

Original Research Papers

## The effect of circuit weight training under ultraviolet B rays as vitamin D supplementation in preventing COVID-19

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### Abstract

The body's immune stability is essential by increasing fitness through exercise and getting enough vitamin D from ultraviolet B rays from sunlight. The exercise that is carried out, namely circuit weight training, is a mechanical exercise that can be applied outdoors to get exposure to ultraviolet B rays as a natural source of vitamin D. Exposure to sunlight is the best source of vitamin D for the synthesis of vitamin D from pre-vitamin D which is found under the skin. UVB rays (290–315 nm) originating from the sun will be absorbed by the skin and will then convert 7-dehydrocholesterol in the skin to pre-vitamin D<sub>3</sub> which is then converted to vitamin D<sub>3</sub> to be processed in the liver into 25(OH)D and in the kidneys into 1,25(OH)<sub>2</sub>D<sub>3</sub>. This study aimed to determine the effect of circuit weight training under ultraviolet B rays as vitamin D supplementation in preventing Covid-19. Associated with the severity of Covid-19 occurred because reduced vitamin D supplementation could be used as a better control of SARS-COV-2. This research method was a quasi-experimental design with a pretest-posttest with a control group of 80 subjects with a ratio of 1:1 for each group. Test the normality of normally distributed data. Hypothesis analysis found a significant effect on vitamin D levels ( $p=0.001$ ) in circuit weight training exercises under UV-B light sourced from sunlight. There was no significant effect on increasing vitamin D levels ( $p=0,710$ ) with circuit weight training exercises performed not under UV-B rays from sunlight. This study states that circuit weight training is practical under ultraviolet B rays as vitamin D supplementation in preventing Covid-19.

**Keywords:** circuit weight training; covid-19; ultraviolet B; vitamin D

### 1. Introduction

The body's immune stability is essential to be maintained by increasing fitness through exercise and getting enough vitamin D from ultraviolet B rays. Vitamin D deficiency can occur due to a lack of exposure to ultraviolet B rays. A lack of outdoor activities causes low vitamin D intake, so they tend to avoid sunlight. Information on Vitamin D related to the immune system can support the physical ability to carry out daily activities properly, especially during the Covid-19 pandemic (Barakbah & Handajani, 2012).

The geographical area of North Sumatra is a tropical region that should have a low prevalence of vitamin D deficiency. Still, the results obtained for some people are even the opposite. There were 27 students with a vitamin D deficiency of 31 whose vitamin D levels were measured (Zannah et al., 2019). Studies in countries where vitamin D insufficiency occurs at the end of winter are influenced by decreased sun exposure which can help the skin to achieve the target of vitamin D metabolism, so public health experts recommend doing physical exercise to sufficient vitamin D levels (Fayet-Moore et al., 2019). Then there is research to determine serum levels of 25-hydroxyvitamin D (25[OH]D) in people in South Asia who get enough ultraviolet exposure. Still, UVB exposure is so low in January and February that vitamin D status decreases (Farrar et al., 2013).

Sport is an individual's physiological need to improve body fitness inside and outside the room. Physical fitness can be enhanced by doing programmed physical activity. Circuit weight training is a

mechanical exercise that can be applied outdoors to get exposure to ultraviolet B rays as a natural source of vitamin D. The fact is that 91% of insufficiency that occurs in athletes and 100% of athletes experiencing deficiencies are athletes who exercise indoors (Peeling et al., 2013). The exercise aspect of circuit weight training covers the whole body by involving significant muscle contractions such as squats, sit-ups, push-ups, shoulder presses, prone trunk extensions, bench presses, hamstring curls, and heel raises (Kisner & Lynn Allen Colby, 2007).

Lipid-soluble vitamins are vitamin D which acts as a pleiotropic hormone in body tissues to regulate mineral homeostasis (Prietl et al., 2013). Vitamin D levels can be assessed from serum levels of 25-hydroxyvitamin D (25[OH]D), which is a pro-hormone vitamin D (Benson et al., 2012).

One of the biological effects of vitamin D is to increase calcium metabolism. Many studies have demonstrated the function of vitamin D in all organ systems, including muscle (muscle strength, muscle mass, and volume), cardiovascular, and respiratory (Mattozzi et al., 2016). Foods that contain vitamins D2 and D3 are very few. Vitamin D metabolic pathways are available in plants' phospholipid 7-dehydrocholesterol and ergosterol tissues. Vitamin D is produced by synthesizing pre-vitamin D under the skin tissue. Sunlight that the skin can absorb is UVB (290 – 315 nm) to convert 7-dehydrocholesterol into pre-vitamin D3, which is then converted to vitamin D3 and processed in the liver to become 25(OH)D and in the kidneys to become 1,25(OH)2D3 (Mattozzi et al., 2016). Vitamin D levels are known from micronutrient levels of vitamin D in blood plasma. This study aimed to determine the effect of circuit weight training under ultraviolet B rays as vitamin D supplementation in preventing Covid-19.

## 2. Research Methods

This research was a quantitative study using a quasi-experimental method with a pretest-posttest design with a control group, namely by intervening in the experimental group. This research was conducted at Grandmed Lubuk Pakam Hospital with 80 respondents. Sampling using a probability sampling method. Sample collection started by asking for the consent of the respondents, who were asked to agree to the consent form to become respondents. After the respondents were willing, after being given the circuit weight training intervention, the respondents were asked to be willing to take blood samples for examination of vitamin D levels measured by looking at serum 25 (OH)D levels. Analysis of serum 25(OH)D levels using the Enzyme Link Immunosorbent Assay (ELISA) kit has a size of 1 x 96 wells, a sensitivity of 1.6 ng/ml, 20 µl plasma. ELISA Kit materials consist of Calibrator AF 25(OH)D, Stop Solution, Assay Buffer, Incubation Buffer, Wash Buffer, TMB Substrate 25(OH)D, Control low and control high 25(OH)D, Biotin Conjugate Concentrate and Streptavidin conjugate concentrate. The stages of implementing the ELISA Reader are determined by the absorbance of each well with a reading of 450 waves±10nm. The health research ethics committee approved the research at USU's Faculty of Nursing (No. 2302/VI/SP/2021).

## 3. Results and Discussion

### 3.1. Results

This study used a case-control design to determine vitamin D levels in blood plasma to prevent Covid-19. The research was conducted from June to August 2021. The research respondents were employees of Grandmed Lubuk Pakam Hospital.

**Table 1.** Distribution of research subject characteristics

Variable	Case		Control	
	n (%)	Min;Max	n (%)	Min;Max
<b>Age</b>				
18-26 years	6 (15)	18;51	33(82.5)	18;45

Variable	Case		Control	
	n (%)	Min;Max	n (%)	Min;Max
27-35 years	17 (42.5)		3 (7.5)	
36-44 years	10 (25)		2 (5)	
45-52 years	7 (17.5)		2 (5)	
<b>Gender</b>				
Man	18 (45)	-	12 (30)	-
Woman	22 (55)		26 (65)	

The distribution of the control group by gender is in table 1, with the most 26 women with the youngest age of 18 years and the oldest at 45 years and the case group, there were 18 men and 22 women with the youngest age of 18 years and the most senior 51 years.

**Table 2.** Frequency distribution of vitamin D levels

Group	Vitamin D levels	Treatment	Min;Max	Control	Min;Max
		N (%)		N (%)	
Pretest	Deficiency: < 20 ng/ml	15 (37.5)		32 (80)	
	Insufficiency: 21-29 ng/ml	17 (42.5)	5.55 ; 30,2	7 (17.5)	6.57; 30,2
	Sufficiency: 30-85 ng/ml	8 (20)		1 (2.5)	
Posttest	Deficiency: < 20 ng/ml	10 (25)		30 (75)	
	Insufficiency: 21-29 ng/ml	18 (45)	4.55 ; 31.8	7 (17.5)	7.28; 59,10
	Sufficiency: 30-85 ng/ml	12 (30)		3 (7.5)	

Table 2. Most of the vitamin D levels in the control group were deficient, namely 30 people (75%), while sufficiency was even only three people (7.5%). In most cases of insufficiency, there were 18 people (45%), while ten people with deficiency (25%).

**Table 3.** Effect of vitamin D levels in the treatment and control groups

Group	Vitamin D levels	Sig- 2 tailed
Treatment	Pretest	0.001*
	Posttest	
Control	Pretest	0.710*
	Posttest	

For statistical analysis, the group trained under UVB rays, but not under UVB rays, then measured the level of vitamin D (25(OH)D) before and after circuit weight training for statistical tests. The significant value was obtained in the case group,  $p=0.001$ , and considerable importance in the control group,  $p=0.710$ .

### 3.2 Discussion

Insufficiency in the case group (45%) and deficiency in the control group (75%) were most common in vitamin D levels. A lack of vitamin D could pose several risks for diseases such as cardiovascular problems, Osteomalacia, and metabolic problems. The control group did not exercise outside the room, so the blood plasma vitamin D levels in the control group are deficient, with stories of 25(OH)D less than 25 nmol/L due to Exposure to UVB rays is the first catalyst for vitamin D biosynthesis (Vera et al., 2015). It is also essential to know that the effect of ultraviolet is vital for the differentiation of immunity (Teymoori-Rad & Marashi, 2021).

Research related to this research was also conducted by (Peeling et al., 2013), who provided training to athletes indoors, outdoors, and a combination of both by looking at each athlete's vitamin D

levels. Based on the results of this study, it was found that the average vitamin D level was 37 nmol/L with the indoor exercise of 28 nmol/L (insufficiency) lower than the outdoor exercise of 35 nmol/L (sufficiency) and a combination of indoor and outdoor activity of 29 nmol /L (deficiency).

Deficiency in the control group could cause weakness in the immune system. Vitamin D is the homeostasis of the immune system, namely the innate and adaptive immune systems. The natural immune system is the primary defense against microorganisms and injury to avoid inflammation and tissue damage. The role of vitamin D in this process is fundamental in inhibiting and modulating the immune response. In the adaptive immune system, lymphocytes and antigen receptors are specific for foreign pathogens. Cells involved in the adaptive immune system have vitamin D receptors on their surface. Vitamin D, in this case, can reduce Th1 production to inhibit T cell proliferation (Mattozzi et al., 2016).

Vitamin D levels in employees who do circuit weight training under ultraviolet B rays from sunlight have a significant value ( $p=0.001$ ). Analysis of vitamin D levels in the control group found many deficiencies. The same thing was found in 240 subjects in the city of Bandung. A significant relationship ( $p=0.000$ ) was found between the number of sun protection (protection) and vitamin D deficiency (Vera et al., 2015).

Other studies did not find a significant difference in serum 25(OH)D levels in the control group who received exercise, not under ultraviolet B rays. The levels of 25(OH)D may be influenced by factors such as race, diet, and exposure to ultraviolet rays which must be considered in research on vitamin D (Wilson, 2013).

The causative factor for the occurrence of covid-19 is a decrease in the immune system through a deficiency of vitamin D (Teymoori-Rad & Marashi, 2021). A decline in the health of bones, muscles, and other organs marks the implication of vitamin D deficiency. Regarding the many consequences of vitamin D, it is necessary to review the risk factors for vitamin D deficiency, including sun exposure, nutritional status, medications, and chronic degenerative diseases.

The role of vitamin D as a micronutrient is not only for calcium metabolism but also as a regulation of immunity, especially in modulating acquired and innate immunity as antiproliferation and differentiation of keratinocytes. Some of the nutrients associated with vitamin D deficiency can be obtained from nutrition and synthesis in the skin from UVB (Wilkens & Liesegang, 2015). Vitamin D3 is naturally obtained from salmon, mackerel, and fish oil. Fish, especially those high in vitamin D, are fish fat and fish liver. Then it was also found that high levels of vitamin D in chicken eggs (Schmid & Walther, 2013). An efficient source comes from exposure to UV rays to increase the level of micronutrients in plasma. In the United States of America, the most significant UVB (290-315 nm) is 10 am to 4 pm from April to October (Holick, 2016).

Less exposure to UVB rays from sunlight is a factor that causes vitamin D deficiency (Rimahardika et al., 2017). Exposure to UVB rays that should be needed by the skin but not received by the skin due to the use of sunscreen throughout the day. The right sunscreen should be used to protect the skin from exposure to UVA rays at certain times (Holick, 2016).

#### **4. Conclusion**

This study gives the result that there is an effect of circuit weight training as an exercise under ultraviolet-B rays as supplementation of vitamin D for the prevention of Covid-19 in employees of Grandmed Lubuk Pakam Hospital. Still, examining vitamin D levels is better than checking for 1,25(OH)D, but an examination of 1,25(OH)D is hard.

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