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The effect of skin thickness on vitamin D levels! Where do you measure from?

Cilt kalınlığının vitamin D seviyesi üzerine etkisi! Peki nereden ölçüm?

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ABSTRACT

Objective: Vitamin D is a steroid hormone, about 80-90% of which is produced by the skin. On the other hand, its deficiency is very common and its treatment is of great importance due to its multisystem effects. In addition to factors affecting vitamin D levels such as skin color, sunscreen used, geographical location, and obesity, there are also studies related to the effect of skin thickness. It was aimed to determine the effect of skin thickness and subcutaneous adipose tissue measurements on vitamin D results in the areas where there is the most contact with the sunlight in our body, in the study.

Methods: A total of 116 (71 female, 45 male) volunteers were included in the study. The results of vitamin D in the last month, demographic data, height, and weight were recorded. Skin thickness and subcutaneous adipose tissue measurements performed by ultrasound were recorded from the forehead, cheek, hand dorsum, umbilicus, and trochanter major regions.

Results: The exposure time to the sun (r=0.637, p<0.001), the statistically significant difference between the results of the trochanter major subcutaneous adipose tissue (r=0.347, p<0.001) and subcutaneous adipose

ÖZET

Amaç: Vitamin D yaklaşık %80-90'ı ciltten üretilen bir steroid hormonudur. Eksikliği ise çok sık görülmekte ve multisistemik etkileri nedeni ile tedavisi büyük önem taşımaktadır. Cilt rengi, kullanılan güneş kremi, coğrafi konum, obezite gibi vitamin D seviyesini etkileyen faktörler yanında cilt kalınlığının etkisi ile ilgili de çalışmalar mevcuttur. Çalışmamızdaki amacımız; vücudumuzda güneş ışınları ile temasın en fazla olduğu bölgelerde, cilt kalınlıklarının ve subkutan yağ dokusu ölçümlerinin vitamin D sonuçlarına etkisini belirlemektir.

Yöntem: Çalışmaya toplam 116 (71 kadın, 45 erkek) gönüllü dahil edildi. Son 1 ay içerisindeki serum vitamin D sonuçları, demografik verileri, boy ve kiloları kayıt edildi. Ultrason ile yapılan cilt kalınlığı ve subkutan yağ doku ölçümleri alın, yanak, el dorsum, umbilikus ve trochanter majör bölgelerinden yapılarak kayıt edildi.

Bulgular: Güneşe maruziyet süresi (r=0,637, p<0,001), trochanter majör subkutan yağ dokusu (r=0,347, p<0,001) ve umbilikal bölgenin subkutan yağ dokusu (r=0,022, p=0,020) ve el dorsum cilt kalınlığı

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tissue of the umbilical region (r= 0.022, p=0.020), hand dorsum skin thickness (r= 0.242, p=0.010) and vitamin D level (p<0.05). Statistically, a significant difference was found between the umbilicus skin thickness and vitamin D level (r=0.087, p<0.001).

Conclusion: The question of "whether vitamin D deficiency is pandemic?" is sought worldwide, and the reasons for deficiency are still being studied. The literature on skin thickness has a limited number of studies evaluated by objective data. In particular, the thickness of the hand dorsum skin, and the effect of regional obesity on vitamin D in our study, which reveals the importance of exposure time to sunlight, are remarkable. However, to demonstrate the effects of skin thickness, many areas of our body need to be evaluated.

Key Words: Skin thickness, vitamin D, ultrasound evaluation

(r=0,242, p=0,010) sonuçları ile vitamin D seviyesi arasında istatistiki anlamlı fark bulundu (p<0,05). Umbilikus cilt kalınlığı ile vitamin D seviyesi arasında istatistiki anlamlı fark bulundu (r=0,087, p<0,001).

Sonuç: Dünya çapında, "vitamin D eksikliğinin sebebi pandemi mi?" sorusuna cevap aranırken, eksiklik nedenleri üzerinde çalışmalar devam etmektedir. Cilt kalınlığı ile ilgili literatürde, objektif verilerle değerlendirme yapılan sınırlı sayıda çalışma mevcuttur. Özellikle el dorsum deri kalınlığı, güneş ışığına maruziyet süresinin önemini ortaya çıkaran çalışmamızda, bölgesel obezitenin vitamin D seviyesi üzerine etkisi dikkat çekicidir. Ancak özellikle cilt kalınlığının etkilerini gösterebilmek için vücudumuzda birçok bölgenin değerlendirildiği çok sayıda çalışmaya ihtiyaç vardır.

Anahtar Kelimeler: Cilt kalınlığı, vitamin D, ultrason değerlendirmesi

INTRODUCTION

Why vitamin D? Vitamin D is a steroid hormone that is known to affect many systems in our body. In clinical practice, especially as physicians dealing with the musculoskeletal system, many factors are blamed for the causes of this vitamin deficiency, which is associated with chronic pain and which we have started treating (1, 2).

Vitamin D, which is a prohormone, has two main sources. The endogenous source is produced from the skin after exposure to sunlight, and the exogenous source is a diet supplement. Its main source is that ultraviolet B in the sunlight is absorbed by 7-dehydrocholesterol in both epidermal keratinocytes and plasma membranes of dermal fibroblasts, into previtamin D3, then 1,25-dihydroxycholecalciferol vitamin D3 (calcitriol), which is an active form in our body. An estimated 80-90% of it is due to skin synthesis by sunlight activation, while the rest is provided through supplements or food (3, 4).

This is where the importance of skin in vitamin synthesis occurs. It can also be sorted between skin type, body mass index, gender, vitamin D receptor polymorphism, the latitude of the area experienced, season, use of sunscreen, and other factors affecting vitamin D level (5).

The style of dressing has an important role in them. Clothing choices can cause a decrease in the amount of exposure to sunlight and, as a result, a lack of vitamin D. Considering the cultural, belief structure of our society and the effects of the current geographical region on lifestyle, it becomes important where the measurement of skin thickness should be done in terms of vitamin D synthesis (6).

In studies where the relationship with obesity and vitamin D is assessed as one of the other risk factors, it is stated that the increase in fat tissue affects the

vitamin D synthesis in a negative way, and that there is a reverse ratio between the body mass index and the vitamin D level (7).

In this study, we aim to determine the relationship of exposure time to the sunlight, skin thickness in areas where there is most contact with the sunlight, and subcutaneous adipose tissue measurements with the current vitamin D results and to find the answer to the question of where the effect of skin thickness, which is very few in the literature, on the vitamin level.

MATERIAL and METHOD

This observational study was conducted in a third-line university hospital. 116 volunteers were included in the study. Demographic data, height, and weight of the volunteers were recorded. BMI (body mass index) values were then calculated by dividing the weight by the square of the height. As criteria for inclusion in the study; it was that they were aged 18-80 years and the level of vitamin D in the blood was evaluated within the last one month before the skin ultrasound assessment. The exclusion criteria were to have liver, kidney disease, skin pigmentation, or any skin disease that would affect vitamin D production by affecting the level of keratinocyte, an intestinal disease that would affect vitamin D absorption, and vitamin D supplement in the last three months. The normal range was defined as 30 to 100 ng/ml, insufficient as 20 to 30 ng/ml, deficient as <20 ng/ml, and toxic level as higher than 100 ng/ml (8). The volunteers were divided into three groups according to vitamin D level. Vitamin D levels were classified as group I for those with 30-100 ng/ml, group II for those with 20-30 ng/ml, and group III for those with <20 ng/ml. The study protocol as volunteers of the skin, subcutaneous fat tissue thickness and the thickness measurements, the percent area (1 cm above the glabella), the cheek region (zygomatic bone), back of the hand (dorsi) (the middle point of the metacarpal bones), and 2 cm lateral of umbilicus and the trochanter major through 5-12 MHz linear ultrasound (US) probe (voluson medical systems) according to individuals by adjusting the frequency and depth were measured. Skin (epidermis and dermis), and subcutaneous adipose tissue (distance between dermis and muscle) thickness measurements in the short axis view were performed with the ultrasound device found in our clinic. Vitamin D levels of 25 (OH) were noted from medical records that were looked at in the serum in the last one month. Vitamin D levels were taken in the fall, winter, and spring.

Data normality was assessed with the Shapiro Wilks test, histograms, and q-q plots. The Student's t test and Mann Whitnay U test were used to compare the differences between continuous variables. Correlations among the variables including age, BMI, duration of exposure to sunlight, 25(OH)D levels, regional skin thickness and adipose tissue thickness were analyzed by using Pearson or Spearman correlation analysis. $p<0.05$ was considered as statistically significant. Analyses were conducted using SPSS version 22.

All participants were informed about the study procedure and those who agreed to participate were evaluated further. The study was approved by the Sivas Cumhuriyet University, Faculty of Medicine Clinical Research Ethics Committee (Date: 23.11.2021 and Number: 2021-11/01).

RESULTS

A total of 116 patients, 71 male, and 45 female were included in the study. The mean age of the volunteers was 43.49± 11.93, the duration of sun exposure was 53.23± 59.09 minutes and the BMI was 25.95± 3.02 kg/m^2. Vitamin D levels were 16.52± 11.79 ng/ml. The volunteers were divided into three groups according to vitamin D level. The demographic data of all groups and the averages of BMI, duration of exposure to sunlight, and vitamin D levels are given in Table 1. There was a statistically significant difference between decrease in vitamin D levels and

reduction in exposure to sunlight duration (r=0.637, p<0.001). There was no statistically significant difference between age, BMI, and vitamin D level (p>0.05). Demographic data, duration of sunlight exposure, vitamin D level and mean BMI data are shown in Table 1.

The average forehead skin thickness of all volunteers was 1.15 ± 0.26 mm, adipose tissue 0.11 ± 0.06 mm, cheek skin 1.15 ± 0.32 mm, adipose tissue 0.42 ± 0.23 mm, hand dorsum skin 1.04 ± 0.20 mm, subcutane adipose tissue 0.07 ± 0.03 mm, umbilicus skin 2.25 ± 0.51 mm, adipose tissue 2.85 ± 1.34 cm, the trochanter major skin was 2.00 ± 0.47 mm, the adipose tissue was 2.30 ± 5.68 cm. Subcutaneous

Table 1. Demographic data, duration of sunlight exposure, vitamin D level, and mean BMI data

	Group I n=14 (%12.1)	Group II n=22 (%19)	Group III n=80 (%69)
Gender (W/M)	9/5	11/11	51/29
Age	40.93± 12.39	47.00± 11.55	42.97± 11.90
BMI kg/m^2	25.76± 2.74	26.30± 3.11	25.89± 3.07
Duration of sun exposure (min)	180.00± 80.27	35.23± 16.44	36.00± 22.80
Vitamin D level ng/ml	41.29± 13.30	22.27± 2.96	10.61± 4.19

W; woman, M; man BMI; body mass index, min; minute, mean± standart deviation

Table 2. Statistical data of skin and adipose tissue thickness measurement results

	Group I n=14 (%12.1)	Group II n=22 (%19)	Group III n=80 (%69)	p
Forehead skin thickness (mm)	1.00 (0.20)	1.20 (0.60)	1.10 (0.40)	0.120
Subcutaneous adipose tissue of the forehead (mm)	0.10 (0.08)	0.08 (0.11)	0.08 (0.08)	0.371
Cheek skin thickness (mm)	0.95 (0.20)	0.90 (0.50)	1.10 (0.50)	0.220
Subcutaneous adipose tissue of the cheek (mm)	0.49 (0.29)	0.40 (0.46)	0.38 (0.23)	0.332
Hand dorsum skin thickness (mm)	0.90 (0.00)	1.10 (0.30)	1.00 (0.20)	0.010
Subcutaneous adipose tissue of the dorsum of the hand (mm)	0.06 (0.02)	0.07 (0.04)	0.06 (0.05)	0.100
Umbilicus skin thickness (mm)	2.60 (0.40)	2.40 (1.05)	2.20 (0.48)	<0.001
Subcutaneous adipose tissue of Umbilicus (cm)	2.07 (5.50)	3.28 (3.07)	2.95 (1.28)	0.020
Trochanter major skin thickness (mm)	1.85 (0.65)	2.10 (0.80)	1.90 (0.80)	0.471
Subcutaneous adipose tissue of Trochanter major (cm)	1.56 (4.85)	2.28 (4.18)	2.43 (9.55)	<0.001

Data were presented as median (interquartil range), p<0.05 significant

adipose tissue statistically significant difference between the skin thickness of the hand dorsum and the level of vitamin D (r=0.242). A statistically significant difference was found between the increase in umbilicus adipose tissue (r=0.022) and the increase in trochanter major adipose tissue (r= 0.347) and vitamin D deficiency. A statistically significant difference was found between the umbilicus skin thickness and vitamin D level (r=0.087). The statistical data of skin and fat tissue thicknesses and relation with vitamin D level are given in Table 2.

DISCUSSION

Due to the multi-systemic effects of vitamin D in our body, the deficiency of vitamin D remains an important health problem worldwide, and the question of why the endogenous source is insufficient and what can be done in prophylactic treatment is still being investigated. Skin thickness is listed among these factors, but when we look at the work done, we find conflicting results. One of the connective tissue diseases in which skin thickness is most affected is Scleroderma. In this disease, skin thickness measurement was performed manually in a study that included 38 scleroderma and 38 healthy controls from studies conducted with vitamin D levels, and no statistically significant correlation was found with vitamin D levels (9). In a review in which 40 studies were evaluated, different results were explained regarding the relationship between skin involvement and vitamin D level, but the modified Rodnan skin scoring, which is manually checked, was used in the evaluation of skin thickness (10). Skin and ultrasound studies were done by dermatologists and using high frequency ultrasound, but mostly used in the evaluation and follow-up of skin diseases. No study included scleroderma (11).

There are limited studies in the normal population where the effects of skin thickness on vitamin level are evaluated. According to Ata, et al. (6) in a study conducted by 116 volunteers, the effect on skin thickness and vitamin D levels was investigated. Skin thickness measurements from various parts of the body were found statistically significant between the decrease in the forearm and tibia anterior skin thickness and the lack of vitamins and explained this by the increased exposure to sunlight in these areas. In another study, where the thickness of the hand dorsum skin curve is evaluated with a special device, they found it associated with vitamin D deficiency and an increase in skin thickness (12). In our study, in addition to the umbilicus and trochanter region, we measured the skin thickness of hand dorsum, cheek, and forehead, considering the clothing style and the weather conditions in the geography. We found statistically significant differences between the thickness of the hand dorsum and umbilicus skin and the vitamin D deficiency. The increase in skin thickness in the umbilicus area, which is not affected by the sunlight, has a weak positive relationship with the decrease in vitamin D level, while it is negatively associated with the dorsum of the hand, Ata et al. (6) was correlated with the study data.

Exposure of more than 40% of the skin to sunlight for about 20 minutes is important for the prevention of vitamin D deficiency (13). Many studies have shown that exposure to sunlight has an increasing effect on the level of vitamin D (14, 15). In our study, similar to the studies in the literature, we found that the increase in the duration of exposure to sunlight and the increase in vitamin D levels were statistically significant in the positive direction.

It has been shown that there is a decrease in endogenous vitamin production with increasing age (16). The skin synthesis of vitamin D in elderly people is compromised by many factors, including decreased exposure to sunlight due to reduced mobility and physiological atrophy, and decreased synthesis performance of aging skin (17). However, in our study, there was no statistically significant difference between age and vitamin D levels, and the average age in our study corresponded to the middle age group on the age scale determined by the world health organization.

In studies emphasizing the negative effect of body mass index on vitamin D, volumetric dilution, an increase in fat tissue storage because it is a fat-soluble vitamin, and a decrease in sun exposure as a result of obesity leading to reduced physical activity was listed as the reasons (18). In a study that included 31 obese and 20 normal weight individuals, it was shown that patients with obesity had lower vitamin D levels, which normalized after significant weight loss, as a result of pre-post vitamin D measurements following weight loss and included in a diet program (19). The another study in which adolescent was evaluated in 136 obese and 60 normal-weight, vitamin D deficiency was found to be significantly higher in obese children. In addition, decelerated physical activity, decreased sunlight exposure, and increased time spent with technological devices are listed among the reasons (20). In the study of Ata et al. (6), no significant relationship was found between BMI and vitamin D level, but they found statistical significance between the increase in subcutaneous adipose tissue and decrease in vitamin D level as a result of ultrasound measurement made from the trochanter region. It has been interpreted that regional obesity will cause this (6). In our study, we could not find a significant difference between vitamin D level and BMI, but we found statistical significance between the increase in subcutaneous fat tissue in the umbilical and trochanteric regions and the decrease in vitamin D levels. This result supported the result of Ata et al. (6). In our study, the significant effect of the skin and subcutaneous adipose tissue thickness in various parts of the body of vitamin D levels in healthy volunteers contributes to the limited number of literature data available. At the same time, it has been shown that more comprehensive studies are needed.

In conclusion, vitamin D deficiency is reported in about a third of the world's population (21). At the same time, the answer to the question of whether the lack of this vitamin is a pandemic is being sought (22, 23). There are still many studies on the causes of vitamin D deficiency, which also plays an important role in immunomodulating, cardioprotective, and fighting cancer, and the effect on many other systems has been proven. The importance of multifaceted evaluation such as skin color, clothing style, and geographical region effects is emphasized persistently in its treatment. The effects of clothing style and obesity on vitamin D synthesis have been emphasized in many studies. However, in our study, the effect of skin thickness in closed areas of the body on vitamin D level and the lack of BMI effect, raises questions in the direction of investigating different mechanisms in endogenous production. In our study, it is emphasized that skin thickness has an effect, but more studies are needed to answer the question of how much and to be included in this ranking.

The limitations of the study were that the number of evaluated volunteers was small and the ultrasound device used was not high resolution.

ETHICS COMMITTEE APPROVAL

* The study was approved by the Sivas Cumhuriyet University, Faculty of Medicine Clinical Research Ethics Committee (Date: 23.11.2021 and Number: 2021-11/01).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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