



## Evaluation of the Knowledge, Attitudes and Behaviors of Family Physicians Regarding Vitamin D Deficiency and Osteomalacia

*D Vitamini Eksikliği ve Osteomalazi Hakkında Aile Hekimlerinin Bilgi, Tutum ve Davranışlarının Değerlendirilmesi*

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### Abstract

**Objective:** Vitamin D acts as a hormone in many systems in the body, especially in the context of bone health. Osteomalacia is a condition characterized by widespread muscle and bone pain and is associated with vitamin D deficiency in most patients. The aim of this study was to evaluate the knowledge, attitudes and treatment approaches of family physicians in Türkiye regarding vitamin D deficiency and osteomalacia.

**Materials and Methods:** A total of 202 family physicians were included in our descriptive and cross-sectional study. A questionnaire form prepared by reviewing the literature and using Google forms was used to collect the data. The questionnaire included a total of 37 questions.

**Results:** Approximately three-quarters of the physicians who participated in the study stated that they frequently encountered vitamin D deficiency in outpatient clinics and that vitamin D levels should be checked in family health centers. With respect to their awareness of osteomalacia, there was a statistically significant greater awareness in favor of family medicine specialists and more experienced physicians ( $p<0.001$ ). When the results regarding the participants' level of self-efficacy in the management of vitamin D deficiency were analyzed, family medicine specialists felt more competent than general practitioner family physicians did. When asked about postgraduate education related to vitamin D deficiency and osteomalacia, 87.6% of the physicians stated that they had not received any education.

**Conclusion:** There are differences in the approaches used to treat vitamin D deficiency and osteomalacia between specialists and general practitioners working as family physicians in Türkiye and a standardized approach has not yet been established. Postgraduate education sessions should be an indispensable part of continuous medical education to refresh and update the knowledge of physicians.

**Keywords:** Family physicians, vitamin D, osteomalacia

### Öz

**Amaç:** D vitamini kemik sağlığında başta olmak üzere vücutta birçok sistem üzerinde bir hormon görevi görmektedir. Osteomalazi yaygın kas ve kemik ağrısı ile seyreden ve hastaların birçoğunda D vitamini eksikliğine bağlı gelişen bir durumdur. Bu çalışmanın amacı, Türkiye'deki aile hekimlerinin D vitamini eksikliği ve osteomalazi hakkındaki bilgilerini, tutumlarını ve tedavi yaklaşımlarını değerlendirmektir.

**Gereç ve Yöntem:** Tanımlayıcı ve kesitsel tipte yürütülen çalışmamıza toplam 202 aile hekimi dahil edildi. Çalışmada veri toplamak amacıyla literatür taranarak Google forms aracılığıyla hazırlanan anket formu kullanıldı. Anket, toplam 37 soru içermektedir.

**Bulgular:** Çalışmaya katılan hekimlerin yaklaşık dörtte üçü poliklinikte D vitamini eksikliği ile sık karşılaştıklarını ve aile sağlığı merkezlerinde D vitamini düzeyi bakılması gerektiğini belirtti. Osteomalazi konusunda farkındalıklarına bakıldığında aile hekimliği uzmanları ve daha tecrübeli hekimler lehine istatistiksel olarak anlamlı daha yüksek farkındalık mevcuttu ( $p<0,001$ ). Katılımcıların D vitamini eksikliği yönetiminde kendi yeterlilik seviyelerine ilişkin sonuçlar incelendiğinde aile hekimliği uzmanları pratisyen aile hekimlerine göre kendilerini daha yeterli hissediyorlardı. D vitamini eksikliği ve osteomalaziyle alakalı hizmet içi eğitim alma durumları sorgulandığında ise %87,6 hekim eğitim almadığını belirtti.

**Sonuç:** Ülkemizde aile hekimi olarak çalışan uzman hekimler ve pratisyenler arasında D vitamini eksikliği ve osteomalaziye yaklaşımlarında farklılıklar olduğu ve standart bir yaklaşımın henüz yerleşmediğini düşünebiliriz. Doktorların bilgisini tazelemek ve güncellemek adına hizmet içi eğitimler sürekli tıp eğitiminin vazgeçilmez bir parçası olmalıdır.

**Anahtar kelimeler:** Aile hekimi, D vitamini, osteomalazi

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## Introduction

Vitamin D is a steroid hormone that plays an important role in calcium and bone homeostasis as well as in a number of biological processes with pleiotropic effects (1). Recent studies have shown that the vitamin D receptor is present in many tissues. Vitamin D is very important for bone health, cell growth, cancer prevention, immune function enhancement, infection control and prevention, blood pressure control and cardiovascular disease, as many studies have shown, and there is a strong association between vitamin D deficiency and mortality (2). Maintaining optimal levels of vitamin D in the body can prevent the occurrence of many chronic health problems (3). Vitamin D deficiency leads to hypocalcemia, severe hyperparathyroidism and increased bone turnover. This may be associated with osteoporosis and fractures. In prolonged and severe cases, osteomalacia and childhood rickets may occur, resulting in bone pain, myopathy and difficulty walking (4). Osteomalacia is a condition characterized by widespread muscle and bone pain and is associated with vitamin D deficiency in most patients.

Today, the diagnosis, treatment and, more importantly, prevention of vitamin D deficiency are at the forefront of health policies. In addition, knowledge of the risk factors that can lead to vitamin D deficiency and the signs/symptoms and findings that allow early detection of vitamin D deficiency by primary care physicians will enable primary care physicians, who have an important public health responsibility, to better intervene in this issue. The aim of this study was to evaluate the knowledge, attitudes and treatment approaches of family physicians in Türkiye regarding vitamin D deficiency and osteomalacia. With this study, we aimed to draw attention to the relationship between vitamin D deficiency and osteomalacia to identify patients in need of vitamin D supplementation and to ensure that they can be treated with an appropriate and safe dose.

## Materials and Methods

Our study is a descriptive and cross-sectional study. In this study, family medicine specialists and general practitioner family physicians composed the target population. There was no condition other than being a family physician for participation, and physicians of all ages and experiences were consulted. A total of 202 family physicians who voluntarily agreed to participate in the study and completed the questionnaire completely were included in the study.

In this study, a questionnaire form prepared through Google forms were used to collect data. This questionnaire was prepared by 2 family physicians with at least 10 years of field experience in the field on the basis of the literature and their experiences. The questionnaire form prepared for this study was applied to 10 people as a preliminary questionnaire, and necessary corrections were made in line with the results. The questionnaire form was sent to all participants via e-mail. Informed consent was obtained from the participants before they filled out the questionnaire,

indicating that they gave permission to participate in the study. The questionnaire includes 37 questions in total. One question was open-ended, while the other questions provided the participant with options. Some of the questions with options were designed to allow a single response option, whereas others were designed to allow more than one response option at the same time. The questionnaire included a total of 31 questions concerning the sociodemographic characteristics of the participants, their level of knowledge about vitamin D, their attitudes toward vitamin D deficiency, and 6 questions concerning their knowledge and attitudes toward osteomalacia. Approval for the study was granted by Düzce University Non-Invasive Clinical Research Ethics Committee (decision no: 2023/47, date: 20.03.2023).

In addition, necessary permissions were obtained from Düzce Provincial Health Directorate to conduct a survey with physicians working in family health centers (decision no: 213428761, date: 27.04.2023).

## Statistical Analysis

The SPSS version 26 package program was used for statistical analysis to evaluate the findings obtained in the study. By examining similar studies, the sample size was calculated considering Type I error (0.05) and targeted power (0.80), and it was concluded that at least 196 people should be surveyed (5). Descriptive statistical methods (minimum, maximum, mean, standard deviation, percentage value) were used to evaluate the study data. Difference analyses were applied to the variables. For the selection of the appropriate difference analysis, the compatibility of the variables with a normal distribution was examined visually (histogram and probability graphs) and analytically (Kolmogorov-Smirnov/Shapiro-Wilks tests). Analyses revealed that the variables did not have a normal distribution, so non-parametric test methods were used. The Mann-Whitney U test was used for comparisons between two independent groups, and the Kruskal-Wallis test was used for comparisons involving more than two independent groups. The Pearson chi-square test was used to analyze categorical variables in 2x2 eyes. For more than 2x2 eyes, post hoc analyses were performed with Bonferroni correction. The significance level was set at 95% ( $p < 0.05$ ). Pie and column graphs were used to present the data, which are presented in detail in the tables.

## Results

A total of 202 physicians participated in the study. The mean age of the participants was  $38.66 \pm 7.93$  years (minimum=26, maximum=58). The mean ages of the general practitioner family physicians and family medicine specialists were  $40.29 \pm 8.61$  and  $36.34 \pm 6.19$  years, respectively. Other characteristics of the physicians are given in Table 1. All of the general practitioner family physicians ( $n=119$ , 58.9%) who participated in the study were working in family health centers (FHCs). Among family medicine specialists, 71.1% ( $n=59$ ) were working in FHCs, 12% ( $n=10$ ) were working in community health centers, 8.4% ( $n=7$ ) were working

in university hospitals, 4.8% (n=4) were working in training and research hospitals, and 3.6% (n=3) were working in state hospitals. The participants were questioned about their in-service training related to vitamin D deficiency and osteomalacia. There was a statistically significant difference between the two groups, with 94.1% (n=112) among general practitioners and 78.3% (n=65) among family medicine specialists (p=0.001). However, 95.5% of the physicians (n=193) thought that clinical guidelines would be useful. The participants were asked to determine their own level of competence in the management of vitamin D deficiency by giving a score between 1 and 10. When the results were analyzed, significant difference was found between the groups (p=0.002). There was no statistically significant difference between the groups in terms of years of occupation (Table 2).

The participants were asked questions to measure their level of knowledge about vitamin D and its deficiency. Some of these questions were multiple-choice questions, and participants were allowed to mark more than one option.

The participants were asked about the body systems/organs that are most affected and important by vitamin D, allowing them to select more than one option. A total of 98.5% (n=199) of the physicians selected the bone system, and 93.6% (n=189) selected the immune system as important (Table 3). The participants were asked about signs/symptoms that may be associated with vitamin D deficiency. The most common response was fatigue (n=191, 94.6%), and the least common response was gait disturbance (n=138, 68.3%). When the risk factors for vitamin D deficiency were examined according to the

participants, the most common answers were indoor lifestyle (n=194, 96%) and old age (n=179, 88.6), whereas the least common answers were dark skin color (n=89, 44.1%) and genetics (n=93, 46%). The laboratory parameters requested by the participants in addition to serum 25(OH)D levels when they suspected vitamin D deficiency are shown in Table 3.

When the attitudes of the physicians participating in the study toward the propositions related to vitamin D sources were examined, no significant difference was found between family medicine specialists and general practitioner family physicians. Notably, approximately half of the participants' answers to the proposition "Using sunscreen prevents vitamin D synthesis from the skin" were correct. The physicians who participated in the study were asked whether they could check 25(OH)D levels at the institution where they worked, and 95.5% of them stated that they could not. All 9 participants who could check 25(OH)D levels were family medicine specialists. None of the physicians working in an FHC could check 25(OH)D levels. Physicians were also asked "Is it necessary to check 25(OH)D levels at the FHC?". A total of 72.3% (n=146) answered that it was necessary. There was a significant difference between specialist (n=53, 63.9%) and general practitioner family physicians (n=48, 40.3%), who correctly answered the statement "Community screening should be done for vitamin D deficiency" (p=0.004). The frequency of encountering vitamin D deficiency in the outpatient clinic was questioned, and family medicine specialists stated that they encountered vitamin D deficiency significantly more frequently than general practitioner family physicians (p=0.019).

When the 25(OH)D levels at which the participants considered vitamin D deficiency were analyzed, 77.1% of the family medicine specialists and 65.6% of the family practitioners stated that the level was <30 ng/mL. Remarkably, 25.2% of the general practitioner family physicians considered vitamin D deficiency to be less than 10 ng/mL (Figure 1).

All of the physicians who participated in the study recommended vitamin D to adults who were found to be deficient. Details are given in Table 4.

When evaluated according to the participants' years of experience, the proportion of physicians who recommended vitamin D supplementation to healthy adults decreased with increasing experience.

**Table 1. Socio-demographic data of the participants**

		n	%
<b>Gender</b>	Woman	99	49
	Male	103	51
<b>Title</b>	Practitioner	119	58.9
	Expert	83	41.1
<b>Profession year</b>	<5 years	27	13.4
	5-10 years	63	31.2
	10-20 years	69	34.2
	>20 years	43	21.3

**Table 2. Data on participants' level of self-efficacy in the management of vitamin D deficiency**

			n	Average	p
On a scale of 0 to 10, how would you rate your own level of competence in the management of vitamin D deficiency?		Practitioner	119	6.43±1.505	<b>0.004*</b>
	Employment status	Expert	83	7.13±1.716	
		<5 years	27	6.70±1.489	
	Year of profession	5-10 years	63	6.70±1.672	<b>0.995**</b>
		10-20 years	69	6.74±1.559	
>20 years		43	6.72±1.804		

\*: The Mann-Whitney U test, \*\*: Kruskal-Wallis test

When the dose of vitamin D supplementation recommended by the participants for healthy adults was analyzed, 36.6% stated that they used 600 IU/day, which is a correct approach (Figure 2). When the loading dose preferences of the participants in the treatment of vitamin D deficiency were analyzed, 31.2% stated that they used 50000 IU/week, which is a correct approach. A total of 24.7% of the participants stated that they used a dose of 20000 IU/week. In addition, 31.2% of the participants stated that they did not use a loading dose.

When the maintenance dose preferences of the participants in the treatment of vitamin D deficiency were analyzed, 43.6% stated that they used 2000 IU/day (Figure 3).

In our study, the percentage of physicians who accepted a 25(OH)D level less than 20 as deficient and stated that they administered a loading dose of 50000 IU/week was 14.9% of all physicians. In our study, the percentage of physicians who accepted a 25(OH)D level <20 as deficient and stated that they administered a 2000 IU/day maintenance dose was 24.8%

of all physicians. When the 25(OH)D levels determined as the treatment target by the physicians participating in our study were analyzed, 54.2% (n=45) of family medicine specialists and 57.1% (n=68) of family practitioners considered the level of 30-50 ng/mL to be appropriate. In the treatment of vitamin D deficiency, 44.6% (n=90) preferred oral drops, 37.6% (n=76) preferred oral capsules, 16.3% (n=33) preferred oral tablets, and 1.5% (n=3) preferred oral ampoules. Family practitioners preferred the oral drop form the most (47.9%, n=57), whereas family medicine specialists preferred the oral capsule form the most (50.6%, n=42).

A significant difference was found between family medicine specialists (n=66, 79.5%) and general practitioners (n=76, 63.9%) when the participants' responses to the statement "Osteomalacia rather than osteoporosis should be considered in patients with diffuse bone and joint pain, bone tenderness, muscle weakness and difficulty walking" were analyzed (p=0.044). The percentage of correct answers to the statement "Initial bone mineral density should be requested to support the diagnosis in a patient with suspected osteomalacia" was 35% for family medicine specialists (n=29) and 13.4% for general practitioners (n=16), and a significant difference was found between the groups (p<0.001). All the physicians provided correct answers to the statements "Vitamin D deficiency is the most common cause of osteomalacia" and "Vitamin D and calcium treatment is effective in most patients with osteomalacia" (Table 5).

When the physicians who participated in the study were evaluated according to their years of experience, a statistically significant difference was found between the correct responses of those with 20 years or more of experience to the statements in Table 6 and those with other years of experience (p=0.001). The participants were asked about the laboratory findings observed in the osteomalacia by allowing them to mark more than one option. Low 25(OH)D levels and low serum calcium levels were detected at high rates.

## Discussion

In the literature, studies have examined the level of vitamin D knowledge of family physicians and whether they make supplements (5-7). However, only one study has examined the attitudes of general practitioners about vitamin D deficiency and vitamin D supplementation in Türkiye (8). This study was conducted before the transition to the family medicine system in Türkiye; it included only general practitioners and focused on their knowledge of rickets. To the best of our knowledge, no study has evaluated the knowledge, attitudes and practices of family physicians in Türkiye regarding vitamin D deficiency, supplementation and osteomalacia.

A review of the literature revealed that 77% of participants in an Australian study and 54% in a New Zealand study were confident in their knowledge of vitamin D (9,10). In our study, participants were asked to determine their own level of competence in the management of vitamin D deficiency. As a result, the mean

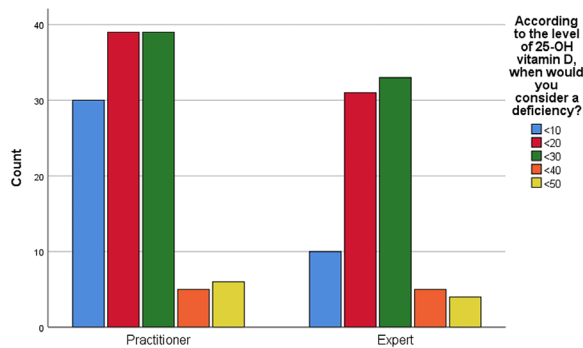
**Table 3. Participants' responses to questions about vitamin D**

<b>Distribution of participants' answers to the question "for which is vitamin D important"</b>		
	<b>n</b>	<b>%</b>
Bone	199	98.5
Muscle	164	81.2
Cardiovascular system	145	71.8
Immune system	189	93.6
Brain	126	62.4
Skin	144	71.3
<b>Distribution of participants' answers to the question on laboratory tests to be ordered in vitamin D deficiency</b>		
	<b>n</b>	<b>%</b>
Hemogram	75	37.1
Creatinin	95	47
Ure	83	41.1
ALT	76	37.6
AST	73	36.1
GGT	34	16.8
ALP	85	42.1
Magnesium	80	39.6
Calcium	169	83.7
Phosphor	127	62.9
Albumin	40	19.8
TSH	93	46
T4	61	30.2
Parathormon	172	85.1
Calcitonin	136	67.3

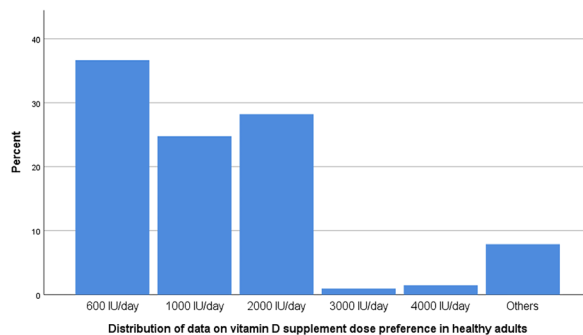
ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, GGT: Gamma-glutamyl transferase, ALP: Alkaline phosphatase, TSH: Thyroid-stimulating hormone

**Table 4. Clinical approaches of physicians to patients admitted to the outpatient clinic regarding vitamin D according to employment status**

		Expert		Practitioner		p
		n	%	n	%	
Do you recommend vitamin D supplements to patients who apply to your outpatient clinic?	Always	23	27.7	14	11.8	0.005
	Frequently	43	51.8	63	52.9	
	Occasionally	17	20.5	42	35.3	
In which cases do you recommend vitamin D supplementation to patients who apply to your outpatient clinic?	Most of the patients	58	<b>69.9</b>	55	<b>46.2</b>	0.004
	Only those diagnosed with a deficiency	18	21.7	45	37.8	
	Only in fall and winter	7	8.4	19	16	
Do you recommend vitamin D supplements for healthy adults?	Yes	69	<b>83.1</b>	72	<b>60.5</b>	0.001
	No	14	16.9	47	39.5	
Would you recommend vitamin D supplements for adults diagnosed with a deficiency?	Yes	83	<b>100</b>	119	<b>100</b>	<0.001
	No	0	0	0	0	
Do you recommend vitamin D supplementation for pregnant women and breastfeeding mothers?	Yes	83	<b>100</b>	110	<b>92.4</b>	<0.001
	No	0	0	9	7.6	



**Figure 1.** Distribution of 25(OH)D levels of participants' perceived vitamin D deficiency according to employment status



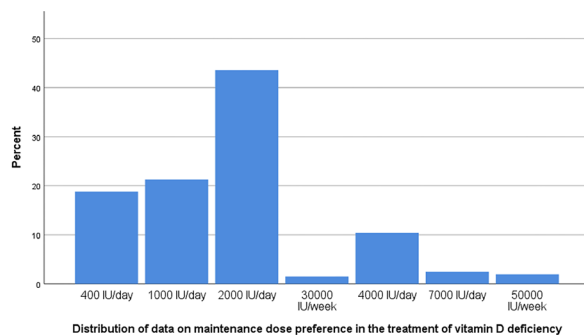
**Figure 2.** Distribution of data on vitamin D supplement dose preference in healthy adults

score of the physicians was 6.7/10, and a statistically significant difference was found between general practitioner family physicians and family medicine specialists (p=0.002). Moreover, a significant difference was found in favor of family medicine specialists among physicians who stated that they received in-

service training (p=0.001). This is consistent with the rates of correct answers given between the groups when evaluating the clinical approach to vitamin D and its deficiency in our study. Research shows that sunlight is the most important source of vitamin D. On the other hand, there is evidence that prolonged exposure to the sun does not increase vitamin D production in the long term (11,12). According to a study of 2.000 adults conducted by the National Osteoporosis Society in the United Kingdom, only 35% of respondents knew that vitamin D was essential for healthy life and bones. Almost a quarter of those surveyed did not know why they needed vitamin D, and only 6% knew that going outside without sunscreen helped them make better use of sunlight (13). Doctors may disagree on the advisability of sun exposure. This is because overexposure to ultraviolet (UV) radiation is a major risk factor for skin diseases and skin cancer. The American Academy of Dermatology recommends the use of skin protection, including sunscreens, during sun exposure (14). On the other hand, increasing evidence suggests that inadequate exposure to UV radiation is also associated with general health risks and decreases life expectancy (15). Therefore, up-to-date and accurate knowledge of physicians on this subject will be more important in terms of approaching patients and making the right recommendations. In our study, three-quarters of the physicians supported that nutrients are insufficient as a source of vitamin D and that sunlight is the most important source for vitamin D synthesis, whereas approximately half of the physicians reported that sunscreen inhibits vitamin D synthesis from the skin. This may cause physicians' recommendation of vitamin D supplementation to be insufficient, especially in the summer months. Vitamin D, which is primarily responsible for bone health, is also known to play an important role in modulating the immune system. Many studies have examined the effect of vitamin D on

the course of the disease, both in the prophylaxis and treatment of coronavirus disease-2019 infection, and positive effects have been observed (16). Some researchers have reported that vitamin D supplementation is effective in reducing the risk of viral infections (17). In our study, the physicians stated that the immune system is the second most important system affected by vitamin D and that they are highly aware of this issue. The most important cause of vitamin D deficiency is insufficient exposure to the sun (18). The physicians who participated in our study identified indoor dwellers and elderly people as the most common causes of vitamin D deficiency, as indicated in the literature.

According to previous studies, dark skin color is also a major risk factor for vitamin D deficiency, and compared with light-skinned individuals, dark-skinned individuals produce less vitamin D when exposed to the same amount of sunlight (11). In our study, similar to other studies in the literature, the dark skin color was marked at a low rate (9,19). Patients with chronic renal failure



**Figure 3.** Distribution of data on maintenance dose preference in the treatment of vitamin D deficiency

were also highly flagged by respondents. The development of chronic renal failure is associated with a progressive decrease in vitamin 1.25(OH)D production. Low 25(OH)D levels are observed in all stages of chronic renal failure (20).

Since vitamin D deficiency can lead to serious changes in body homeostasis, it should not be overlooked during physician control and should be acted upon each time. In our country, serum 25(OH)D levels cannot be measured in FHCs. Among the physicians who participated in the study, 72.3% stated that vitamin D levels should be checked in FHCs. On the other hand, the cost-effective strategy of many clinicians is to opt for vitamin D supplementation without routine testing on the basis of symptoms (21). In our study, three-quarters of the physicians who stated that they could not measure serum 25(OH)D levels stated that they frequently recommended supplements in the outpatient setting.

The participants were questioned about their 25(OH)D levels, which they considered vitamin D deficiency. When the results were analyzed, 77.1% of family medicine specialists and 65.6% of general practitioner family physicians stated that they considered vitamin D deficiency to be less than 30 ng/mL. Remarkably, in our study, 25.2% of the general practitioner family physicians considered vitamin D deficiency to be less than 10 ng/mL. This may be due to the lack of current knowledge of the physicians who participated in our study because they could not routinely check vitamin D levels.

In cases of severe vitamin D deficiency, laboratory tests [such as calcium, phosphorus, alkaline phosphatase (ALP) and parathyroid hormone]), which are also included in the diagnostic criteria for osteomalacia, may be ordered. Calcium was requested at a high rate, whereas ALP and phosphorus were preferred at a low rate in the responses to the question we asked to the participants

**Table 5. Attitudes of physicians toward propositions related to osteomalacia according to employment status**

		Expert		Practitioner		p
		n	%	n	%	
<b>In a patient with diffuse bone and joint pain, bone tenderness, muscle weakness and difficulty walking, osteomalacia should be considered rather than osteoporosis.</b>	I agree	66	79.5	76	63.9	<b>0.044</b>
	No opinion	8	9.6	25	21	
	Disagree	9	10.8	18	15.1	
<b>Vitamin D deficiency is the most common cause of osteomalacia.</b>	I agree	71	85.5	101	84.9	0.999
	No opinion	10	12	15	12.6	
	Disagree	2	2.4	3	2.5	
<b>In a patient with osteomalacia, initial bone mineral density should be ordered to support the diagnosis.</b>	I agree	44	53	71	59.7	<b>&lt;0.001</b>
	No opinion	10	12	32	26.9	
	Disagree	29	35	16	13.4	
<b>Osteomalacia is an incurable disease once it has developed.</b>	I agree	6	7.2	11	9.2	0.366
	No opinion	13	15.7	27	22.7	
	Disagree	64	77.1	81	68.1	
<b>In osteomalacia, vitamin D and calcium treatment is effective in most patients.</b>	I agree	78	94	106	89.1	0.516
	No opinion	4	4.8	11	9.2	
	Disagree	1	1.2	2	1.7	

Table 6. Attitudes of physicians toward propositions related to osteomalacia according to years of occupation										
Profession year		<5		5-10		10-20		>20		p
		n	%	n	%	n	%	n	%	
<b>In a patient with diffuse bone and joint pain, bone tenderness, muscle weakness and difficulty walking, osteomalacia should be considered rather than osteoporosis.</b>	I agree	18	<b>66.7</b>	44	<b>69.8</b>	41	<b>59.4</b>	39	90.7	<b>0.001</b>
	No opinion	2	7.4	8	12.7	19	27.5	4	9.3	
	Disagree	7	25.9	11	17.5	9	13.1	0	0	
<b>Vitamin D deficiency is the most common cause of osteomalacia.</b>	I agree	19	<b>70.4</b>	50	<b>79.4</b>	61	<b>88.4</b>	42	<b>97.7</b>	<b>0.015</b>
	No opinion	6	22.2	12	19	6	8.7	1	2.3	
	Disagree	2	7.4	1	1.6	2	2.9	0	0	
<b>In a patient with osteomalacia, initial bone mineral density should be ordered to support the diagnosis.</b>	I agree	12	44.4	34	54	41	59.4	28	65.1	0.194
	No opinion	5	18.5	11	17.5	17	24.6	9	20.9	
	Disagree	10	<b>37</b>	18	<b>28.6</b>	11	<b>15.9</b>	6	<b>14</b>	
<b>Osteomalacia is an incurable disease once it has developed.</b>	I agree	1	3.7	7	11.1	4	5.8	5	11.6	0.603
	No opinion	4	14.8	10	15.9	17	24.6	9	20.9	
	Disagree	22	<b>81.5</b>	46	<b>73</b>	48	<b>69.6</b>	29	<b>67.4</b>	
<b>In osteomalacia, vitamin D and calcium treatment is effective in most patients.</b>	I agree	25	<b>92.6</b>	58	<b>92.1</b>	60	<b>87</b>	41	<b>95.3</b>	0.588
	No opinion	2	7.4	4	6.3	7	10.1	2	4.7	
	Disagree	0	0	1	1.6	2	2.9	0	0	

on this subject. In our study, the answers to the questions asked about laboratory diagnostic criteria in patients with osteomalacia also confirmed this approach.

A United States study has shown that doctors often do not consider vitamin D deficiency in adult patient management (22). This may be because patients believe that they are exposed to enough sunlight. However, often, especially in older people, they are housebound and do not receive enough sunlight. In addition, vitamin D deficiency often goes unrecognized because the clinical picture is insidious or non-specific. In our study, to measure physicians' awareness of vitamin D deficiency, the frequency of encountering vitamin D deficiency in the outpatient clinic was investigated. Most physicians reported frequent encounters, with family medicine specialists reporting significantly more frequent encounters than general practitioners did.

Patients with vitamin D deficiency often complain of widespread body pain (23). In a study conducted in Türkiye, the prevalence of vitamin D deficiency was found to be 71.7% in patients with widespread body pain (24). Osteomalacia is a condition characterized by widespread muscle and bone pain and is associated with vitamin D deficiency in most patients. In these patients, vitamin D replacement plays an important role in the remission of complaints. Therefore, it is important to consider osteomalacia in patients presenting with diffuse muscle pain and to refer patients for vitamin D level measurement or to start prophylactic treatment in centers where vitamin D measurement is not available. In our study, a significant difference was found between specialist and general practitioner family physicians (p=0.044) when the participants' responses to the statement "Osteomalacia should be considered rather than osteoporosis in a patient with diffuse bone and joint pain, bone tenderness,

muscle weakness and difficulty walking" were analyzed. This may be because clinical rotations, especially physical medicine and rehabilitation, in family medicine education increase the awareness of physicians about vitamin D deficiency and osteomalacia. We believe that increasing in-service training for physicians, especially supporting general practitioner family physicians on this issue and clinical guidelines that can be created for family physicians on vitamin D deficiency and common related diseases, may help increase the awareness of physicians on this issue.

The treatment goal is to maintain serum 25(OH)D levels at 30-50 ng/mL (25,26). Approximately 50% of the physicians who participated in our study considered 30-50 ng/mL to be an appropriate treatment target. According to the results published by Costa-Fernandes et al. (27), the level of knowledge of healthcare professionals in the United Kingdom on the management of vitamin D deficiency was found to be adequate. According to a previous study, 75% of pediatricians and 65% of general practitioners correctly defined maintenance and treatment doses for vitamin D deficiency. In another study, the general knowledge of prescribing physicians in Khartoum (Sudan) on the treatment of vitamin D deficiency was rated as poor (28). In our study, physicians' knowledge of treatment dosage was also evaluated as inadequate. The loading and maintenance treatment dose preferences of approximately 30% and 40% of the physicians, respectively, were consistent with the literature. In addition, when loading dose preferences were analyzed, 31% of the physicians did not recommend a loading dose. According to these results, the loading dose recommendation rate is low, and those who recommend loading and maintenance have different approaches to the dose amount.

The percentage of physicians who recommended the correct supplement dose for healthy adults was 36%. When evaluated according to the professional years of the participants, the proportion of physicians who recommended vitamin D supplementation to healthy adults decreased with increasing experience. This may be due to the recent increase in developments in vitamin D and the inability of physicians to follow current information sufficiently.

In the treatment of vitamin D deficiency, the most preferred forms of vitamin D by the physicians participating in the study were oral drops and oral capsules. In recent years, oral capsules accounted for an important share of the preferences of physicians in our study. Daily administration is more effective at increasing serum 25(OH)D levels, but weekly administration is often preferred because of its ease of use (29). When evaluated according to years of practice, the preference for capsules over drops increased with decreasing years of practice (younger physicians). Family medicine specialists preferred the capsule form, whereas general practitioner family physicians preferred the drop form. The oral ampoule form, which is less preferred in treatment today, was preferred by only 3 family practitioners.

Vitamin D deficiency is common in women, but during pregnancy, the fetus is even more susceptible to deficiency because of the need for vitamin D for growth and development. Maternal vitamin D stores are the only source of vitamin D for the developing fetus (30). In a study conducted with healthcare professionals in Türkiye, 55.6% of the participants recommended vitamin D supplementation to pregnant women, while the rate of vitamin D supplementation recommended by family medicine specialists (66.7%) was higher than that recommended by other groups (31). In our study, 95.5% of the participants stated that they recommended vitamin D supplementation to pregnant women and breastfeeding mothers. This result suggests that the awareness of physicians about vitamin D supplementation for pregnant women has increased in recent years.

### Study Limitations

The small sample size is the most important limitation of our study. Another limitation of our study is that the guideline data on vitamin D and osteomalacia were not clarified when the questionnaire data were prepared; therefore, the questionnaire questions were open to interpretation.

### Conclusion

In conclusion, there is no uniform approach to the diagnosis and treatment of vitamin D deficiency among family physicians. There is wide variation in prescription options, dosing frequency and dosing duration. There is a lack of clarity on the normal range of vitamin D levels and doses for the treatment of vitamin D deficiency. Taken together, our results suggest that family physicians need more training, especially in vitamin D therapy. Moreover, as knowledge about vitamin D is rapidly evolving, in-service training should be an essential part of continuing medical education to refresh and update physicians' knowledge.

### Ethics

**Ethics Committee Approval:** Approval for the study was granted by Düzce University Non-Invasive Clinical Research Ethics Committee (decision no: 2023/47, date: 20.03.2023). In addition, necessary permissions were obtained from Düzce Provincial Health Directorate to conduct a survey with physicians working in family health centers (decision no: 213428761, date: 27.04.2023).

**Informed Consent:** Informed consent was obtained from the participants before they filled out the questionnaire, indicating that they gave permission to participate in the study.

### Footnotes

#### Authorship Contributions

Concept: V.M.S., Z.G., R.S., Design: V.M.S., Z.G., R.S., Data Collection or Processing: V.M.S., Analysis or Interpretation: V.M.S., Literature Search: V.M.S., Z.G., R.S., Writing: V.M.S., Z.G., R.S.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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