Effect of Vitamin D Supplementation on Body Composition, Depressive Symptoms and Health-Related Quality of Life in Vitamin D Insufficient Healthy Adults

D Vitamini Yetersizliği olan Sağlıklı Erişkinlerde D Vitamini Replasmanının Vücut Kompozisyonu, Depresif Duygudurum ve Sağlık Ilişkili Yaşam Kalitesi Üzerine Etkileri

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ABSTRACT

Objective: Vitamin D deficiency/insufficiency is a high prevalent worldwide health problem in all age groups. Data regarding whether vitamin D insufficiency is associated with any effects on body composition, quality of life and depressive symptoms in healthy adults is limited. Our aim was to evaluate the effects of vitamin D supplementation on body composition, depression and health-related quality of life (HRQoL) in vitamin D insufficient healthy adults.
Methods: Thirty-one vitamin D insufficient (serum level <30 ng/ml) healthy participants were included in the study. Bioelectrical impedance analysis (BIA), handgrip strength, Short Form Health Survey 36 (SF-36) scores and Beck depression inventory (BDI) scale were compared before and after 6 months 25 (OH) vitamin D supplementation.
Results: There was statistically significant improvement in both depression scores (19.0 [13-26] vs 8.0 [3-14], p=0.002) and most of HRQoL scoring components (physical functioning (61.0±22.9 vs 69.0±22.0, p=0.02), vitality (30.0 [23-38] vs 55.0 [40-75], p <0.001), bodily pain (52.0 [35-66] vs 74.0 [59-91], p=0.004), physical role functioning (0.0 [0.0-75.0] vs 75.0 [0.0-100], p=0.001), emotional role functioning (0.0 [0-33] vs 67 [0-100.0], p=0.001), social role functioning (37.0 [23-48] vs 50.0 [35-63], p=0.01) and mental health (44.0 [22-56] vs 64.0 [50-78], p=0.002) after vitamin D supplementation. But there were no significant difference in body composition and handgrip strength before and after vitamin D supplementation (p>0.05).
Conclusion: We found that 6 months vitamin D supplementation had positive effects on depressive symptoms and HRQoL, but it didn't effect body composition and handgrip strength in vitamin D insufficient healthy adults.

Keywords: Vitamin D deficiency, Vitamin D supplementation, Body composition, Depressive symptoms, Quality of life

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ÖZET

Amaç: D vitamini eksikliği/yetersizliği dünya genelinde tüm yaş gruplarını ilgilendiren bir sağlık sorunudur. D vitamini yetersizliğinin sağlıklı yetişkinlerde vücut kompozisyonları, yaşam kalitesi ve depresif duygudurum üzerine etkisini ortaya koyan veriler sınırlıdır. Bu çalışmada amacımız D vitamini replasmanının sağlıklı yetişkinlerde vücut kompozisyonları, sağlık ilişkili yaşam kalitesi ve depresif duygudurum üzerine etkisinin araştırılmasıdır.
Yöntem: Çalışmaya D vitamini yetersizliği olan (serum düzeyi <30 ng/ml) 31 sağlıklı yetişkin dahil edildi. Biyoelektrik impedans analizi (BIA), el kavrama gücü, Kısa Form 36 (SF-36) ve Beck Depresyon Ölçeği (BDI) değerlendirilmeleri 25 (OH) vitamin D replasmanı öncesinde ve 6 aylık replasman sonrasında tekrarlanarak birbirleriyle karşılaştırıldı.
Bulgular: Vitamin D replasmanı sonrasında hem depresif duygudurum ile ilişkili skorlarda (19.0 [13-26] vs 8.0 [3-14], p=0.002) hem de sağlık ilişkili yaşam kalitesi skorlarının büyük bir kısmında (fiziksel fonksiyon (61.0±22.9 vs 69.0±22.0, p=0.02), vitalite (30.0 [23-38] vs 55.0 [40-75], p <0.001), ağrı (52.0 [35-66] vs 74.0 [59-91], p=0.004), fiziksel rol güçlüğü (0.0 [0.0-75.0] vs 75.0 [0.0-100], p=0.001), duygusal rol güçlüğü (0.0 [0-33] vs 67 [0-100.0], p=0.001), sosyal rol güçlüğü (37.0 [23-48] vs 50.0 [35-63], p=0.01) ve mental sağlık (44.0 [22-56] vs 64.0 [50-78], p=0.002) anlamlı düzeyde iyileşme saptandı.
Sonuç: D vitamini yetersizliği olan sağlıklı yetişkinlerde 6 aylık D vitamini replasmanının depresif duygudurum ve sağlık ilişkili yaşam kalitesi üzerinde olumlu etkileri olduğunu, ancak vücut kompozisyonu ve el kavrama gücü üzerinde anlamlı bir etkisi olmadığını saptadık.

Anahtar Sözcükler: D vitamini eksikliği, D vitamini replasmanı, Vücut kompozisyonu, Depresif duygudurum, Yaşam kalitesi

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INTRODUCTION

Vitamin D is a fat soluble vitamin which is responsible for calcium and bone metabolism. Vitamin D is called a 'hormone' because it's synthesized in the human body unlike other vitamins (1). Vitamin D deficiency is a high prevalent worldwide health problem in all age groups. Endocrine Society suggests the diagnosis of vitamin D deficiency as 25(OH) vitamin D levels ≤ 20 ng/ml and vitamin D insufficiency as 21-29 ng/ml (2).

It is well known that vitamin D deficiency is related with osteoporosis and secondary hyperparathyroidism. In addition, there are many studies revealing that it may also be related with dyslipidemia, hypertension, atherosclerotic diseases, insulin resistance, obesity, diabetes mellitus, immune system dysfunction, solid tumors and even some leukemia types (3-5). Even though there are studies linking vitamin D deficiency with obesity, diabetes mellitus and obesity, effect of supplementation on muscle strength, body composition and body mass index is not clear. Additionally, vitamin D deficiency has been suggested to be linked with depression and impaired quality of life in healthy population (6). However, data in healthy adults is limited and results about effect of vitamin D supplementation is contradictory (7-8).

Thus, this study targetted to evaluate the effects of vitamin D supplementation on body composition, muscle strength, depression and health-related quality of life (HRQoL) in vitamin D insufficient healthy adults.

SUBJECTS AND METHOD

Study participants

Thirty-one vitamin D insufficient (serum 25-(OH) vitamin D level <30 ng/ml), otherwise healthy, adult participants between the age of 18-65 years were included in the study. Subjects were recruited from Internal Medicine and Endocrinology and Metabolism outpatient clinics at Gazi University Hospital. Participants were chosen from the subjects who have given blood samples for routine control and who did not have vitamin D supplementation in the last 3 months. Vitamin D insufficient participants who had any chronic diseases, who had pregnancy or in lactation period, or using drugs which might effect vitamin D metabolism were not included in the study. Vitamin D3 (300.000 IU/month) were given to all participants per orally 1-3 times until 25-(OH) vitamin D levels were >30 ng/ml. Then, vitamin D supplementation was continued with 800 IU/day. The study was approved by Gazi University Local Ethics Committee (22.07.2013-67) and all subjects gave informed consent.

Biochemical assessment

Fasting samples for serum calcium (Ca), phosphorus (P) and parathormone (PTH) levels were measured with standard enzymatic-sphectrophotometric method by Olympus AU2700 plus autoanalyzer. Serum 25-(OH) vitamin D level was measured with high performance liquid chromatography (HPLC) method by Agilent 1100 Series autoanalyzer.

Health-related quality of life (HRQoL) assessment

HRQoL was evaluated with the Turkish validated version of Short Form Health Survey 36 (SF-36) questionnaire (9). SF-36 is a generic and multidimensional HRQoL questionnaire which evaluates a person's overall satisfaction with life and health (10,11).

SF-36 consists of two summary scales that aggregate eight sub-scales; 1) Physical component: physical functioning, physical role functioning, bodily pain, general health; 2) Mental component score: vitality, emotional role functioning, social role functioning, mental health. Physical functioning score measures how well a person performs physical activities from basic activities like dressing to most effortful activities. Physical role functioning measures the effect of physical health on problems with work or other daily activities. Bodily pain score measures the intensity of pain and limitations because of pain and assesses the effect of pain on normal work. General health score measures how healthy a person feels and assesses personal evaluation of health. Vitality measures how tired a person feels and the energy level of the respondent. Emotional role functioning score measures the effect of emotional problems on work and other daily activities. Social role functioning score measures the effect of physical and emotional problems on social activities. Mental health score measures the mental state from depression to happiness. The weighed sum of each scale is transformed to range from 0 to 100, of which the person has the worst possible health to best possible health.

Beck depression inventory (BDI)

BDI is a 21 item self-report, measuring the depression symptom severity (12). Higher scores indicate more severe depressive symptoms. The validity and reliability of the Turkish version of BDI was performed by Hisli et al (13).The questionnaires (HRQoL and BDI) were self-administered and all subjects completed them in their clinical visit after they accepted to take part in the study.

Body composition analysis and handgrip strength measurements

Body fat mass and percentage, lean body mass, total body water, waist/hip ratio, intracellular and extracellular water level were measured using the Biospace InBody 720 bioelectrical impedance analyzer (InBody 720 bioelectrical impedance analyzer, Cerritos USA) while the subjects were at the standing position. Using Tanita ViScan device (Tanita Corporation, Illinois USA) the degree of fat mass in the abdominal region was determined in the supine position. This device measures the fat mass in the abdominal region regardless of age, height, body weight variables. Right and left hand grip forces were measured with a hydraulic dynamometer (JAMAR hydraulic hand dynamometer, Sammons Preston USA). All of the measurements were performed in the same session after 8 hours of night-fasting. Subjects were warned about avoiding rigorous physical activity, smoking, using alcohol, stimulants and sedatives at least six hours before the measurements.

Statistical analysis

Statistical analyses were carried out by SPSS (Statistical Package for Social Sciences) for Windows version 21.0. Normality of the data distribution was analyzed with Kolmogorov Smirnov test. If data corresponds normal distribution criteria, parametric tests (Paired t test); if not, non-parametric tests (Wilcoxon Signed Rank Test) were used. If the distribution was parametric, mean±SD; if not, median [minimum-maximum] values were used. P values lower than 0.05 were considered statistically significant.

RESULTS

Twenty (64.5%) of 31 participants were male and 11 (35.5 %) were female and the median age was 28.0 [19-30] years. Twenty five (80.6%) had vitamin D insufficiency and 6 (19.3%) had vitamin D deficiency. Before supplementation, serum 25 -(OH) vitamin D level was 9.0 [5-16] ng/ml and after supplementation it was 39.0 [25-49] ng/ml ($p<0.01$). Serum calcium levels were 9.6 [9.4-9.9] before and 9.5 [9.4-9.8] mg/dl after supplementation ($p>0.05$). Serum PTH levels were 62.7±27.5 before and 32.3±1.3 pg/dl after supplementation ($p<0.001$), (Table 1).

Table 1. Biochemical Parameters Before and After Vitamin D Supplementation

Biochemical Parameters	Before Supplementation	After Supplementation	P Value
25(OH) Vit D (ng/ml)	9.0 [5-16]	39.0 [25-49]	**p<0.001**
Ca (mg/dl)	9.6 [9.4-9.9]	9.5 [9.4-9.8]	p>0.05
P (mg/dl)	3.5 [3.3-3.9]	3.84 [3.62-4.12]	**p=0.012**
ALP (mg/dl)	70.8±19.7	70.1±18.1	p>0.05
Creatinine (mg/dl)	0.7 [0.6-0.8]	0.7 [0.6-0.8]	p>0.05
PTH (pg/ml)	62.7±27.5	32.3±12.3	**p<0.001**

*Ca: Serum calcium level
**P: Serup phosphorus level
***ALP: Alkaline phosphatase
****PTH: Parathormone

There was a statistically significant difference in BDI score before and after vitamin D supplementation (19.0 [13-26] vs 8.0 [3-14], p=0.002), (Table 2). There was improvement in almost all of the SF-36 scoring components with vitamin D supplementation: physical functioning (61.0±22.9 vs 69.0±22.0), (p=0.02); physical role functioning (0.0 [0.0-75.0] vs 75.0 [0.0-100], p=0.001); bodily pain (52.0 [35-66] vs 74.0 [59-91], p=0.004); vitality (30.0 [23-38] vs 55.0 [40-75], p <0.001); emotional role functioning (0.0 [0-33] vs 67 [0-100.0], p=0.001); social role functioning (37.0 [23-48] vs 50.0 [35-63], p=0.01) and mental health (44.0 [22-56] vs 64.0 [50-78], p=0.002); except general health (48.2±15.2 vs 50.8±17.1) (p>0.05), shown in Table 2. But there were no significant difference in body mass index, weight, body fat mass, visceral fat percentage, total body water, waist/hip ratio, lean body mass and handgrip strength before and after vitamin D supplementation (P >0.05 for all results), (Table 3).

Table 2. Parameters of BDI and HRQoL Before and After Vitamin D Supplementation

	Before Supplementation	After Supplementation	P Value
BDI Score	19.0 [13-26]	8.0 [3-14]	**P=0.002**
Physical functioning score	61.0±22.9	69.0±22.0	**P=0.02**
Physical role functioning score	0.0 [0.0-75.0]	75.0 [0.0-100]	**P=0.001**
Bodily pain score	52.0 [35-66]	74.0 [59-91]	**P=0.004**
General health perceptions score	48.2±15.2	50.8±17.1	P>0.05
Vitality score	30.0 [23-38]	55.0 [40-75]	**P<0.001**
Social role functioning score	37.0 [23-48]	50.0 [35-63]	**P=0.01**
Emotional role functioning	0.0 [0-33]	67 [0-100.0]	**P=0.001**
Mental health score	44.0 [22-56]	64.0 [50-78]	**P=0.002**

*BDI: Beck Depression Inventory
**HRQoL:Health-Related Quality of Life
***SF-36:Short Form-36

Table 3. Anthropometric Measurements, Body Composition Analysis and Handgrip Strength

	Before Supplementation	After Supplementation	P Value
Body Mass Index (kg/m²)	26.8±5.3	26.9±5.1	>0.05
Weight (kg)	73.0±14.4	73.3±13.9	>0.05
Body Fat Mass (kg)	24.1±8.6	24.0±8.3	>0.05
Visceral Fat %	35.7±8.1	35.8±8.6	>0.05
Total Body Water (lt)	33.3 [29-39.6]	33.5 [28.5-40.8]	>0.05
Waist/Hip Ratio (cm/cm)	0.9±0.6	0.9±0.7	>0.05
Lean Body Mass (kg)	24.9 [19.9-30.9]	25.1 [19.1-29.5]	>0.05
Handgrip Strength (kg)	25.2 [15.2-32.7]	27.1 [17.1-33.1]	>0.05

DISCUSSION

Vitamin D deficiency is an important health issue all over the world. This situation gets more important with studies questioning if vitamin D is linked with diseases which have high morbidity and mortality rates like diabetes mellitus, coronary artery disease, and even some kind of tumors (3,14-16). There have been few studies regarding whether vitamin D insufficiency is linked with depression in healthy adults. We found that vitamin D supplementation has improved depressive symptoms and HRQoL in vitamin D insufficient healthy adults. Studies evaluating relationship between depression or HRQoL and vitamin D deficiency or supplementation in vitamin D deficient adults don't build consensus about the benefit of vitamin D supplementation (17,18). In a study of Kjærgaard M. et al. (19), with 334 community dwelling men and women, depressive symptoms were found more frequent in participants with lower 25-(OH) vitamin D levels.

But in the same study, there was also no statistically significant improvement in depressive symptoms after high dose vitamin D supplementation. In this trial, study group was chosen from the participants who had mild or no depressive symptoms, which may be the reason of the lack of improvement in depressive symptoms after vitamin D supplementation. On the contrary, Khoraminya N. et al. (20) demonstrated improvement in depressive symptoms of 42 major depressive patients with vitamin D supplementation. A meta-analysis which includes six trials, five of the studies involved adults at risk of depression, and one trial used depressed subjects. The trial showed no effect of vitamin D supplementation on depressive symptoms, but the gender distribution was heterogeneous and quality of evidence was low (21). In this review, subjects of five articles were at risk of depression and only one of the articles were with

depressive subjects, and this could explain why vitamin D supplementation showed no benefit in those participants. We didn't include participants with serious depressive symptoms to our study.

In our trial, we found that our participants' depressive symptoms have improved after vitamin D supplementation. There are trials suggesting that vitamin D supplementation can improve depressive symptoms in overweight and obese adults and elderly population (22,23). But there is insufficient evidence to support the efficacy of Vitamin D supplementation on depression in young healthy adults. Our findings may be in relation with the properties of limited study population. We think that more prospective trials on younger and healthy adults are needed to confirm the clinical significance of our results. In our study, most components of SF-36 HRQoL score improved after vitamin D supplementation. In a study of Ecemiş G.C. and Atmaca A. (24), 80 premenopausal healthy participants were divided in three groups; vitamin D level is normal, deficient, and insufficient. In that study, only physical functioning score were lower in vitamin D insufficient participants than normal and deficient groups, but there was no difference in the rest of the parameters. The results were explained as physicial functioning limitations didn't reflect on any daily life expectations. Also, there was no difference in bodily pain score and general health perceptions even though one of the most frequent symptoms of vitamin D insufficiency is pain, this situation has been underlined with results of low participant number and possible differences in vitamin D supplementation dosing, time or evaluation of pain. Emotional role functioning, social role functioning and mental health scores also had no significant difference between groups and this was explained as with vitamin D deficiency has some effects on physical conditions but may not be related with mental and emotional conditions. In our study, physical functioning, vitality, bodily pain, physical role functioning, emotional role functioning, social role functioning and mental health scores improved but there was no statistically significant change in general health perceptions score after vitamin D supplementation. Bodily pain score shows the effect of the pain we feel in our daily activity, vitality score is a number which shows how energetic we feel. Both these scores to show improvement in our study after vitamin D supplementation may be about generalized body pain and fatigue are most frequent symptoms of vitamin D deficiency and supplementation might have been helpful. Physical role functioning and physical functioning scores show how our health condition effects our daily physical activities for the past 4 weeks and improvement in these scores is thought to be related with betterment of vitality and bodily pain scores. Emotional role functioning means limitation of our daily activities based on our emotional problems, social role functioning shows effect of our health condition on our social state and mental health scoring means how calm and happy you feel and improvement of these scores may be related with less pain and more energetic feel after vitamin D supplementation. Only the parameter which didn't show improvement after vitamin D supplementation was general health perceptions score, and this may be about none of the participants in our study had any chronic diseases and none of them had a treatment for any disease which will effect general health perceptions during the study.

Even though there are studies linking vitamin D deficiency with higher fat mass and obesity, effect of vitamin D supplementation on body composition is unclear. There are only a few studies that have examined the impact of vitamin D supplementation on body composition and the results are indefinite (25,26). Results of our study showed there were no significant difference in body composition before and after vitamin D supplementation, which is consistent with the most of the literature data. On the other hand, a systematic research of randomized controlled trials, performed between 1966 and 2014 showed that vitamin D supplementation has a small positive impact on muscle strength. Additionally, strength outcome measures were significantly improved after vitamin D supplementation in athletes in two different trials (27). Our study didn't show the minimal positive effect mentioned in previous data and there was no change in handgrip strength after vitamin D supplementation. Our study population was healthy mid-aged adults and the number of the subjects were limited, which both may be the reason why our study failed to show any effect of vitamin D supplementation on muscle strength.

Distinctly from other studies about vitamin D deficiency, importance of our study is; it is a prospective clinical trial which shows vitamin D supplementation improves HRQoL and depressive symptoms on healthy adult participants, which is an absence in the literature. The limitation of this study is the number of participants. A prospective study with more participants is needed.

CONCLUSION

We found that vitamin D supplementation has improved depressive symptoms and HRQoL but didn't have an effect on body composition and muscle strength in vitamin D insufficient healthy adults. Our study supports vitamin D deficiency and insufficiency should be in differential diagnosis of patients with non-specific symptoms such as fatigue, pain and low mood. Also larger population-based prospective studies are needed to determine the potential benefit of vitamin D deficiency on depression and HRQoL in healthy adults.

Conflict of interest

No conflict of interest was declared by the authors.

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