ASSESSING RELATIONSHIP BETWEEN BMI AND VITAMIN D IN COVID-19 SURVIVORS

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Annotation: This study investigates the impact of age, BMI, and vitamin D levels on the severity of COVID-19 in a cohort of 32 patients. It utilizes logistic regression analysis and correlation testing to examine the relationships between these variables and COVID-19 severity, shedding light on potential risk factors and clinical implications.

Aims: The primary objectives of this study are twofold: 1) to assess the influence of age, vitamin D levels, and BMI on the severity of COVID-19, and 2) to examine the association between BMI and blood vitamin D levels.

Materials and Methods: Retrospective analysis was conducted on data from patients aged 40 to 63 years who attended the Endocrinology department of Tashkent Medical Academy from January 2023 to September 2023. Medical documentation was utilized, and anthropometric measurements were performed to calculate BMI. COVID-19 severity was assessed based on hospitalization records, with severe illness defined by admission to the Intensive Care Department. Descriptive statistics, logistic regression, and correlation analysis were employed for data analysis.

Results: Descriptive statistics revealed a median age of 50 years, with a range of 40 to 63 years. The majority (55%) of patients experienced mild COVID-19, while 45% had severe illness. Logistic regression analysis indicated a significant association between lower vitamin D levels and the likelihood of severe COVID-19 ($p < 0.05$). However, age and BMI did not demonstrate significant effects on COVID-19 severity. A moderate negative correlation ($r = -0.44$, $p = 0.01$) was observed between BMI and vitamin D levels.

Conclusion: The study suggests that lower vitamin D levels may increase the risk of severe COVID-19, highlighting the importance of assessing and maintaining adequate vitamin D status, especially in individuals with higher BMIs. However, age and BMI were not found to significantly influence COVID-19 severity in this cohort. These findings underscore the potential clinical implications for risk assessment and intervention strategies in managing COVID-19 outcomes. Further research is needed to elucidate underlying mechanisms and optimize preventive measures.

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

Background. In December 2019, the coronavirus disease (COVID-19) caused by SARS-CoV-2019 broke out in Wuhan, China, and rapidly spread, causing a global health crisis.

As of December 6, 2023, 772 138 818 people have been confirmed to have been infected with the novel coronavirus worldwide, of which 6 985 964 have died, as reported to the WHO [1]. Symptoms of coronavirus disease (COVID-19) include cases ranging from asymptomatic infection [2] to severe pneumonia, adult acute respiratory distress syndrome (ARDS), and death [3]. That has led medical researchers to identify risk factors for the severity of coronavirus disease (Covid-19). Hypertension, cardiovascular disease, chronic respiratory disease, and cancer have been found to be risk factors for severe Covid-19 [4-6].

Patients with SARS-CoV-2 infection can present with a variety of clinical manifestations, ranging from asymptomatic to critical illness. In general, adults with SARS-CoV-2 infection can be grouped into the following disease severity categories (however, the criteria for each category may overlap or differ in clinical guidelines and clinical trials, and the patient's clinical status may change over time):

1) Asymptomatic or asymptomatic infection: Individuals who test positive for SARS-CoV-2 in a virologic test (nucleic acid amplification test [NAAT] or antigen test) but do not have symptoms consistent with COVID-19. Mild illness: People with some of the various signs and symptoms of COVID-19 (fever, cough, sore throat, malaise, headache, muscle pain, nausea, vomiting, diarrhea, loss of taste and smell) but not shortness of breath, shortness of breath or an abnormal chest image. Moderate disease: subjects with evidence of lower respiratory disease on clinical assessment or imaging and with oxygen saturation ≥ 94% of room air at sea level as measured by pulse oximetry (SpO2). Severe disease: individuals with SpO2 less than 94% of room air at sea level, ratio of partial pressure of arterial oxygen to fraction of inspired oxygen (PaO2/FiO2) less than 300 mm Hg, respiratory rate and more than 30 breaths/min or lung infiltrates less than 50% Critical illness: Individuals with respiratory failure, septic shock and/or multiple organ dysfunction.

The incidence of obesity has recently increased in many developed and developing countries [8, 9], doubling in 73 countries since 1980 [10].

The global prevalence of obesity is estimated to be approximately 12% (603.7 million) in adults and 5% (107.7 million) in children [10]. These statistics indicate a

trend towards increasing prevalence of obesity and therefore the importance of treating this pathological condition as a risk factor for other diseases.

The fact that obesity is a separate disease and its effects on the respiratory system is also mentioned in the famous physician of all times -- Ibn Sina's "Canon of Medicine" (completed in 1025) [12]. Also, a link between obesity and the severe course of respiratory viral infections was observed during the 1918 "Spanish" flu pandemic [13]. Albashir in his study linked high estimations of BMI with COVID-19 severity, thus "obesity was considered as a strong independent risk factor for hospitalization". According to this study, obese patients can be at risk of more severe clinical course of COVID-19. Furthermore, they are more inclined to become infected by this virus and they can be more contagious virus carriers because of longer period virus shedding [14]. Additionally, as other cross-sectional studies suggest, obesity is consistently characterized by lower blood vitamin D levels, which means higher prevalence of vitamin D deficiency and insufficiency in patients with excess body weight [15].

Aims of our study:

1) To assess the impact of age, vitamin D levels and BMI on COVID-19 severity;

2) To assess an association between BMI and blood Vitamin D level.

Materials and methods.

This study retrospectively analyzed data of 32 patients aged 40 to 63 years attended Endocrinology department of Tashkent Medical Academy from January 2023 till September 2023 for planned hospital care. This research contains 1 categorical (COVID-19 severity), and 3 numeric variables (Age, BMI, Vitamin D levels). For obtaining this data medical documentation was used, an anthropometric study was performed, including measurement of height (m), weight (kg) to calculate BMI (kg/m2).

To assess the severity of COVID-19, we considered the fact whether or not they admitted in Intensive Care Department while suffering from the illness, using past hospital discharges provided by patients. If patient was hospitalized, we indicated it as a severe illness, if there was not hospitalization, and from anamnesis the were only mild flu-like symptoms without shortness of breath we indicated that as a mild illness.

Initially, the baseline characteristics of the participants were summarized using descriptive statistics. The normality distribution of the variables was assessed using Shapiro-Wilk test. Measures of central tendency and measures of

dispersion were used for summarizing numeric variables. Also, frequency (%) was described for the categorical variables.

Statistical significance was defined as a value of $p < 0.05$. (Confidence interval is 95%) Statistical analyses were done using R. For assessing relationship between two numeric variables correlation testing was used, for assessing influencing factors on COVID-19 severity logistic regression was used.

Results:

1. Summarizing data:

	Age	BMI	Vitamin D
Min.	40	20,10	5.50
1st Qu.	45	24.95	11.55
Median	50	28,00	20,40
Mean	50,84	27.49	19,85
3rd Qu.	55,50	30.30	26,50
Max.	63	34,10	35,50
Mode	39	30,1	20,5
Range	40-63	20,1-34,1	5,5-35,5
St.dev	6,6	4,1	8,7

Distribution in terms of Age is positively skewed (mean>mode), in BMI is Vitamin d skewness is negative (mean<mode).

Summary statistics of categorical variable: 17 (55%) of patients had undergone mild COVID-19, while 14 (45%) of them had severe COVID-19.

2. Output from logistic regression:

Coefficients:

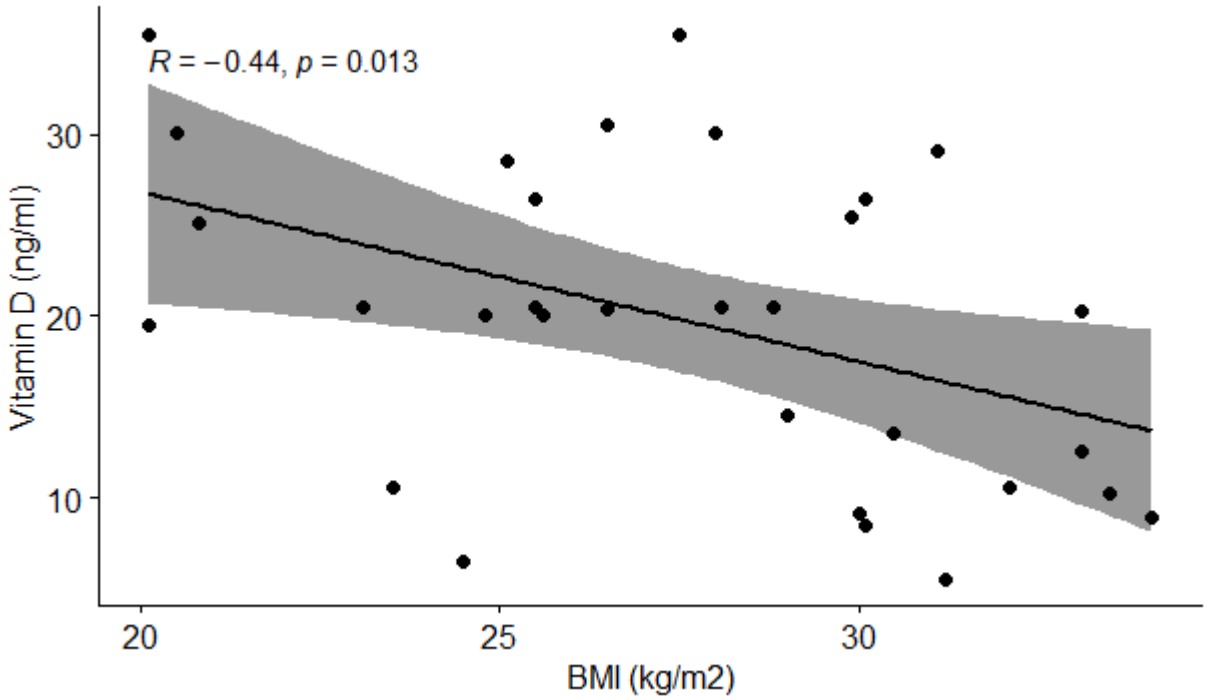
	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-5.89856	4.99493	-1.181	0.2376	
Age	0.11761	0.08148	1.443	0.1489	
BMI	0.09700	0.12242	0.792	0.4281	
`Vitamin D`	-0.15550	0.06928	-2.244	0.0248	*

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

This is a logistic regression analysis that examines the relationship between COVID-19 (the response variable) and Age, BMI, and Vitamin D (the predictor variables).

Overall, the results suggest that Vitamin D may have a significant impact on the odds of having COVID-19, while Age and BMI may not have a significant effect.

3. Pearson correlation:



The correlation coefficient between BMI and Vitamin D levels of -0.44 indicates a moderate, negative relationship between these two variables. This means that as BMI increases, Vitamin D levels tend to decrease, and vice versa.

The p-value of 0.01 suggests that the correlation coefficient is statistically significant. This means that the likelihood of observing this correlation coefficient by chance alone is very low (less than 1%). Therefore, we can have confidence in the relationship between BMI and Vitamin D levels.

Conclusions: Based on the findings of this logistic regression analysis, it can be concluded that Vitamin D levels may play a significant role in the likelihood of having severe COVID-19, while Age and BMI may not have a significant impact. This indicates that individuals with lower Vitamin D levels may have higher odds of undergoing severe form of COVID-19.

Taking note of the moderate negative relationship between BMI and Vitamin D levels, it can be inferred that as BMI increases, Vitamin D levels tend to decrease.

This suggests that individuals with higher BMIs may be at a higher risk of having lower Vitamin D levels, which could potentially contribute to a higher risk of acquiring severe symptoms COVID-19. However, it is important to note that correlation does not imply causation, and there may be other factors involved in this relationship. Further research is needed to explore the underlying mechanisms and potential contributing factors to better understand this relationship.

Based on these conclusions, clinicians may consider assessing the Vitamin D status and levels in patients, especially those with higher BMIs, as part of their routine care and COVID-19 severity risk management. Encouraging individuals with lower Vitamin D levels to supplement their intake or seek appropriate sunlight exposure may be a clinical recommendation to potentially reduce the risk of COVID-19 complications such as shortness of breath. Additionally, providing education on maintaining a healthy BMI through proper nutrition and exercise may also be beneficial.

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