Reciprocal Influence of Obesity and Vitamin D Deficiency in Covid-19 Survivors

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ABSTRACT

Relevance: Worldwide, the prevalence of obesity has increased dramatically during the last four decades. Recent years vitamin D deficiency has also been scrutinizing as a cause of obesity. There is growing evidence that vitamin D has a significant role in metabolism, in particular in regulating the glucose homeostasis. Furthermore, a number of studies have suggested obesity as an independent risk factor of COVID-19 severity. After COVID-19 pandemic, it is topical to assess the link between obesity and vitamin D deficiency especially in people who suffered from SARS-CoV-2 infection before.

Aim: To assess vitamin D levels in people with and without obesity on those who underwent COVID-19 prior to the study. To study the mutual influence of obesity and vitamin D deficiency in these patients. To identify is there any link between severity of COVID-19 and obesity.

Materials and methods: 27 patients aged 35 to 55 years (mean age 43.4±0.3 years) were examined. The first group consisted of 15 (55.56%) patients with BMI ≥30, including 11 women (73.3%) and 4 men (26.6%). The control group consisted of 12 (44.46%) patients with BMI=22.3±0.18, including 9 women (75%) and 3 men (25%). Medical documentation was used, an anthropometric study was performed, including measurement of height (m), weight (kg), calculation of BMI (kg/m2). The level of 25(OH)D in blood serum was determined by the immunochemiluminescent method. Positive PCR test results for COVID-19, and past medical discharges from hospitals.

Results: It was found that the average level of vitamin D in the first group (BMI ≥30) was 22,07±2.36 ng/ml, in the control group 29±2.76 ng/ml. In the obese group, 7 patients (46.6%) were found to be vitamin D deficient, 5 (33.3%) were found to be vitamin D insufficient. In the group with normal BMI only 2 had vitamin D deficiency and 5 (60%) had insufficiency. It was discovered that just 2 (16.6%) of the 12 patients in the non-obese cohort required hospitalization and critical care due to the severity of COVID-19, compared to 8 (53,4%) of the 15 patients from the obese group who were admitted to the ICU.

Conclusion: In our studies, vitamin D deficiency in obese individuals was more common than in non-obese individuals. Thus, it can be assumed that the level of vitamin D in the presence of obesity (BMI ≥30) may be lower than in people with a normal body mass index. The issue of considering vitamin D deficiency as a cause or consequence of obesity remains open and requires further study. With regards to COVID-19, our study demonstrates obese patients are more likely to have critical COVID-19 symptoms which lead to ICU.

Keywords: 25-hydroxy vitamin D; COVID-19 severity; SARS-CoV-2; obesity; vitamin D deficiency

Introduction

In the Chinese region of Hubei, an acute lung ailment of unclear etiology first appeared in December 2019. Chinese researchers isolated a novel coronavirus, known as SARS-CoV-2, on January 7 of 2020 and determined it to be the culprit behind pneumonia brought on by the virus (1, 2). According to the WHO's classification of the illness, it is currently known as coronavirus disease 2019 (COVID-19) and is rapidly spreading throughout the world as a person-to-person droplet infection (3). The infection can present clinically in a variety of ways, from asymptomatic to oligosymptomatic to fatal organ dysfunction and severe organ dysfunction. As WHO reports, as of 10 May 2023, there have been 765 903 278 confirmed cases of COVID-19, including 6 927 378 deaths globally.

Obesity is a chronic metabolic disorder that can occur in men and women at any age. Obesity is understood as an increase in body weight due to excessive formation of fat and its deposition in the body. This disease significantly worsens the quality of life of people, reduces the efficiency and overall life expectancy of patients.

Worldwide, the prevalence of obesity has increased dramatically during the last four decades. The World Obesity Atlas 2022, published by the World Obesity Federation, predicts that one billion people globally, including 1 in 5 women and 1 in 7 men, will be living with obesity by 2030. Interaction of many factors including genetic, metabolic, behavioral, and environmental influences has resulted in this situation. Recent years vitamin D deficiency has also been scrutinizing as a cause of obesity. There is growing evidence that vitamin D has a significant role in metabolism, in particular in regulating the glucose homeostasis [1-4]. Vitamin D deficiency has been identified as a global health issue by epidemiological studies [5,6] and is defined by serum calcidiol levels of lower than 50 nmol/L or 20 ng/ml [7]. Early studies reported poor vitamin D status in the morbidly obese. More recently, it has been observed that a graded relationship between vitamin D status and BMI, or specifically adiposity, exists in the general population. Several studies recognized association between hypovitaminosis D and obesity [9-11]. There are several potential pathophysiological explanations for this connection. Excess body fat can serve as a repository of vitamin D and, thus, alter the kinetics between that depot and the circulation. In addition, obesity may be associated with lower dietary intake of vitamin D, reduced outdoor physical activity with limited skin exposure to sunlight, impaired hydroxylation in adipose tissue, and alterations in vitamin D receptors. [9-11]. Because the vitamin D receptor (VDR) is expressed on adipocytes, it is intriguing to consider the possibility that vitamin D may play a role in modulating adipose tissue distribution and function [12]. Obese subjects, particularly if elderly, often demonstrate low levels of 25(OH)D, which are inversely correlated with body mass index and adiposity [13,14].

Aim of the study

To assess vitamin D (25(OH)D in blood serum) levels in people with and without obesity on those who underwent COVID-19 within 3 months. To study the mutual influence of obesity and vitamin D deficiency on these patients. To determine the link between obesity and severe complications of COVID-19 if there any of such cases.

Materials and methods

For our study 27 patients aged 35 to 55 years (mean age 43.4±0.3 years) who admitted to the second therapy department of Tashkent Medical Academy were recruited. Two cohorts of obese and non-obese adults were formed: the first group consisted of 15 patients with BMI =32.1±0.17, including 11 women (73.3%) and 4 men (26.6%). The control group consisted of 12 patients with BMI=22.3±0.18, including 9 women (75%) and 3 men (25%). Notably, both two cohorts underwent SARS-CoV-2 infection within one-year period (in 2021-2022). Medical documentation was used, an anthropometric study was performed, including measurement of height (m), weight (kg), calculation of BMI (kg/m2). The level of 25(OH)D in blood serum was determined by the immunochemiluminescent method. As individuals from both cohorts were infected with SARS-CoV-2 and recovered from the illness prior to our study, we collected anamnesis about whether or not admitted they to the hospital, significantly to ICU, in order to detect disease severity according to BMI. As a reliable source of medical documentation certifying the fact of COVID-19 infection in these patients, positive PCR test taken in period of suffering the disease was considered. Hospital discharges provided by patients demonstrated the fact of hospital admission because of severer symptoms.

Classifications used in our measurements:

BMI	CLASSIFICATION
< 18.5	Underweight
18.5-24.9	Normal
25.0-29.9	Overweight
30.0-34.9	Obesity (Class I)
35.0-39.9	Obesity (Class II)
>40	Extreme Obesity (Class III)

In our studies, as a obese cohort we have chosen patients with class 1 obesity, as a control group we recruited patients with normal BMI.

Vitamin D Status	Blood levels (ng/mL)	Blood levels (nmol/L)
Severe deficiency	Less than 10	Less that 25
Deficiency	10-20	25-50
Insufficiency	20-30	50-75
Normal	Above 30	Above 75
Overdose	Over 100	250

Vitamin D levels medical documentations we used were shown in ng/ml.

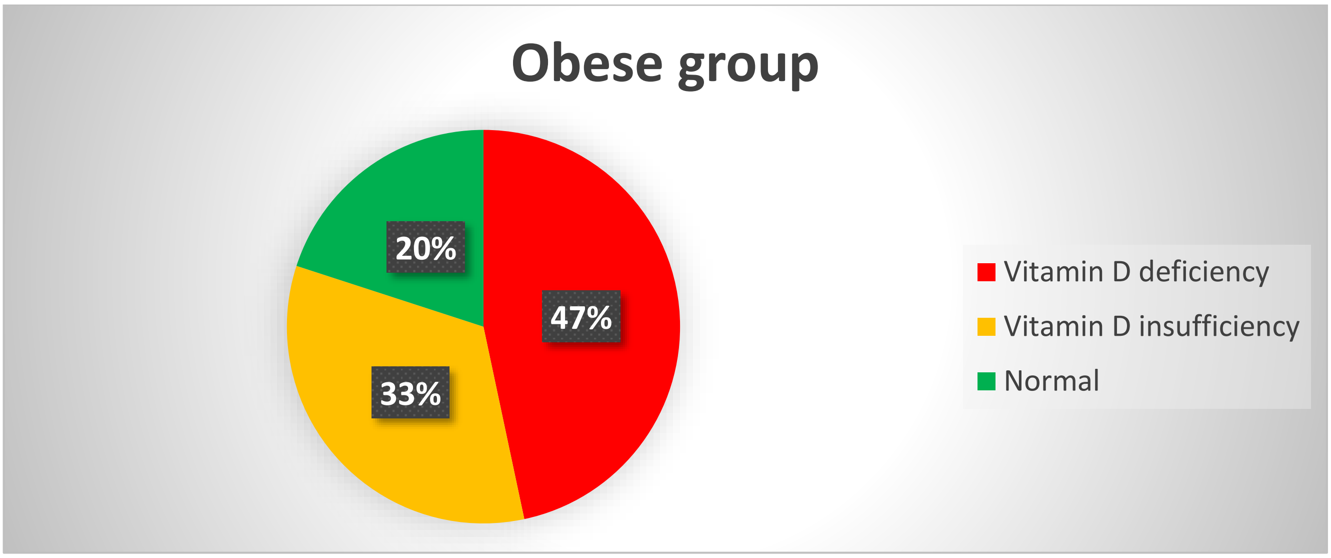
Results

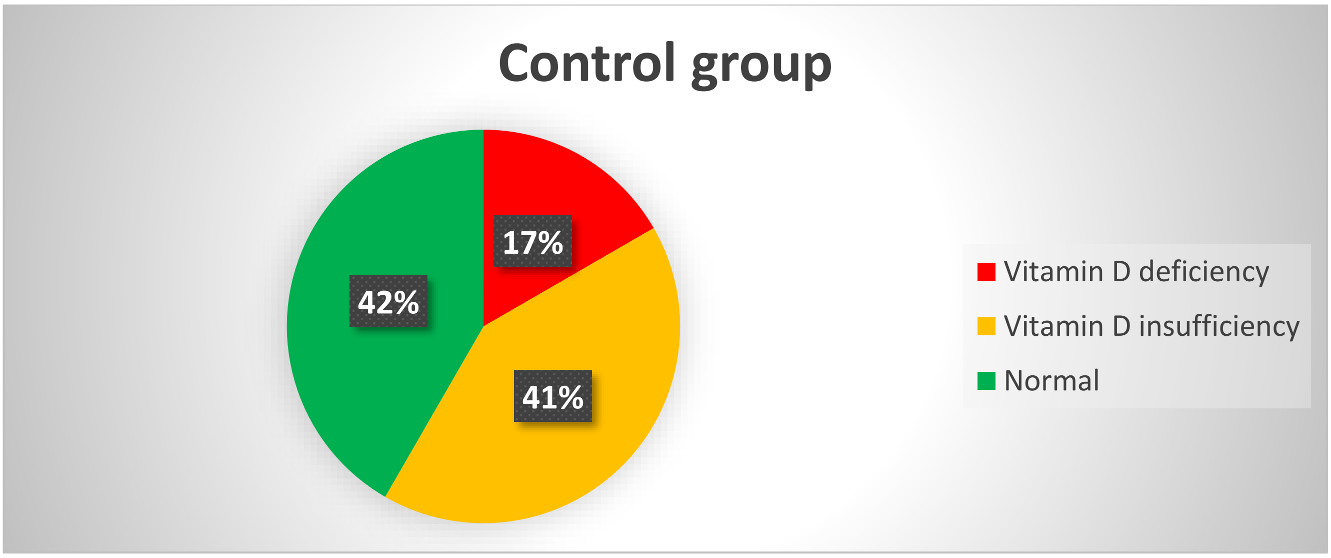
1)It was found that the average level of vitamin D in the obese group was 22,07±2.36 ng/ml, in the control group was 29±2.76 ng/ml. In the obese group, 7 patients (47%) were found to be vitamin D deficient, and 5 (33%) were found to be vitamin D insufficient. In the group with normal BMI only 2 had vitamin D deficiency, and 5 (60%) had insufficiency.

Below are exact numbers of Vitamin D levels which were assesses by immunochemiluminescent method:

vitamin D (ng/ml)	obese	11,3	12,6	28,6	13,8	18	25,6	10,1	40,1	25,5	13,1	33,8	29,3	20,5	18,6	30,2
	control	35,5	12,5	15,6	39,1	24,2	29,5	25,6	40,5	42,1	28,8	21,6	33,1			

Pie charts below clearly demonstrate that healthy levels of vitamin D is more than two-times higher in control group, while vitamin D deficient people are predominant in obese group:





2) To consider about the link between COVID-19 severity and obesity, it is found that 8 (53,4%) of 15 patients from obese group were hospitalized and admitted to ICU, while only 2 (16.6%) of 12 non-obese cohort were hospitalized and received intensive care because of COVID-19 severity. The remaining from both groups had mild flu-like symptoms and did not receive hospital care, having positive PCR result.

Conclusions

1. Vitamin D deficiency in obese individuals can be more frequent than in non-obese individuals. That means, there can be correlation between vitamin D levels and body mass index as it was observed in other studies before. Yet, it needs more research by recruiting larger number of patients in cohorts; Moreover, next studies should question how efficient is to add vitamin D medications to body mass lowering therapy for obese individuals.
2. Our study demonstrates obese patients are more likely to have critical COVID-19 symptoms which lead to ICU, which is consistent with the results of the studies run by numerous authors prior to our study. That means, obese adults with infection SARS-CoV-2 should be treated promptly and considered in prioritization of vaccine and antiviral medications during shortages.

References

1. S. J. Wimalawansa, "Associations of vitamin D with insulin resistance, obesity, type 2 diabetes, and metabolic syndrome," ;e Journal of Steroid Biochemistry and Molecular Biology, vol. 175, pp. 177–189, 2018.
2. S. J. Mutt, G. S. Raza, M. J. Makinen, S. Keinanen Kiukaanniemi, M. Jarvelin, and K. Herzig, "Vitamin D deficiency induces insulin resistance and re-supplementation attenuates hepatic glucose output via the PI3K-AKT-FOXO1 mediated pathway," Molecular Nutrition & Food Research, vol. 64, no. 1, Article ID e1900728, 2020
3. T. Mezza, G. Muscogiuri, G. Sorice et al., "Vitamin D deficiency: a new risk factor for type 2 diabetes?" Annals of Nutrition & Metabolism, vol. 61, no. 4, pp. 337–348, 2012.
4. [4] Y. Dhas, J. Banerjee, G. Damle, and N. Mishra, "Association of vitamin D deficiency with insulin resistance in middleaged type 2 diabetics," Clinica Chimica Acta, vol. 492, pp. 95–101, 2019.
5. M. F. Holick, "High prevalence of vitamin D inadequacy and implications for health," Mayo Clinic Proceedings, vol. 81, no. 3, pp. 353–373, 2006.
6. M. F. Holick, E. S. Siris, N. Binkley et al., "Prevalence of vitamin D inadequacy among postmenopausal North American women receiving osteoporosis therapy," Journal of Clinical Endocrinology & Metabolism, vol. 90, no. 6, pp. 3215–3224, 2005.
7. K. Amrein, M. Scherkl, M. Hoffmann et al., "Vitamin D deficiency 2.0: an update on the current status worldwide," European Journal of Clinical Nutrition, vol. 74, no. 11, pp. 1498–1513, 2020.
8. Migliaccio S, Di Nisio A, Mele C, et al. Obesity and hypovitaminosis D: causality or casualty? Int J Obes Suppl. 2019;9(1):20– 31. https://doi.org/10.1038/s41367-019-0010-8.
9. Pramono A, Jocken JWE, Essers YPG, Goossens GH, Blaak EE. Vitamin D and tissue-specifc insulin sensitivity in humans with overweight/obesity. J Clin Endocrinol Metab. 2019;104(1):49– 56. https://doi.org/10.1210/jc.2018-00995. 11. Earthman CP, Beckman LM, Masodkar K, Sibley SD. The link between obesity and low circulating 25-hydroxyvitamin D concentrations: considerations and implications. Int J Obes. 2012;36(3):387–96.
10. Park CY, Han SN. The role of Vitamin D in adipose tissue biology: adipocyte differentiation, energy metabolism, and infammation. J Lipid Atheroscler. 2021;10(2):130–44. https://doi.org/ 10.12997/jla.2021.10.2.130.
11. Pereira-Santos M, Costa PR, Assis AM, Santos CA, Santos DB. Obesity and vitamin D deficiency: a systematic review and meta-analysis. Obes Rev.

2015;16(4):341–9. https://doi.org/10.1111/obr.12239.

12. Hajhashemy Z, Shahdadian F, Ziaei R, Saneei P. Serum vitamin D levels in relation to abdominal obesity: a systematic review and dose-response meta-analysis of epidemiologic studies. Obes Rev. 2021;22(2): e13134. https://doi.org/10.1111/obr.13134.