




## Literature Review

### Sun Bathing Affects Overweight-Obese Subjects Vitamin D Deficiency

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#### ABSTRACT

**Background:** There are increasing number of studies that discuss the effect of sun exposure to overweight and obese individuals with vitamin D deficiency (which is UVB exposure can increase serum 25-Hydroxyvitamin D levels). However, until now there is no a literature review about these studies. This shows a weak correlation between sun bathing and serum 25-Hydroxyvitamin D elevation in overweight and obese people.

**Aim:** Describe the effect of the sun bathing for overweight-obese patient with vitamin D deficiency.

**Material and Methods:** Electronic searching tools (*ScienceDirect*, *Pubmed*, and *Google Scholar*) were conducted from the 1990s until the recent literature. A sensitive search strategy uses specific terms. Studies were included if the population with BMI > 25 Kg/m<sup>2</sup>; Sun Exposure intervention, the studies provided the comparison of implementation method, the studies provided 25-Hydroxyvitamin D status as the outcome. For the exclusion criteria: studies that included subjects metabolics syndrome. MMAT was used for eliminating biased research.

**Results:** Two studies were fulfilled our inclusion criteria. The studies, were excluded, mainly because they lacked data, biased reseach, and failure to answer any authors questions.

**Conclusion:** The sun exposure method has a positive corellation for increasing serum 25-Hydroxyvitamin D level in overweight and obese subjects with vitamin D deficiency, but internal factors (age and skin color) and external factors (season, temperature, dose, and duration) need to be considered to get effective result.

**Keywords:** *Obese, Overweight, Sun bathing, Vitamin D deficiency, 25-Hydroxyvitamin D.*

## Introduction

Vitamin D is an essential micronutrient that helps bone tissue maintenance and calcium-phosphorus homeostasis. Besides, vitamin D is also useful in differentiation, cell proliferation, and hormone secretion (beneficial for the body's metabolic process). About 80% of vitamin D is produced from synthesis in the skin by sunlight activation, while the other is obtained from supplement and food.<sup>1,2</sup>

Overweight and obesity are defined as excess body fat accumulation which is ultimately affects body health (WHO, 2020).<sup>3</sup> Today, several studies have examined the association of being overweight/obese with vitamin D deficiency. This can be proven by research that says consistently low serum 25-*Hydroxyvitamin D* levels in adults and children of different ethnicities but within the same geographic location.<sup>4,5</sup> In Different research at the United State in 2003-2006 with population aged 6-18 years old showed a prevalence of vitamin D deficiency with normal weight, overweight and obesity was 21%, 29%, and 34%.<sup>6,7</sup> In different study at the United State in 2005-2006 with population aged 20 years and over, the prevalence of vitamin D deficiency with normal weight, overweight and obesity was 33%, 37.7%, and 53.8%.<sup>8</sup> Based on research, one of the causes of vitamin D deficiency in overweight/obese is decreasing the bioavailability of vitamin D in the skin. Although the vitamin D diet is recommended for individuals with vitamin D deficiency, the synthesis of vitamin D in the skin through Ultra violet B exposure (UVB) plays an important role as a large source of vitamin D. Some other reasons are due to the low availability of fortified foods and the speed of production of 25-*Hydroxyvitamin D* in the skin after UVB exposure is too slow.<sup>9</sup>

Today, there is increasing number of studies that discussing effect of sun bathing exposure (source of UVB) to overweight and obese individuals with vitamin D deficiency where the exposure can increase serum 25-*Hydroxyvitamin D* levels. Beside that fact, until now there is

no one has done the literature review. It shows a weak correlation between elevating serum 25-*Hydroxyvitamin D* levels in overweight and obese people after UVB exposure. Therefore, this article has a purpose to analyze the effect of the "sun bathing" method on overweight and obese populations with vitamin D deficiency to evaluate the association of UVB exposure with increased 25-*Hydroxyvitamin D* based on literature method. The results obtained are expected to provide information accurately to the public.

## Materials and Method

Online Electronic searching tools (ScienceDirect, Pub med, and Google Scholar) were conducted from the 1990s until 11 August 2020. These 3 search tools are used because they have a broad scope to access journals. To anticipate journals that are less credible, a journal assessment will be carried out with MMAT. The Author used terms "(sun exposure OR Ultraviolet B OR sun bathing OR tanning) AND (vitamin D deficiency OR 25-*Hydroxyvitamin D*) AND (Overweight OR Obesity OR BMI)" to find related researches. Studies were included if they follow (1) Population were subjects with BMI>25 Kg/m<sup>2</sup>; (2) Sun Bathing or sun exposure intervention; (3) the studies provided the comparison of implementation method (before and after intervention); (4) the studies provided 25-*Hydroxyvitamin D* status as the outcome. For the exclusion criterias: studies that included subjects post-bariatric, kidney disease, liver, metabolic syndromes, and thyroid disease in their population. Though quality of assessment, MMAT (Mixed Method Appraisal Tools) was used for eliminating biased research. The reviewed researches were showed in the result section and the analysis explained later in discussion section. The studies included in the review were restricted to English and Indonesia languages.

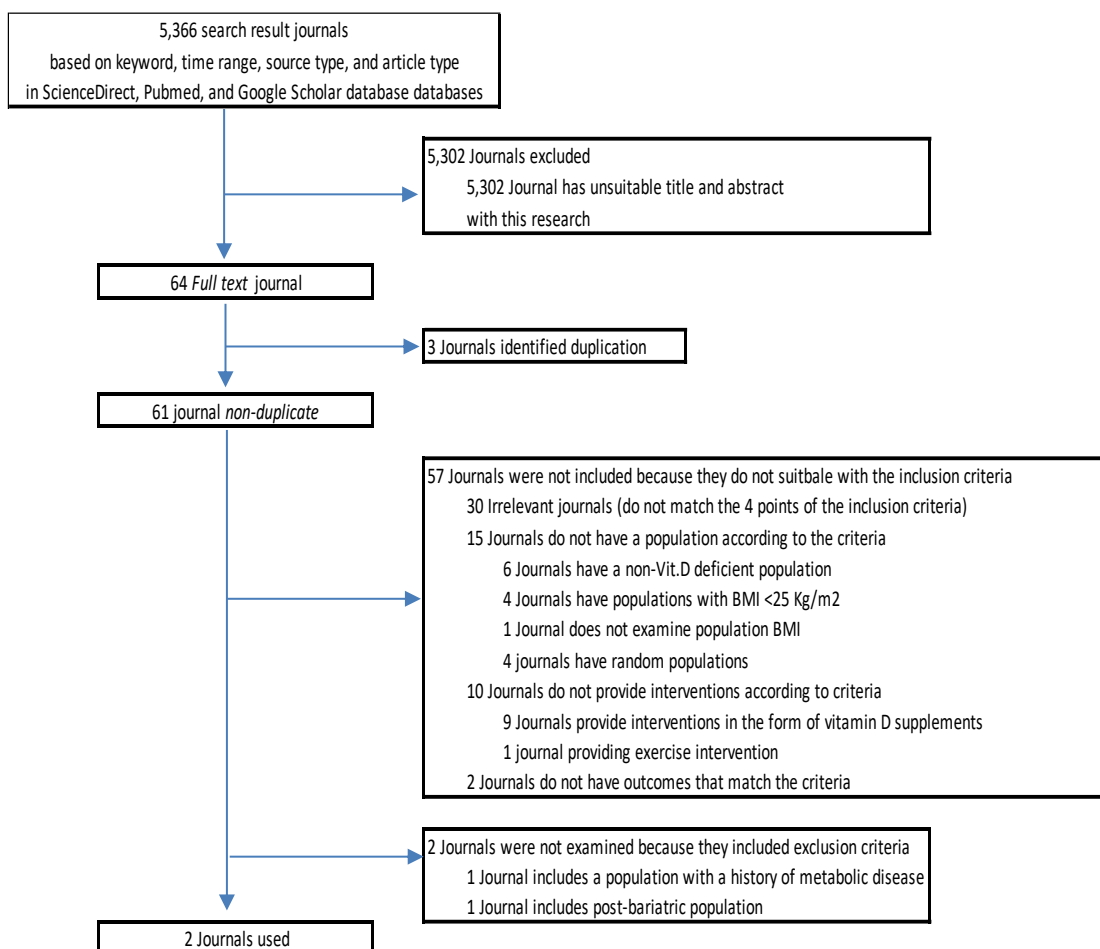
## Result

The first stage, these terms used: "(sun exposure OR Ultraviolet B OR sun bathing OR tanning) AND (vitamin D

deficiency OR 25-Hydroxyvitamin D) AND (Overweight OR Obesity OR BMI)” to find related studies and it showed 5.366 studies. The second stage, 5.302 studies by the title and abstract that no relevant to our research were excluded, so there were only

64 studies left. In Third stage, 3 studies were identified as duplication. In fourth stage, 57 studies based on full reading were not match with the inclusion criterias and 2 studies were exclusion criterias so the result were just 2 studies left.

**Table 1.** The study selection stage



**Discussion**

After reviewed, these 2 studies had examined the effect UVB exposure for the overweight and obese people with vitamin D deficiency. they described the elevation of 25-Hydroxyvitamin D significantly on those subjects. So, these studies contain data and information that can be used to answer the formulation of this research problem. The explanation is below:

*1. The effectiveness of using the “Sun Bathing” method in overweight and obese subjects with vitamin D deficiency*

This literature review studies contain various kinds of subjects in term of age and gender, but still followed inclusion criteria.

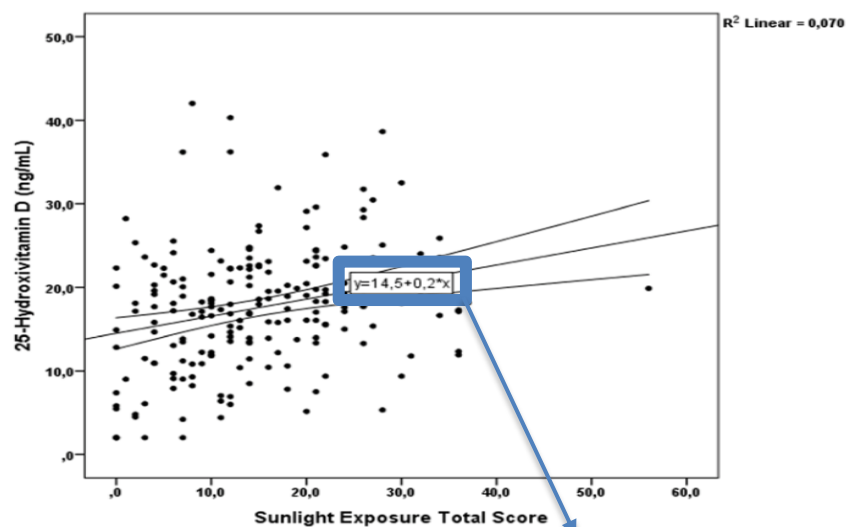
Although each studies used different intervention/ treatments but still these studies showed a correlation between UVB exposure and elevation of 25-Hydroxyvitamin D.

In study that was conducted by Bittar *et al* used 200 individuals that were consisting Caucasian men and women in Sao Paulo, Brazil.<sup>1</sup> Thus studies wanted to find correlation between Total Sun Exposure Score (TSES) and 25-Hydroxyvitamin D levels. The subjects were divided into 4 groups with 50 persons in each group. These divisions were based on age (<50 years old and >50 Years old) and season (summer and winter). After they surveyed the subject, they found 133 persons from 200 persons

(66.5%) with vitamin D deficiency (serum 25-Hydroxyvitamin D lower than 20ng/mL) with the mean serum level in young age was  $18.27 \pm 7.13$  ng/mL and in old age is  $16.93 \pm 7.45$  ng/mL ( $P = 0.29$ ). The mean Body Mass Index from young group was  $26.44 \pm 4.76$  (overweight) and from old age is  $25.85 \pm 3.57$ . The authors used TSES questionnaire which was measured every day for a week (The minimum score is 0 and the maximum score is 56) to check the correlation between dose of UVB serum 25-Hydroxyvitamin D levels. The results of this study showed the TSES mean is  $14.9 \pm 9.58$  (with a maximum value of 28),  $P < 0.001$ . When the authors separated the

groups according to age, the researchers found a strong correlation between TSES values and serum 25-Hydroxyvitamin D elevations in the elderly group but not in the young group even though the TSES values in the younger group had higher TSES values than those in the older group. The Authors said that the questionnaire have a low level of accuracy because the TSES assessment is subjective. Based on the season, it was found that the TSES value in summer was higher than in winter in two groups ( $p = 0.005$ ). The average results of this study are shown in graph 1.1

**Graph 1.1** Graph of the linear formula for serum levels of 25-Hydroxyvitamin D with Total Sun Exposure Score (TSES),  $r = 0.264$  ( $-1 < r < 1$ ),  $P < 0.001$  ( $P < 0.05$ ).



Average TSES =  $14.9 \pm 9.58$ . So the mean of 25-Hydroxyvitamin D is **20.5 ng/mL**

Then in the relationship between TSES and BMI with serum 25-Hydroxyvitamin D there is a significant relationship ( $r=0.297$ ), but it only affects 8.8%. Therefore the study of Bittar *et al* concluded the sun bathing method is associated with increasing of serum 25-Hydroxyvitamin D levels in overweight-obese subjects with vitamin D deficiency.<sup>1</sup> The average results showed that this study had an average serum 25-Hydroxyvitamin D amounting to 20.5 ng/mL (above the threshold value for vitamin D deficiency) with regard to age and climate.

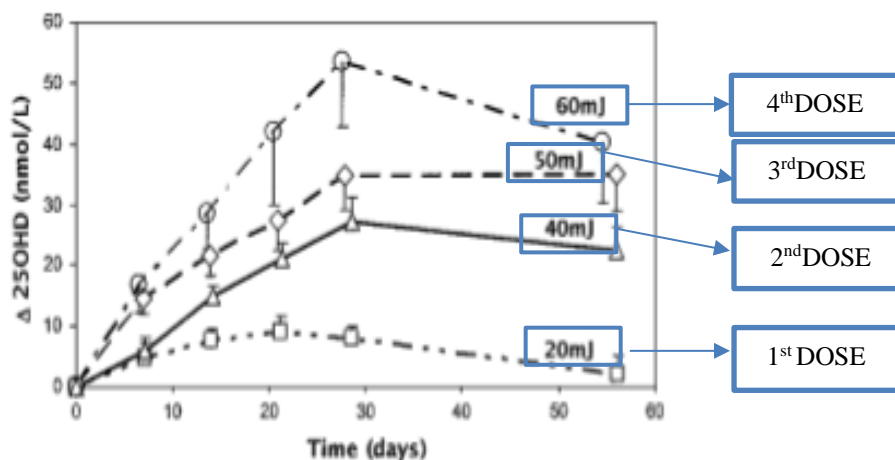
In a study conducted by Duthuluru *et*

*al* (before and after study time series), the subjects were 69 healthy people aged 19 - 49 years.<sup>10</sup> Exclusion criteria for subjects were subjects with granulomatous conditions, liver, kidney, thyroid disease, diabetes, skin cancer, drug consumption (such as anticonvulsants, barbiturates, vitamins, steroids, and others). To get the wanted subject, this study used a screening by questionnaire containing tanning history, self-described skin color, hair color, ethnicity to emphasize skin type according to the Fitzpatrick score. The average BMI of the subjects who participated in this study was  $24.9 \pm 3.6$  kg/m<sup>2</sup> (tend to

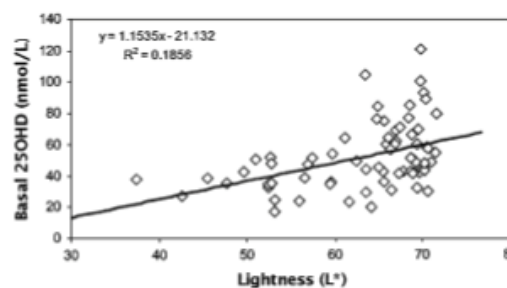
overweight) and serum 25-Hydroxyvitamin D baseline is average of  $20.7 \pm 8.5$  nmol / L (vitamin D deficiency) by using a reverse-phase high performance liquid chromatography. The intervention was given to the subject with range of dose 20-80 mJ/cm<sup>2</sup> 3 times a week and carried out for 4 weeks (with 12 times total treatment) without sunscreen. The Authors also considered the skin color factor so that the sample needed to be treated differently, people with lighter skin were given a UVB dose of 20-40 mJ/cm<sup>2</sup> to avoid complications, whereas people with darker skin were given a UVB dose of 50, 60, and 80 mJ/cm<sup>2</sup> for a response. If this dose is accumulated 12 times (4 weeks), each

subject will receive 240-960 mJ / cm<sup>2</sup> of light exposure. The UVB dosing uses a UVB light tool available at the dermatology division of the medical school in Ohio. The results of this intervention showed a significant increase in serum levels of 25-Hydroxyvitamin D along with the increasing number of UVB doses received by the subject and showed a decrease in 25-Hydroxyvitamin D levels when UVB administration was stopped. In the first 4 weeks (given exposure) there was increasing in serum levels of 25-Hydroxyvitamin D levels while in the next 4 weeks (not given UVB exposure) the results tended to decrease. We can see in Graph 1.2

**Graph 1.2** The relationship between serum 25-Hydroxyvitamin D levels with UVB exposure time along with the dose for 8 weeks (dose adjusted to skin color).



From a study conducted by Duthuluru *et al*, they found that the type of skin color was also one of the factors that influenced serum 25-Hydroxyvitamin D.<sup>10</sup> This was found when checking the baseline relationship of 25-Hydroxyvitamin D with the subject's skin color (L). L is a scale of 0-100 to judge how light a person's skin is (the higher the L number, the lighter the subject's skin). The relationship between 25-Hydroxyvitamin D and L levels can be shown in graph 1.3. Graph 1.3 Relationship between serum 25-Hydroxyvitamin D levels with skin color type (L),  $r = 0.431$ ,  $P < 0.01$ .



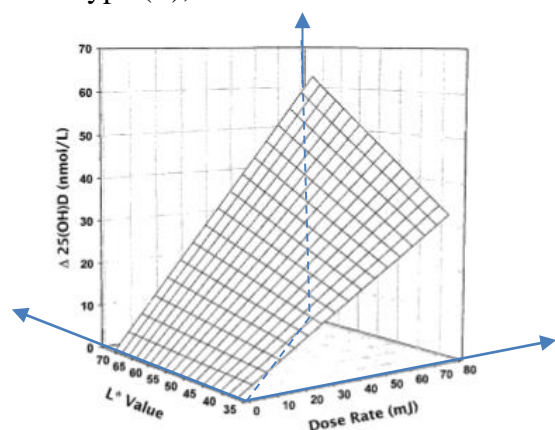
Details of Lightness (L) by race are shown as follows:

1. Northern Europe=70
2. Sub-Saharan African=35
3. African-American=50

In the multiple linear regression analysis there is a close relationship between skin color type, UVB dose, and the increase in serum levels of 25-Hydroxyvitamin D ( $r^2=0.794$ ). This explains that the lighter skin's subjects

color and the higher the UVB dose presented make serum 25-Hydroxyvitamin D level increase significantly in overweight and obese subjects with vitamin D deficiency, we can see at Graph 1.4.

**Graph 1.4** 3D relationship between serum 25-Hydroxyvitamin D, UVB dose, and skin color type (L),  $r=0.794$



Therefore, Duthuluru *et al*'s study finds a strong correlation between the "sun bathing" method and serum levels of 25-Hydroxyvitamin D improvement in overweight and obese subjects with vitamin D deficiency with regard to the subject's skin color as well.<sup>10</sup>

Based on the literature review research that shows that the use of the "sun bathing"/sun exposure method gives positive results increasing serum 25-Hydroxyvitamin D levels in overweight and obese subjects but it is also important to pay attention to internal factors (skin color) and external factors (such as climate, dosage, and duration of exposure) to get an effective result.<sup>10,11</sup>

## 2. Comparison between Studies and Limitation Reviews

The target of this literature review study is to analyze the effect of using the "sun bathing" method on overweight and obese subjects with vitamin D deficiency. Based on studies conducted in several published studies, all subjects with BMI > 25 with vitamin D deficiency after receiving UVB exposure / sun bathing shows a significant increasing of serum 25-Hydroxyvitamin D levels, but in implementing the method, it is necessary to pay attention to internal factors (skin color) and external factors (dose, duration of

exposure, and season) as described above.

There are several limitations in this literature review study. First, research conducted by Bittar *et al* said that the questionnaire has a low-level of accuracy because data collections were subjective.<sup>3</sup> Second, both studies compiled have ambiguous subjects because the authors only wrote down the average BMI, the average serum level of 25-Hydroxyvitamin D, and there were some samples that were not in accordance with the study so there is a possibility of bias. Although these studies have weakness but the number of samples is plentiful so the results obtained are more accurate. Important to have a good quality clinical evaluation to test the effectiveness of the "sun bathing" method in subjects with a BMI > 25 and vitamin D deficiency.<sup>10,11</sup>

## Conclusion

The sun exposure method has a positive correlation to increase serum 25-Hydroxyvitamin D level in overweight and obese subjects with vitamin D deficiency, but internal factors (age and skin color) and external factors (season, temperature, dose, and duration) need to be considered to get effective result.

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