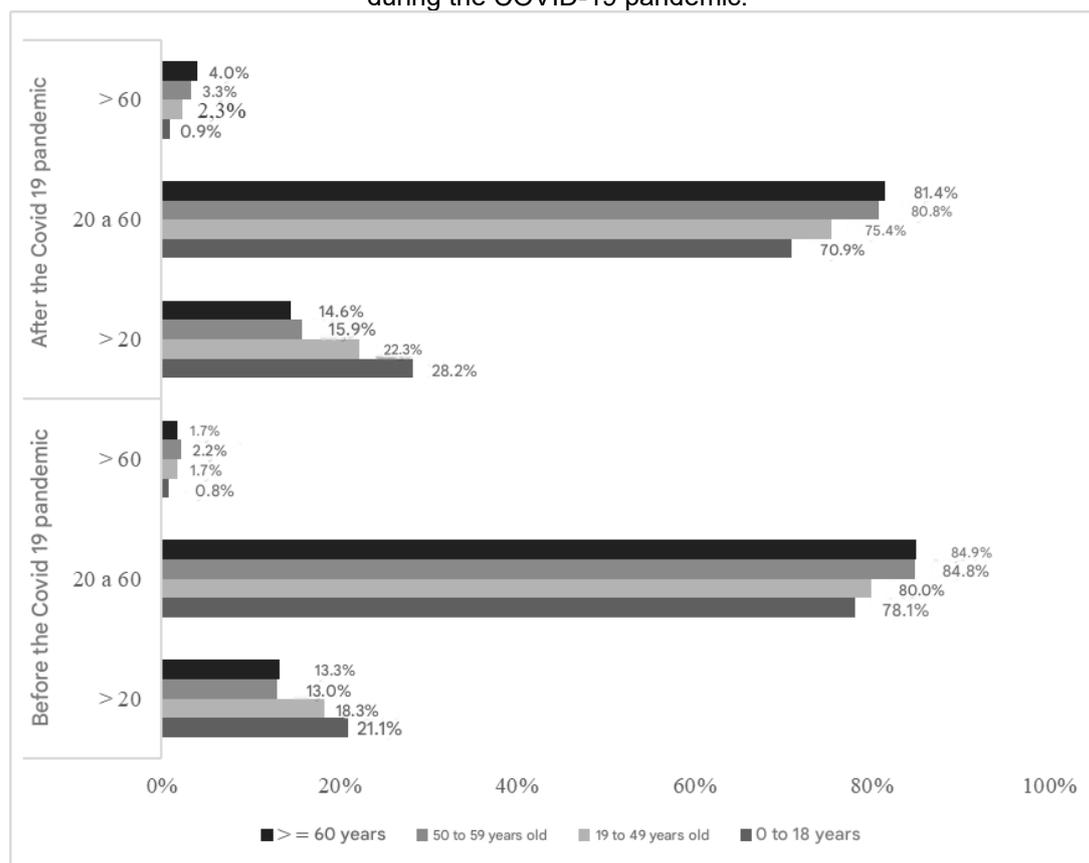


Source: Laboratory Medicine Service

The changes related to the population profile in the stratification represented in Figure 2 demonstrate a statistically significant increase in the proportion of patients with values above 60ng/mL in the pandemic, which signals an excess of vitamin D dosage over this period. The main reason for the increase in supplementation was the perception that vitamin D could offer protection against COVID-19, due to its potential role in modulating the immune system and reducing the severity of viral infections (O'hara; Parker, 2021). In addition, mobility restrictions and social distancing have decreased sun exposure, which is an important source of vitamin D, leading many people to seek supplements to compensate for this deficiency (Smith; Kapoor, 2022).

The level of vitamin D toxicity over the years 2020-2021 was statistically significantly compatible according to age group, in patients aged 60 years or older, observed in Figure 3, in which there was a 150% increase in levels above 60 ng/mL in the period evaluated, with levels considered toxic in these individuals in the post-pandemic period, for inadequate consumption of the product. The increase in supplementation was particularly notable in this population, as it is more susceptible to nutritional deficiencies and infectious diseases, and has a greater propensity to adopt preventive measures due to the high risk of serious complications from COVID-19 (Lee; Ng, 2022).

Figure 3. Mean vitamin D value according to age group, in population groups in the Amazon, before and during the COVID-19 pandemic.



Source: Laboratory Medicine Service

Studies show that vitamin D supplementation among people aged 65 and older has increased considerably, in part due to general public health recommendations and increased awareness of vitamin D during the health crisis (Reynolds; Garland, 2021; Rolle; Garcia, 2021). However, the high demand for supplements has also raised concerns about the risks of overdosing and its adverse effects, especially in an age group that may be experiencing multiple health issues (O'hara; Parker, 2021).

Vitamin D intoxication associated with hypercalcemia is one of the metabolic causes that can lead elderly patients to an altered mental state (AMS), in cases of moderate hypercalcemia, cases of cognitive dysfunction were observed, while in severe hypercalcemia, lethargy, stupor, delirium and coma were observed (Guerra *et al.*, 2016). In addition, according to the research of Moreira *et al.* (2020), in more severe stages of vitamin D intoxication with hypercalcemia, cardiac alterations such as arrhythmias, ECG alterations, QT interval shortening, ST segment shortening, PR interval prolongation, and T wave flattening, in addition to decreased cardiac output and myocardial contractility alterations, may occur. Thus, special care must be taken in supplementation, and it is necessary to monitor the family and health professionals who accompany the patient.



## CONCLUSION

The investigation of vitamin D levels in the Amazonian population during the pandemic period reveals a significant increase in the supplementation of this vitamin, motivated by the perception of its benefits in immunity and prevention against COVID-19. It was observed that the increase in supplementation led to toxic vitamin D levels, especially among individuals aged 60 years and older, demonstrating the need for caution when administering supplements without medical supervision.

The data reinforce that, despite the possible beneficial role of vitamin D in the immune system, self-medication and lack of follow-up can result in serious complications, such as hypercalcemia and cardiovascular changes. In addition, the study highlights that, although both genders have high levels of vitamin D, the older age group showed a greater predisposition to exceed the safe limits. This points to the need for public policies to raise awareness about the proper use of vitamins, especially in populations that are at higher risk of adverse effects. This scenario emphasizes the role of studies such as this one, which help identify specific patterns and suggest targeted interventions, especially in periods of crisis.



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