



The Effect of 25-OH Vitamin D Levels on Grip Strength in Myofascial Pain Syndrome

Miyofasiyal Ağrı Sendromunda 25-OH Vitamin D Seviyelerinin Kavrama Gücüne Etkisi

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ABSTRACT

Objectives: Vitamin D plays an important regulatory role in skeletal muscle through receptor-dependent pathways, and its deficiency has been associated with several chronic pain disorders. Although handgrip strength is frequently used as a proxy for overall muscular performance, the link between circulating 25-hydroxyvitamin D (25(OH)D) and muscle strength in individuals diagnosed with myofascial pain syndrome (MPS) has not been clearly established. This study investigated whether serum 25(OH)D concentrations are related to handgrip strength in patients with MPS.

Methods: This cross-sectional analysis included 39 individuals meeting the diagnostic criteria for MPS according to Travell and Simons and who had documented serum 25(OH)D values obtained within the previous six months. Participants were stratified into two groups based on vitamin D status: <20 ng/mL (Group 1, n=23) and ≥20 ng/mL (Group 2, n=16). Demographic features, duration of symptoms, body mass index, occupational status, number of trigger points, visual analog scale (VAS) pain scores, and grip strength of both hands were assessed.

Results: The mean 25(OH)D level of the cohort was 18.67±10.99 ng/mL. Dominant-hand and nondominant-hand grip strength averaged 21±9.98 kg and 17.33±9.31 kg, respectively. No significant differences were identified between the two vitamin D groups regarding clinical parameters, trigger point counts, VAS scores, or grip strength (p>0.05). While BMI, VAS score, and vitamin D concentrations showed no association with grip strength, an inverse correlation was observed between grip strength and the number of trigger points (p<0.05).

Conclusion: Serum 25(OH)D concentrations did not appear to influence handgrip strength in individuals with myofascial pain syndrome. Larger-scale, prospective, and interventional research is needed to clarify whether vitamin D supplementation may have a role in improving muscle function or clinical outcomes in this patient population.

Keywords: Hand strength; muscle strength; myofascial pain syndromes; vitamin D; vitamin D deficiency.

ÖZET

Amaç: Vitamin D, reseptör bağımlı yollar aracılığıyla iskelet kaslarında önemli bir düzenleyici rol oynar ve eksikliği çeşitli kronik ağrı bozukluklarıyla ilişkilendirilmiştir. El kavrama gücü, genellikle genel kas performansının bir göstergesi olarak kullanılır, ancak miyofasiyal ağrı sendromu (MPS) tanısı konmuş bireylerde dolaşımdaki 25-hidroksivitamin D (25(OH)D) ile kas gücü arasındaki bağlantı henüz net olarak belirlenmemiştir. Bu çalışma, serum 25(OH)D konsantrasyonlarının MPS hastalarında el kavrama gücü ile ilişkili olup olmadığını araştırmıştır.

Yöntem: Bu kesitsel analiz, Travell ve Simons'a göre MPS tanı kriterlerini karşılayan ve önceki altı ay içinde elde edilen serum 25(OH)D değerleri belgelenmiş 39 kişiyi içermektedir. Katılımcılar, vitamin D durumuna göre iki gruba ayrılmıştır: <20 ng/mL (Grup 1, n=23) ve ≥20 ng/mL (Grup 2, n=16). Demografik özellikler, semptomların süresi, vü-

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cut kitle indeksi, mesleki durum, tetik noktalarının sayısı, görsel analog skala (VAS) ağrı skorları ve her iki elin kavrama gücü değerlendirilmiştir.

Bulgular: Kohortun ortalama 25(OH)D seviyesi $18,67 \pm 10,99$ ng/mL idi. Dominant el ve non-dominant el kavrama gücü sırasıyla ortalama $21 \pm 9,98$ kg ve $17,33 \pm 9,31$ kg idi. İki vitamin D grubu arasında klinik parametreler, tetik nokta sayısı, VAS skorları veya kavrama gücü açısından anlamlı bir fark saptanmadı ($p > 0,05$). BMI, VAS skoru ve vitamin D konsantrasyonları kavrama gücü ile ilişkili bulunmazken, kavrama gücü ile tetik nokta sayısı arasında ters bir korelasyon gözlemlendi ($p < 0,05$).

Sonuç: Serum 25(OH)D konsantrasyonlarının, miyofasiyal ağrı sendromu olan bireylerde el kavrama gücünü etkilediği görülmemiştir. Vitamin D takviyesinin bu hasta popülasyonunda kas fonksiyonunu veya klinik sonuçları iyileştirmede bir rolü olup olmadığını açıklığa kavuşturmak için daha geniş ölçekli, prospektif ve müdahaleli araştırmalar gereklidir.

Anahtar sözcükler: El gücü; kas gücü; miyofasiyal ağrı sendromları; Vitamin D; Vitamin D eksikliği.

Myofascial pain syndrome (MPS) is a persistent or intermittently recurring musculoskeletal disorder characterized by pain and tenderness originating from affected muscles and their surrounding fascia. A hallmark of the condition is the presence of myofascial trigger points (MTrPs)—palpable, hyperirritable nodules situated within taut muscle fibers—that can provoke local discomfort as well as referred pain patterns.^[1] Individuals with MPS may experience limitations in joint mobility, reductions in muscle strength, and accompanying motor or autonomic manifestations.^[2] Numerous intrinsic and extrinsic factors have been proposed to contribute to the development of MPS,^[3] and systemic abnormalities, including nutritional deficiencies and metabolic disturbances, have been increasingly recognized as potential contributors.^[4] Among these, vitamin D insufficiency has received growing attention. Cross-sectional investigations suggest that a substantial proportion of patients with MPS present with low serum vitamin D levels,^[5] which may interfere with normal muscle function and facilitate the persistence of MTrPs.^[6]

MPS is frequently implicated in otherwise unexplained pain conditions affecting the cervical, shoulder, thoracic, and lumbar regions, and may also involve less common sites such as the pelvic girdle, abdomen, or chest wall. The contractile dysfunction induced by taut muscle bands can lead to muscle shortening and strength reduction even in the absence of observable muscle atrophy.^[7] Handgrip strength, although dependent primarily on upper-extremity musculature, is widely regarded as a reliable estimate of general muscle strength and overall physical performance.^[8,9]

Growing interest has emerged regarding the potential role of vitamin D in muscle health. The biological mechanisms through which vitamin D influences muscular function appear to involve both genomic pathways—affecting muscle cell proliferation and differentiation—and rapid non-genomic signaling mechanisms that regulate calcium dynamics within the muscle cell. Insufficient levels of 25-hy-

droxyvitamin D have been associated with proximal muscle weakness, often described as vitamin D-related myopathy.^[10,11] Several studies among athletes and dancers have suggested that inadequate vitamin D status may compromise muscle strength and performance.^[12,13] Conversely, other research has reported no meaningful association between vitamin D levels and indices of muscle strength or physical capability.^[14,15]

Given these conflicting findings and the paucity of research addressing this question specifically in individuals with MPS, the present study aimed to investigate whether serum 25-hydroxyvitamin D concentrations are associated with handgrip strength in patients diagnosed with myofascial pain syndrome.

Methods

The research protocol received approval from the Scientific Research Ethics Committee of Fatih Sultan Mehmet Training and Research Hospital on January 26, 2023 (Decision No: 2023/16). All study procedures complied with the ethical principles outlined in the Declaration of Helsinki and its later amendments. Written informed consent was obtained from all eligible participants prior to enrollment.

Study Design and Participant Selection

This observational cross-sectional study enrolled 39 individuals who presented to the Physical Therapy and Rehabilitation outpatient clinic of Fatih Sultan Mehmet Training and Research Hospital between February 1 and March 1, 2023, with complaints of neck or upper back pain. To be included, participants had to meet the diagnostic criteria for myofascial pain syndrome (MPS) as defined by Simons and colleagues and have a recorded serum 25-hydroxyvitamin D value obtained within the preceding six months.

The diagnostic framework required the presence of major criteria such as localized or spontaneous pain, typical

patterns of referred pain, a detectable taut band within the muscle, tenderness over myofascial trigger points (MTrPs), and restricted joint motion. Minor criteria consisted of reproduction of the patient's usual pain upon compression of the MTrP, a local twitch response, and symptom relief after stretching or trigger point-targeted treatment.^[7,16]

Participants were excluded if they had fibromyalgia, cervical disc pathology, cervical radiculopathy or myelopathy, were aged 60 years or older, had undergone treatment for MPS within the previous six months, had a history of surgery involving the cervical spine or shoulder region, or had inflammatory, infectious, malignant, or pregnancy-related conditions.

Participants were separated into two groups based on their serum 25(OH)D concentrations:

- Group 1: <20 ng/mL (vitamin D deficient; n=23)
- Group 2: ≥20 ng/mL (vitamin D sufficient/non-deficient; n=16)

Data collected included age, sex, occupation, symptom duration, anthropometric measurements (height, weight, BMI), number of trigger points, pain severity, bilateral grip strength, and serum vitamin D level.

Pain Assessment

Pain intensity was quantified using the Visual Analog Scale (VAS), a 10-cm line where 0 signifies the absence of pain and 10 represents intolerable pain. Participants were asked to place a mark on the scale that best represented their pain at the time of evaluation.^[17]

Grip Strength Evaluation

Handgrip strength was measured using a Jamar hydraulic dynamometer, which is widely regarded as the reference device for assessing grip force because of its established accuracy and reliability. Testing adhered to the standardized protocol endorsed by the American Society of Hand Therapists (ASHT). Participants were seated with the shoulder adducted and neutrally rotated, elbow flexed at a right angle, forearm in neutral orientation, and wrist positioned between 0–30° of extension and 0–15° of ulnar deviation. Each participant completed three consecutive trials, and the mean of these values was used for statistical analysis. Results were recorded in kilograms (kg).^[18,19]

Statistical Analysis

All analyses were conducted using IBM SPSS Statistics version 22. Distributional assumptions were checked with the Kolmogorov–Smirnov and Shapiro–Wilk tests, indicating non-normal distributions. Descriptive statistics were presented as means, standard deviations, medians, ranges, and frequencies where appropriate.

Between-group comparisons for continuous variables were performed using the Mann–Whitney U test, whereas categorical data were evaluated using Fisher's Exact Chi-square test or the Fisher–Freeman–Halton Exact Chi-square test, depending on the number of categories. Associations between continuous variables were assessed using Spearman's rho correlation coefficient. Statistical significance was set at $p < 0.05$.

Results

A total of 39 individuals participated in the study, of whom 36 were female (92.3%) and 3 were male (7.7%). The descriptive features of the sample are summarized in Table 1.

Participants in Group 2 were significantly older than those in Group 1 ($p = 0.050$; $p < 0.05$). No significant group differences were observed for sex, anthropometric variables (height, weight, BMI), educational background, duration of symptoms, number of myofascial trigger points, VAS pain intensity, hand dominance, or grip strength of either the dominant or non-dominant hand (all $p > 0.05$) (Table 2).

Correlation analyses indicated a moderate, statistically significant negative association between the number of trigger points and grip strength on both sides (dominant: $r = -0.380$, $p = 0.017$; non-dominant: $r = -0.393$, $p = 0.013$). In contrast, neither dominant nor non-dominant grip strength showed a significant relationship with serum 25(OH)D concentrations, BMI, or VAS pain scores (all $p > 0.05$) (Table 3; Figs. 1 and 2).

To address the potential confounding influences of age and sex, multivariable linear regression analyses were conducted for each outcome variable. After adjusting for age and sex, 25-OH vitamin D levels were not significantly related to dominant hand grip strength ($\beta = -0.083$, $p = 0.478$), non-dominant hand grip strength ($\beta = -0.099$, $p = 0.287$), VAS pain scores ($\beta = 0.005$, $p = 0.830$), or trigger point count ($\beta = -0.003$, $p = 0.906$). Sex was a very important factor in predicting grip strength in both the dominant ($\beta = 25.791$, $p < 0.001$) and non-dominant hands ($\beta = 27.123$, $p < 0.001$). Males had grip

Table 1. Characteristics of participants

	Min	Max	Mean±SD	Median
Age (year)	16	56	37.87±9.47	38
Height (cm)	150	197	164.08±9.61	162
Weight (kg)	40	120	68.67±15.08	66
BMI (kg/m ²)	16.2	41.8	25.55±5.42	24.4
<30	33	84.6		
≥30	6	15.4		
Gender (n, %)				
Female	36	92.3		
Male	3	7.7		
Education level (n, %)				
Literate	2	5.1		
Primary School	12	30.8		
Secondary School	2	5.1		
High School	8	20.5		
Associate Degree	3	7.7		
University	12	30.8		
Number of trigger points	1	7	3.15±1.83	3
Symptom duration (months)	1	6	3.1±1.8	3
VAS	5	10	7.38±1.6	8
Dominant hand (n, %)				
Right	37	94.9		
Left	2	5.1		
Dominant hand grip strength (kg)	10	55	21±9.98	20
Nondominant hand grip strength (kg)	8	50	17.33±9.31	15
Serum 25 OH D (ng/mL) level	4	58	18.67±10.99	17
<20 (Grup 1)	23	59.0		
>20 (Grup 2)	16	41.0		

SD: Standart deviation; BMI: Body mass index; cm: centimeter; kg: kilogram; m: meter; VAS: Visuel analog scale.

strength that was about 26-27 kg higher than females. The only significant predictor of trigger point count was body mass index (BMI) ($\beta=0.126$, $p=0.032$), with each 1-unit increase in BMI associated with 0.13 additional trigger points. The explanatory power of the models increased substantially when age and sex were included for grip strength outcomes ($R^2=0.476$ for dominant hand, $R^2=0.618$ for non-dominant hand) compared to unadjusted models containing only vitamin D ($R^2=0.005$ and 0.004 , respectively), primarily due to the sex variable. Age showed no significant associations

with any outcome (all $p>0.05$). These findings suggest that the observed lack of association between vitamin D and clinical outcomes is not due to confounding by age or sex.

Discussion

In this study, serum vitamin D concentrations were not associated with either dominant or nondominant handgrip strength, nor with BMI or VAS pain severity. Although most patients with MPS exhibited inadequate vitamin D levels, these deficiencies did not translate into measurable differences in grip performance. The only significant functional relationship identified was a moderate inverse correlation between grip strength and the number of myofascial trigger points, suggesting that a higher burden of MTrPs may contribute to diminished muscle function. To date, no published work has focused specifically on the link between vitamin D status and grip strength in individuals with clinically diagnosed MPS, highlighting the originality and potential importance of the present findings.

Experimental research has long demonstrated that vitamin D engages multiple pathways to regulate skeletal muscle structure and function. Through activation of vitamin D receptors (VDRs) expressed on muscle precursor cells, the hormone participates in genomic processes that support myoblast proliferation, differentiation, and subsequent muscle fiber development. In parallel, vitamin D also exerts rapid, non-genomic effects by modulating intracellular and extracellular calcium balance—an essential component of effective muscle contraction.^[10,11]

Despite these mechanistic foundations, clinical research examining the vitamin D–muscle strength relationship has yielded conflicting results. Several investigations have reported higher grip strength among individuals with adequate 25(OH)D levels, whereas others have been unable to confirm such an association.^[20–23] These inconsistencies likely stem from substantial variation across study samples in demographic factors, baseline physical fitness, dietary habits, sun exposure, and comorbid health conditions.

For instance, Granlund et al.^[24] reported weaker grip performance in vitamin D–deficient immigrant adults aged 25–65 years, and Iolascon et al.^[20] observed similar findings in postmenopausal women. Beaudart et al.^[25] also documented improvements in limb strength following vitamin D supplementation. Conversely, Kim et al.^[26] reported no meaningful relationship in older Asian men and postmenopausal wom-

Table 2. Distribution of characteristic features

	Group 1		Group 2		p
	Min-Max	Mean±SD (median)	Min-Max	Mean±SD (median)	
Age (year)	16-56	35.3±10.81 (36)	33-51	41.56±5.57 (41)	¹ 0.050*
Height (cm)	150-197	164.87±11.49 (162)	150-170	162.94±6.18 (163,5)	¹ 0.886
Weight (kg)	40-102	68.78±14.26 (70)	50-120	68.5±16.67 (64,5)	¹ 0.679
BMI (kg/m ²)	16.2-41.8	25.4±5.38 (24.9)	19-41.5	25.76±5.65 (24.2)	¹ 0.977
Number of trigger points	1-6	2.96±1.77 (2)	1-7	3.44±1.93 (3.5)	0.459
Symptom duration (months)	1-6	3.09±1.86 (3)	1-6	3.13±1.78 (3)	0.907
VAS	5-10	7.52±1.68 (8)	5-10	7.19±1.52 (7)	0.476
Dominant hand grip strength	10-55	22.65±11.15 (20)	10-39	18.63±7.74 (17)	0.228
Nondominant hand grip strength	8-50	19±10.66 (18)	8-30	14.94±6.5 (12)	0.195
	n	%	n	%	
BMI group					
<30	19	82.6	14	87.5	² 1.000
≥30	4	17.4	2	12.5	
Gender					
Female	21	91.3	15	93.8	² 1.000
Male	2	8.7	1	6.3	
Education level					
Literate	2	8.7	0	0	³ 0.683
Primary School	6	26.1	6	37.5	
Secondary School	1	4.3	1	6.2	
High School	6	26.1	2	12.5	
Associate Degree	1	4.3	2	12.5	
University	7	30.4	5	31.3	
Dominant hand					
Right	22	95.7	15	93.8	² 1.000
Left	1	4.3	1	6.3	

¹Mann Whitney U test, ²Fisher's Exact Test, ³Fisher Freeman Halton Exact Test *p≤0.05; SD: Standart deviation; BMI: Body mass index; cm: centimeter; kg: kilogram; m: meter; VAS: Visual analog scale.

en. Wang et al.^[27] found a positive association only in men aged 50 years or older, with no comparable effect in younger adults. Likewise, Güloğlu et al.^[28] detected no correlation in premenopausal women aged 40–50 years. In our study, no correlation was found between vitamin D levels and grip strength. However, the absence of a statistically significant correlation should not be interpreted as an absolute lack of clinical relevance. This is because the relatively small sample size may have led to a risk of Type 2 error (false negatives).

These divergent outcomes underscore the challenges of isolating vitamin D's contribution to muscle performance. Li et al.^[29] proposed that muscle-related effects may depend

more directly on circulating 1,25-dihydroxyvitamin D—the hormonally active metabolite—rather than on 25(OH)D concentrations alone. Given that 1,25(OH)₂D plays a direct regulatory role in calcium-handling proteins and VDRs are present in human skeletal muscle, future studies incorporating measurements of both metabolites may offer a more refined understanding of vitamin D–muscle interactions.

Study Limitations

This study has several limitations that should be considered. The relatively small sample size and the fact that the sample consisted mostly of women may affect the applicability of

Table 3. Vitamin D, BMI, trigger point count and VAS correlation with grip strength

		Grip strength	
		Dominant hand	Nondominant hand
Dvit	r	0.012	0.020
	p	0.941	0.903
BMI	r	-0.135	-0.074
	p	0.414	0.652
Number of trigger points	r	-0.380	-0.393
	p	0.017*	0.013*
VAS	r	-0.214	-0.174
	p	0.191	0.291

Spearman's rho korelasyon, *p<0.05; BMI: Body mass index; VAS: Visual analog scale.

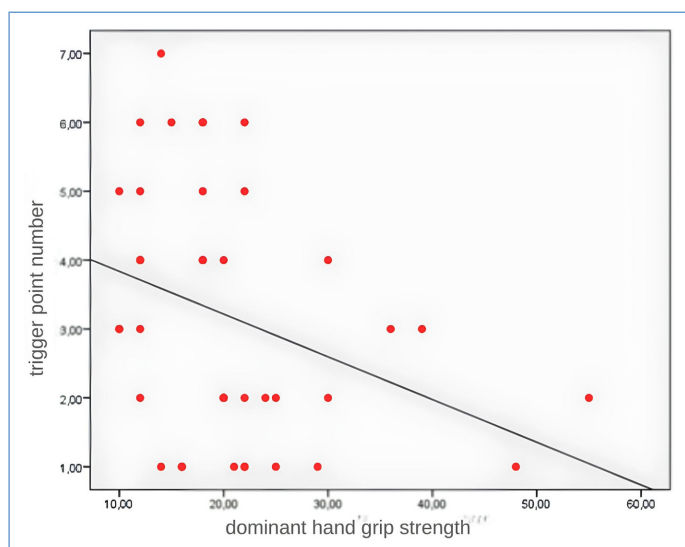


Figure 1. Correlation between dominant hand grip strength and number of trigger points.

the findings to men and broader populations. Additionally, there was an age difference between the two vitamin D groups, and age is a known determinant of muscle strength and vitamin D metabolism. Finally, since serum 25(OH)D measurements were obtained over the previous six months rather than on the day of assessment, they may not fully reflect participants' current vitamin D status.

Conclusion

In the present study, serum 25-hydroxyvitamin D concentrations did not demonstrate a measurable effect on handgrip strength among individuals diagnosed with myofascial pain syndrome. Ongoing inconsistencies in the existing literature—largely attrib-

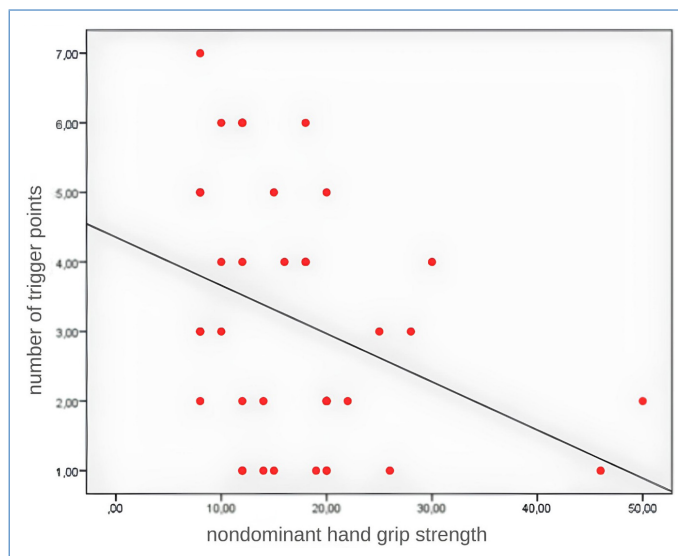


Figure 2. Correlation of trigger point number with nondominant hand grip strength.

utable to methodological differences and heterogeneity across study populations—make it difficult to establish a definitive relationship between vitamin D status and muscle strength. Consequently, well-designed studies with larger sample sizes and more homogeneous patient groups are warranted to better elucidate whether 25-hydroxyvitamin D plays a meaningful role in determining grip strength in this patient population.

Disclosures

Ethics Committee Approval: The study was approved by Fatih Sultan Mehmet Training and Research Hospital Ethics Committee (No: 2023/16, Date: 26.01.2023).

Informed Consent: Written informed consent was obtained from all eligible participants prior to enrollment.

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