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# Correlation of Vitamin D and nutritional status in pediatric systemic lupus erythematosus



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## ABSTRACT

**Introduction:** Systemic lupus erythematosus (SLE) is a chronic autoimmune illness affecting various organ systems, including the skin, joints, kidneys, cardiovascular, and neurological systems. Because of its immunomodulatory properties, vitamin D has been linked to the etiology and therapy of SLE. The link between vitamin D and nutritional status in pediatric systemic lupus erythematosus (pSLE) is complicated and multifaceted. This study aims to see if there is a link between vitamin D and nutritional status in children with systemic lupus erythematosus.

**Method:** This study design was cross-sectional to determine factors influencing children with SLE. The study was conducted at Saiful Anwar Hospital in Malang from January 1, 2021, to June 30, 2022, and was approved by the hospital's research ethics committee. Statistical analysis was performed using the Shapiro-Wilk test for normality and Pearson correlation with SPSS 25 statistical analysis software.

**Results:** All samples (32 children) were female, with a mean age of  $14.1 \pm 1.5$  years. The mean vitamin D level was  $18.32 \pm 2.15$  ng/mL, mean body mass index (BMI) was  $19.51 \pm 1.49$  kg/m<sup>2</sup>. Regarding the nutritional status of children with SLE, 10 children were classified as malnourished (30%), while 19 children had good/normal nutritional status (60%). Three children had overweight (10%). There was a positive correlation between BMI and vitamin D in children with SLE ( $p=0.000$ ,  $r=0.630$ ).

**Conclusion:** The majority of SLE youngsters have inadequate vitamin D levels. Vitamin D and the nutritional health of children with pediatric systemic lupus erythematosus have a significant favorable association.

**Keywords:** Vitamin D, nutritional status, SLE.

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## INTRODUCTION

Chronic autoimmune Systemic Lupus Erythematosus (SLE) can damage several organ systems, including the skin, joints, kidneys, cardiovascular, and neurological systems.<sup>1,2</sup> Estimates of pediatric SLE (pSLE) incidence range from 0.3 to 2.2 per 100,000 children years worldwide, whereas prevalence rates range from 3.3 to 9.7 per 100,000 children and adolescents, depending on the population investigated and ethnic distribution.<sup>3-7</sup> Asian, African, Indigenous North American, and Hispanic/Latino ancestors are afflicted more frequently and severely than European ancestors.<sup>3,8-10</sup> It's a high prevalence in females rather than males (8-9:1). The Almada et al. research found that 13 children were diagnosed with SLE from 1976 to 2018 from an 8-county region in the US.<sup>11</sup> A research study from 12 provinces in Indonesia reported since 2012-2015, the pSLE frequency in girls

was 9 times higher than in boys (18:172).<sup>12</sup>

Vitamin D has been implicated pathogenesis and management of SLE due to immunomodulatory effects.<sup>1,2</sup> It modulates the immune system by inhibiting interleukin-2 (IL-2) synthesis, producing antibodies, and promoting lymphocyte proliferation. 1,25-dihydroxy vitamin D3 (1,25(OH)<sub>2</sub> D3) decreases IFN- $\gamma$  secretion and, via inhibiting NF- $\kappa$ B. Vitamin D insufficiency is frequently documented in patients with systemic lupus erythematosus and in pediatrics with SLE. The relationship between vitamin D and SLE is bidirectional, with SLE causing lower vitamin D levels and vitamin D insufficiency playing a causal role in SLE etiology and/or exacerbation.<sup>13</sup> In addition, vitamin D has been shown to regulate immune cell function, including the differentiation and activity of T cells, B cells, and dendritic cells. Thus, when the level of vitamin D decrease, it leads to immune dysregulation and

promotes autoimmunity, including the development and progression of SLE.<sup>13,14</sup> In pSLE, the correlation between vitamin D and nutritional state is complex and multifactorial. A growing body of evidence suggests an association between vitamin D deficiency and SLE in both pediatric and adult populations. There are some research studies reported.<sup>15</sup>

Some studies have shown that vitamin D may influence therapy responsiveness in SLE. For example, a 2017 study discovered that SLE patients with vitamin D insufficiency responded worse to traditional immunosuppressive medication than those with adequate vitamin D levels.<sup>16</sup> Additionally, most of the studies conducted so far have been observational, and more robust randomized controlled trials are needed to establish relationships and determine the potential benefits of vitamin D supplementation in SLE management.<sup>17-19</sup>

It's worth noting that the relationship

between vitamin D, nutritional state, and pSLE is an active area of research, and further studies are needed to understand underlying mechanisms more and determine the most effective strategies for management. If a child has pSLE, consulting with a pediatric rheumatologist or an appropriate healthcare professional for personalized evaluation and guidance<sup>24-27</sup> is crucial. This study aims to determine the correlation between vitamin D and nutritional status in pediatric systemic lupus erythematosus.

## METHOD

This study design was cross-sectional to investigate factors influencing children with Systemic Lupus Erythematosus (SLE). The research was conducted at Saiful Anwar Hospital in Malang, and it received approval from the hospital's research ethics committee with number 208/EC/KEPK/07/2021. The study was from January 2021 to June 2022. Patients and their families received research consent forms (Informed Consent). The inclusion criteria were willing to follow this research by signing informed consent, aged 0-19 years, has been diagnosed with SLE. The exclusion criteria were incomplete data, diagnosed with other autoimmune diseases besides SLE, cancer, or other conditions affecting levels.

Diagnosis of SLE was established if the patient met a minimum of 4 out of 11 ACR criteria in 1997.<sup>20,21</sup> The severity of SLE was assessed using the SLE Disease Activity Index (SLEDAI), measured by a doctor. For nutritional status assessment, weight measurement was performed using a calibrated scale. Height was measured using a stadiometer. Body Mass Index (BMI) Z-score was calculated from the weight and height values. Results were compared to the WHO reference values.<sup>21</sup> Information regarding gender, disease onset, patient age, and disease duration was obtained from medical records or interviews. Vitamin D levels were measured using an ELISA method. Statistical analysis was performed using the Shapiro-Wilk test for normality, and Pearson correlation, with SPSS 25 statistical analysis software.

## RESULTS

The results showed a mean age of  $14.1 \pm 1.5$  years. All samples were female. The mean BMI was  $19.51 \pm 1.49$  deficient. Nutritional status consisted of 10 children (30%) classified as malnourished, 19 children (60%) with good/normal nutrition, and 3 children (10%) classified as overweight. There were five samples (16.7%) were categorized as normal, 8 samples (23.3%) as sufficient, and 19 samples (60%) as  $\text{kg/m}^2$ . The mean vitamin D level was  $18.32 \pm 2.15$  ng/mL. Table 1 presents the characteristics of the research data.

The samples generally showed vitamin D levels with a mean of  $18.32 \pm 2.15$  ng/mL. This indicates that the majority of the vitamin D levels in the sample were deficient. The results of the vitamin D categories are as follows: 5 children with normal vitamin D levels (16.7%), 8 children with sufficient vitamin D levels (23.3%), and 19 children with deficient vitamin D levels (60%). According to nutritional status, the body mass index (BMI) results were depicted with a mean of  $19.51 \pm 1.49$   $\text{kg/m}^2$ . These findings indicate that the average BMI in the research study falls within the normal/good nutritional range.

We also analyze a correlation between BMI as nutritional status and vitamin D level. A significant relationship between vitamin D and the body mass index (BMI), with a p-value of 0.000. The correlation coefficient (r) of 0.630 indicates a moderate relationship strength. The figure suggests

that lower vitamin D levels are associated with lower body mass index values.

## DISCUSSION

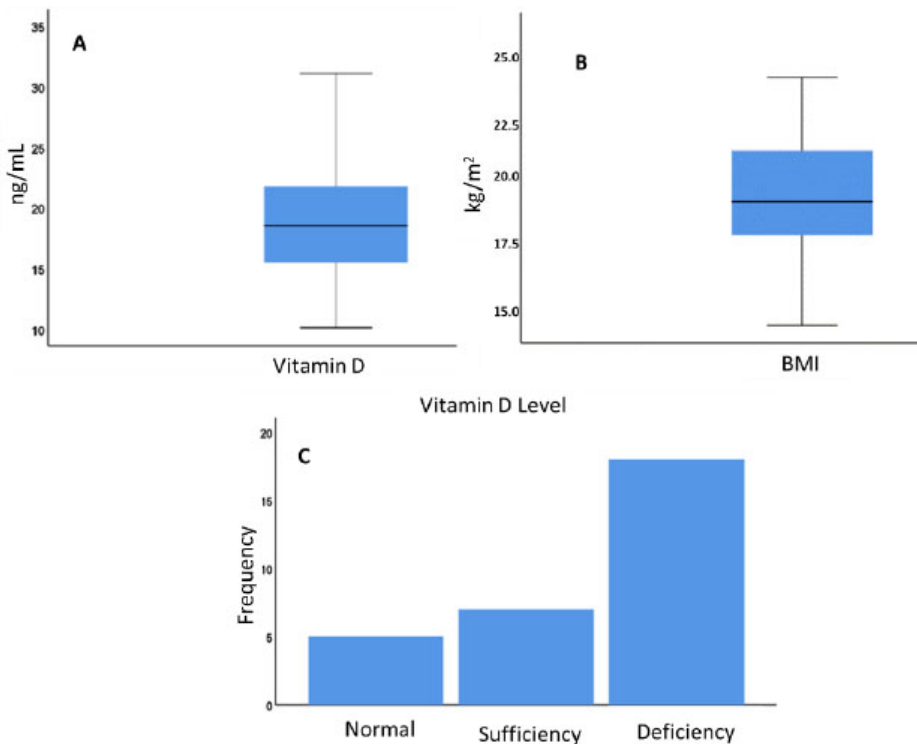
This study indicated that the average age of children with SLE was  $14.1 \pm 1.5$  years. This age range corresponds to rapid growth and puberty in children. This finding is consistent with previous studies reported.<sup>22</sup> The onset of SLE in children is not associated with ethnicity. The occurrence of SLE in children during puberty is related to an increase in estrogen levels during this stage.<sup>23</sup> This study found that a significant number of cases of SLE occurred during puberty, which is associated with estrogen levels influencing the body's immune balance. Therefore, puberty often triggers autoimmune diseases. Regarding gender, all samples in this study were female. This finding is in line with previous research reported.<sup>23,24</sup>

### Vitamin D and SLE

The study found that the average vitamin D level in children with SLE was  $18.32 \pm 2.15$  ng/mL. This indicates that the average vitamin D level falls within the category of vitamin D deficiency (insufficiency and deficiency). When classified, it was found that 5 samples (16.7%) had normal vitamin D levels, 8 samples (23.3%) had sufficient vitamin D levels, and 19 samples (60%) had deficient vitamin D levels. The significant deficiency of serum vitamin D levels in children with SLE compared to

**Table 1. Characteristics data**

Characteristic sample	Value n = 32	%
Age (year)	$1.1 \pm 1.5$	
Gender		
Male	0	
Female	32	
BMI ( $\text{kg/m}^2$ )	$19.51 \pm 1.49$	
Vitamin D level (ng/mL)	$18.32 \pm 2.15$	
Vitamin D Classification		
Normal	5	16.7
Sufficiency	8	23.3
Deficiency	19	60.0
Nutritional Status		
Undernutrition	10	30.0
Normal	19	60.0
Overweight	3	10.0



**Figure 1.** Vitamin D level and nutritional status. A) The mean vitamin D level in all of the samples. B) The mean BMI. C) The classification of vitamin D level and its proportion.

immune system's balance, increasing the risk of autoimmune diseases. Additionally, vitamin D's anti-inflammatory function can serve as an additional therapy for certain autoimmune diseases.<sup>26</sup>

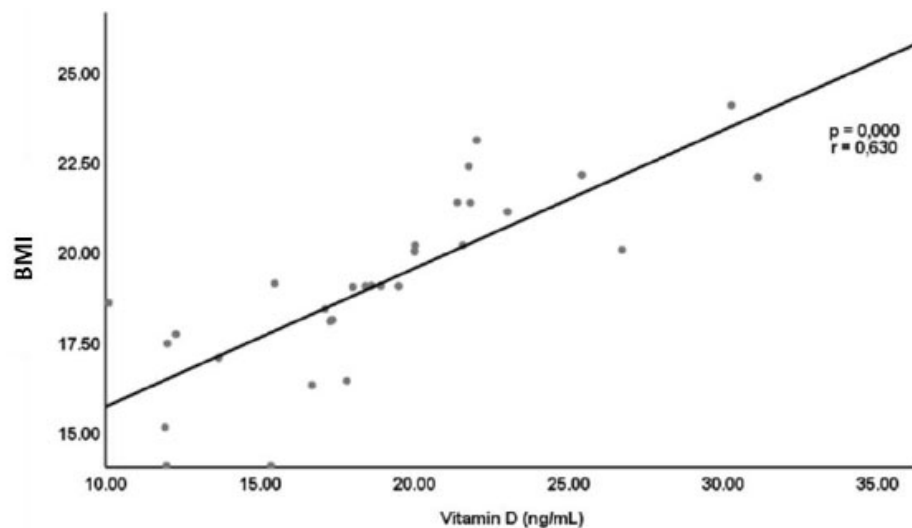
### BMI and Children's SLE

The study shows that children with SLE have an average body mass index (BMI) of  $19.51 \pm 1.49 \text{ kg/m}^2$ , indicating that the average BMI of pediatric SLE patients falls within the normal range. The data presented also suggest that 3 children fall into the overweight category. A cohort study reported that BMI is associated with the severity of SLE, with patients in the overweight and obese categories having significantly lower SLEDAI scores. High BMI predicts higher doses of prednisone, highlighting the need for interventions to reduce the risk of weight gain has reported. A positive association between BMI, height, and SLE risk in children has been reported.<sup>27</sup>

### Correlation between BMI and Vitamin D in Children SLE

The results of this study show that the average BMI of children with SLE is  $19.51 \pm 1.49 \text{ kg/m}^2$ , indicating normal nutritional status. The average vitamin D level in children with SLE is  $18.32 \pm 2.15 \text{ ng/mL}$ , indicating a deficiency in vitamin D (insufficiency and deficiency). In the classification grouping, 5 children with SLE have normal vitamin D levels (16.7%), 8 children have sufficient vitamin D levels (23.3%), and 19 children have deficient vitamin D levels (60%). An increase in BMI often occurs in SLE and is associated with increased severity, osteoporosis, and low vitamin D levels. This is clinically significant and suggests the importance of weight control in potential target improvement for SLE.<sup>27</sup>

The limitation of this study is the lack of a control group, which makes it vulnerable to bias. To control bias in this study, we ensure that data collection and analysis are objective and unbiased. Define clear outcome measures and use standardized methods to collect data. Implement appropriate statistical analysis techniques to account for potential confounding variables and accurately evaluate the intervention's impact.



**Figure 2.** Correlation between Vitamin D and Body Mass Index.

normal subjects suggests regular vitamin D supplementation and monitoring of health and vitamin D levels in health planning. Vitamin D, as a hormone, originates from two sources: diet and synthesis from the epidermal layer of the skin after exposure to ultraviolet B radiation. In children with SLE, who often experience flares, a decrease in appetite can reduce vitamin D levels. Additionally,

children with SLE are often photosensitive and cannot tolerate sunlight, the largest source (90%) of vitamin D from ultraviolet B radiation in sunlight. These factors contribute to low vitamin D levels in children with SLE. Vitamin D plays a role in the immune system's balance. If vitamin D levels are low, it can exacerbate acute inflammation in children with SLE.<sup>25</sup> Low vitamin D levels can also affect the

## CONCLUSION

The results of this study show that the average vitamin D levels in children with SLE are low, indicating a vitamin D shortage in this population. In children with SLE, there is a substantial positive connection between vitamin D and growth, suggesting that greater vitamin D levels are associated with improved nutritional status. Long-term research is recommended to increase the quality of this study. Further trials with control groups as comparators are required to acquire stronger study outcomes. Regular monitoring and vitamin D supplements should be explored to improve children's care and treatment of SLE. Furthermore, bigger sample sizes and proper controls in future studies will give a more thorough knowledge of the link between vitamin D, nutritional status, and SLE in children.

## DISCLOSURE

### Conflict of Interest

None.

### Funding

None.

### Author Contribution

All of the authors contributed to this study.

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