

## Fibromyalgia syndrome and related factors in hemodialysis, peritoneal dialysis, and renal transplant patients: A cross-sectional study

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### ABSTRACT

**Objectives:** This study aims to investigate the point prevalence of fibromyalgia in patients on hemodialysis and peritoneal dialysis and after renal transplantation compared to healthy controls and to evaluate depressive symptoms, anxiety level, and the impact of fibromyalgia on quality of life (QoL).

**Patients and methods:** Between January 2018 and January 2019, a total of 107 hemodialysis patients (Group 1) (48 males, 59 females; median age: 50 years; range, 42 to 56 years), 51 peritoneal dialysis patients (Group 2) (32 males, 19 females; median age: 49 years; range, 39 to 54 years), 52 renal transplant patients (Group 3) (23 males, 29 females; median age: 45.5 years; range, 37 to 52 years), and 50 healthy controls (Group 4) (23 males, 27 females; median age: 46.5 years; range, 42 to 50 years) were included in the study. Age, sex, amount of time spent on dialysis, and laboratory data were recorded. Impact of fibromyalgia on QoL was evaluated using the Fibromyalgia Impact Questionnaire (FIQ), while depressive symptoms and anxiety level were assessed using the Beck Depression Inventory (BDI) and Beck Anxiety Inventory (BAI), respectively.

**Results:** The point prevalence of fibromyalgia was 14% in Group 1 (n=15), 5.9% in Group 2 (n=3), 9.6% in Group 3 (n=5), and 4% in Group 4. There was a significant difference in the point prevalence of fibromyalgia between the hemodialysis group and healthy controls ( $p<0.05$ ). The median FIQ scores were significantly higher in all patient groups than Group 4 ( $p<0.001$ ); however, there was no significant difference between the patient groups ( $p>0.05$ ). The median BDI scores were significantly higher in Group 1 and Group 2 than Group 4 ( $p<0.05$ ). The median BAI scores were significantly higher in Group 1 than Group 4 ( $p<0.05$ ). When the patients with and without fibromyalgia were compared, FIQ and BAI in Group 1, BAI in Group 2, and FIQ in Group 3 significantly differed ( $p<0.05$ ). There was no relationship between fibromyalgia and any of the laboratory data, age, or time spent on dialysis ( $p>0.05$ ).

**Conclusion:** Fibromyalgia is significantly more common among hemodialysis patients than healthy individuals with a similar prevalence to the healthy individuals for peritoneal dialysis and renal transplant patients. The presence of fibromyalgia is related to depressive symptoms, anxiety, and higher impact on QoL for patients with chronic kidney disease.

**Keywords:** Fibromyalgia syndrome, hemodialysis, peritoneal dialysis, renal transplantation.

Fibromyalgia syndrome is characterized by widespread pain, stiffness, fatigue, and low pain threshold, which are called tender points, in specific anatomical areas. Unrelated musculoskeletal system symptoms such as paresthesia, anxiety, sleep disorders, headache, and irritable bowel

syndrome may be associated with fibromyalgia.<sup>1-3</sup> Fibromyalgia is relatively common and its prevalence varies in the general population between 0.5 and 6%; men are less affected by the disease, and its prevalence increases with age.<sup>4</sup> Although the pathophysiology of fibromyalgia

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has not yet been fully elucidated, environmental, psychological, and genetic factors are thought to be implicated.<sup>5</sup>

Chronic kidney disease (CKD) is one of the main systemic diseases that can also display rheumatic symptoms.<sup>6</sup> Disorders of the musculoskeletal system are frequently observed in patients with CKD. Musculoskeletal disorders are one of the most important complications of CKD and often lead to poor quality of life (QoL). Approximately two-thirds of hemodialysis patients develop musculoskeletal problems. The incidence of rheumatic disorders increases with duration of dialysis.<sup>4,7</sup> Therefore, the differential diagnosis of fibromyalgia should be considered in this group of patients. There are few studies about the prevalence of fibromyalgia in patients receiving hemodialysis and peritoneal dialysis and these have produced contradictory results. While some of these studies indicate that fibromyalgia rates in dialysis patients are similar to the general population,<sup>4,7</sup> the frequency of fibromyalgia is higher than the general population according to the results of other studies.<sup>8-10</sup> Although it is well-known that fibromyalgia impairs QoL in the general population,<sup>11</sup> studies about this condition are scarce in CKD patients.<sup>4,7</sup> Studies showing that fibromyalgia is accompanied by increased depression and anxiety in CKD patients are also limited.<sup>7,8</sup>

Review of the literature reveals a limited number of data about fibromyalgia in specific populations, such as patients receiving peritoneal dialysis and renal transplant patients. In this context, there are only five studies about hemodialysis patients,<sup>4,7-10</sup> two studies about peritoneal dialysis patients,<sup>10,11</sup> and one study about renal transplant patients.<sup>12</sup> In the current study, we aimed to investigate the point prevalence of fibromyalgia in patients on hemodialysis and peritoneal dialysis and with renal transplant compared to healthy individuals. In addition, we aimed to evaluate depressive symptoms, anxiety level, and the impact of fibromyalgia on QoL.

## PATIENTS AND METHODS

This cross-sectional study was conducted at Hitit University Faculty of Medicine, Departments of Physical Medicine and Rehabilitation and

Nephrology between January 2018 and January 2019. A total of 107 hemodialysis patients (Group 1) (48 males, 59 females; median age: 50 years; range, 42 to 56 years), 51 peritoneal dialysis patients (Group 2) (32 males, 19 females; median age: 49 years; range, 39 to 54 years), 52 renal transplant patients (Group 3) (23 males, 29 females; median age: 45.5 years; range, 37 to 52 years), and 50 age- and sex-matched healthy controls (Group 4) (23 males, 27 females; median age: 46.5 years; range, 42 to 50 years) were included in the study. Patients with thyroid disorders, rheumatological diseases (i.e., rheumatoid arthritis, ankylosing spondylitis, systemic lupus erythematosus, familial Mediterranean fever, and Sjögren's syndrome), and malignancy were excluded from the study. Data regarding age, sex, time on dialysis, time on transplantation waiting list, education status, marital status, and laboratory test results were recorded. A written informed consent was obtained from each participant. The study protocol was approved by the Hitit University Faculty of Medicine Ethics Committee (No: 2017/41). The study was conducted in accordance with the principles of the Declaration of Helsinki.

The hemodialysis group included patients on hemodialysis with standard bicarbonate dialysate using a synthetic membrane for at least six months, three days a week for 4 h. The adequacy of hemodialysis was evaluated by monitoring urea kinetics (Kt/V). The peritoneal dialysis group consisted of patients who underwent continuous ambulatory peritoneal dialysis and instrumental peritoneal dialysis for more than six months. Hemodialysis and peritoneal dialysis patients used vitamins, calcitriol, paricalcitol, cinacalcet, and phosphate-binding drugs and iron and erythropoiesis stimulating agents to maintain hemoglobin levels within the target range. The renal transplant group included renal transplant recipient patients with a kidney transplant and functioning graft for one year or more. All patients treated with renal transplant were receiving immunosuppressive therapy. The healthy controls were selected from the hospital staff, and laboratory results from the last six months were used.

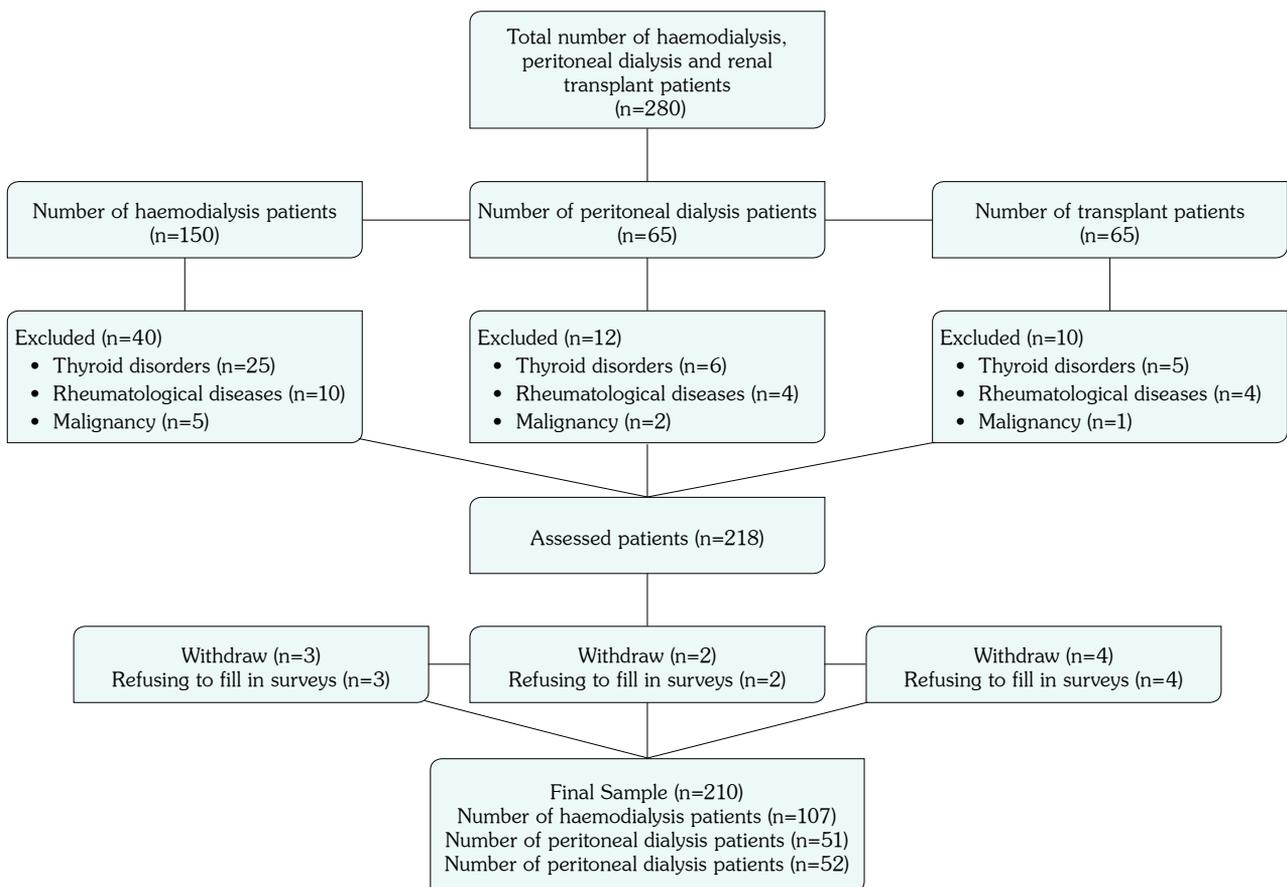
The 2010 American College of Rheumatology (ACR) criteria were used to diagnose fibromyalgia.<sup>13</sup>

Accordingly, the widespread pain index (WPI) should be  $\geq 7$ , Symptom Severity Scale (SSS) score should be  $\geq 5$ ; or if the WPI is between 3 and 6, the SSS should be  $\geq 9$ . In addition, patients' symptoms should have persisted for three months to a similar extent and there should be no other pain-causing disorders.

All participants completed the Fibromyalgia Impact Questionnaire (FIQ) to measure the degree of fibromyalgia symptoms.<sup>14</sup> The validity and reliability of the questionnaire for Turkey was assessed by Sarmer et al.<sup>15</sup> This scale is composed of 10 items to measure physical functioning, well-being, missed work days, difficulty in work, pain, fatigue, morning tiredness, stiffness, anxiety, and depression. The evaluation uses a total of 100 points, with 10 points for each subheading. Low score indicates that the severity of the disease is low. As the score increases, the severity of symptoms increases.<sup>14</sup>

The level of depressive symptoms was evaluated using the Beck Depression Inventory (BDI), and the anxiety level was evaluated using the Beck Anxiety Inventory (BAI). The BAI and BDI consist of 21 items as Likert-type scales and include four self-assessment items. The BAI evaluates the degree of anxiety.<sup>16</sup> The Turkish validity and reliability of the scale were carried out by Ulusoy et al.<sup>17</sup> The total score is 63, and high scores indicate a greater level of anxiety. The anxiety levels were classified as low between 0-17 points, moderate between 18-24 points, and high for  $\geq 25$  points, according to their BAI scores.

The BDI evaluates the symptoms of depression in adults which was developed by Beck et al.<sup>18</sup> The Turkish validity and reliability of the scale were conducted by Hisli.<sup>19</sup> The highest score that can be obtained from the BDI is 63. The score is classified as "no depression" between 0-13, "mild



**Figure 1.** Flow chart for the inclusion of the patients.

**Table 1.** Demographic characteristics of study population

Variables	Group	Median	25 <sup>th</sup> -75 <sup>th</sup> percentile	<i>p</i>
Age	Hemodialysis	50.00	42.00-56.00	0.106
	Peritoneal dialysis	49.00	39.00-54.00	
	Renal transplant	45.50	37.25-52.00	
	Healthy controls	46.50	42.00-50.00	
Body Mass Index	Hemodialysis	21.45	25-29.01	0.144
	Peritoneal dialysis	25.00	4.44-29.13	
	Renal transplant	26.44	21.38-29.11	
	Healthy controls	24.38	27.22-29.39	

Kruskal-Wallis one-way analysis of variance on ranks.

depression” between 14-19, “moderate depression” between 20-28, and “severe depression” between 29-63. High scores indicate a greater level of depression.<sup>18</sup>

The urea, creatinine, alkaline phosphatase (ALP), parathyroid hormone (PTH), calcium (Ca), phosphorus (P), C-reactive protein (CRP), and complete blood count levels of all patients were recorded.

### Statistical analysis

Power analysis and sample size calculation were performed using the PASS version 11.0

software (NCSS LLC, Kaysville, UT, USA). Accordingly, the study power was 0.903 with alpha=0.005, beta=0.09681, standard deviation of means (Sm)=6.23, standard deviation (S)=22.81, and effect size=0.273, k=4, and total n=196. According to the power analysis, there should be at least 49 patients in each group. As we reached the target patient number at that point, we terminated the study and, in totally, we completed recruitment. Totally, 260 patients were included in the study.

Statistical analysis was performed using the IBM SPSS version 21.0 software (IBM Corp.,

**Table 2.** Comparison of groups by FIQ, BAI and BDI

Variables	Group	Median	25 <sup>th</sup> -75 <sup>th</sup> percentile	<i>p</i> <sup>a</sup>	<i>p</i> <sup>b</sup>	<i>p</i> <sup>c</sup>	<i>p</i> <sup>d</sup>	<i>p</i> <sup>e</sup>	<i>p</i> <sup>f</sup>	<i>p</i> <sup>g</sup>
FIQ	Hemodialysis	35.13	15.98-54.29	<.001	>.05	0.900	<.001	>.05	0.010	0.046
	Peritoneal dialysis	26.94	12.59-45.93							
	Renal transplant	24.42	12.11-44.89							
	Healthy controls	14.50	8.65-25.26							
BAI	Hemodialysis	10.00	4.00-22.00	0.021	>.05	>.05	0.035	>.05	0.056	0.076
	Peritoneal dialysis	9.00	5.00-20.00							
	Renal transplant	8.50	4.00-20.25							
	Healthy controls	6.00	2.00-13.25							
BDI	Hemodialysis	10.00	4.00-19.00	<.001	>.05	0.739	<.001	>.05	0.012	0.112
	Peritoneal dialysis	9.50	4.00-14.00							
	Renal transplant	8.00	3.00-13.00							
	Healthy controls	5.00	1.00-8.25							

FIQ: Fibromyalgia impact questionnaire; BAI: Beck anxiety inventory; BDI: Beck depression inventory; Kruskal-Wallis one-way analysis of variance on ranks; a: For intergroup comparisons by Kruskal-Wallis; b: For pairwise differences between Hemodialysis and Peritoneal Dialysis; c: For pairwise differences between Hemodialysis and Renal Transplant; d: For pairwise differences between Hemodialysis and Healthy Controls; e: For pairwise differences between Peritoneal Dialysis and Renal Transplant; f: For pairwise differences between Peritoneal Dialysis and Healthy Controls; g: For pairwise differences between Renal Transplant and Healthy Controls.

**Table 3.** Comparison of patients with and without fibromyalgia among patient groups

	WPI	SSS	FIQ	BDI	BAI	PTH	ALP	Calcium	Phosphorus	CRP
Group 1a (n=15)	6 (4-7)	9 (7-12)	64.40 (58.57-68.21)	19 (7-30)	22 (11-28)	192.70 (148-377)	129 (97-164)	8.80 (8.10-9.20)	4.10 (3.30-5.70)	3.03 (1-11.90)
Group 1b (n=45)	0 (0-2)	3 (2-5)	23.83 (10.43-40.99)	9 (3-13)	6 (3-14.5)	267.50 (202.1-350.25)	114.50 (84.25-137.75)	8.50 (8-8.80)	4.80 (4.20-5.80)	3.10 (0.70-5.80)
p	<0.001	<0.001	<0.001	0.08	0.006	0.15	0.19	0.34	0.25	0.50
Group 2a (n=3)	4 (3.5-7)	9 (8.5-9)	41.91 (33.13-68.01)	10 (8-16.5)	30 (25.50-33.50)	432 (328-512.50)	124 (78.50-130)	8.40 (7.40-8.85)	6.40 (6.35-6.45)	10 (9.90-14.50)
Group 2b (n=9)	0 (0-2)	2 (1-5)	21.30 (11.96-26.38)	9 (5-12)	6 (5-14)	438 (363-547)	101 (92-125)	8.60 (7.70-9)	5.20 (4.70-6.20)	5.20 (3.51-15.70)
p	0.035	0.015	0.17	0.40	0.021	0.64	0.93	0.71	0.09	0.31
Group 3a (n=5)	5 (4-7)	9 (6.5-9.5)	68.32 (36.37-71.32)	10 (2.50-20)	12 (9.50-29)	74 (62.50-88)	67 (50-82.50)	9.20 (8.64-9.60)	3.30 (2.95-3.65)	0.60 (0.40-0.90)
Group 3b (n=15)	0 (0-0)	3 (2-4)	10.64 (7.90-18.91)	3 (0-8)	5 (2-7)	70 (62.10-103.10)	78 (61-128)	9.30 (9-9.50)	2.90 (2.70-3.50)	0.30 (0.30-0.50)
p	<.001	0.008	0.003	>.05	0.16	>.05	>.05	0.33	0.29	>0.05

WPI: Widespread pain index; SSS: Symptom severity scale; FIQ: Fibromyalgia impact questionnaire; BDI: Beck depression inventory; BAI: Beck anxiety inventory; PTH: Parathyroid hormone; ALP: Alkaline phosphatase; CRP: C-reactive protein; Group 1a: Hemodialysis patients with fibromyalgia 1b: Hemodialysis patients without fibromyalgia; Group 2a: Peritoneal dialysis patients with fibromyalgia 2b: Peritoneal dialysis patients without fibromyalgia; Group 3a: Renal transplant patients with fibromyalgia 3b: Renal transplant patients without fibromyalgia; Mann-Whitney rank-sum test, Median (25<sup>th</sup>-75<sup>th</sup> percentile).

Armonk, NY, USA). Continuous variables were expressed in mean  $\pm$  standard deviation (SD), median (25<sup>th</sup>-75<sup>th</sup> percentile), while continuous quantitative variables were expressed in number and frequency. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to evaluate the distribution of data. Two-way groups comprising independent and continuous variables without normal distribution were analyzed using the Mann-Whitney rank-sum test, while the Kruskal-Wallis one-way analysis of variance on ranks was used for multiple comparisons. A *p* value of  $<0.05$  was considered statistically significant.

## RESULTS

Of 280 patients included in the study, 62 who did not meet the inclusion criteria were excluded. Nine patients were withdrawn from the study. The study flow chart is shown in Figure 1.

The age and body mass index (BMI) levels of the groups were similar ( $p>0.05$ ). Duration of dialysis was similar between Groups 1 and 2 ( $p>0.05$ ). According to the sex distribution, women comprised 44.9% of Group 1, 37.3% of Group 2, 55.8% of Group 3, and 54% of Group 4, indicating a similar distribution among the groups ( $p>0.05$ ). Baseline demographic characteristics of the groups are given in Table 1.

The median BDI scores were significantly higher in Groups 1 and 2 compared to the healthy controls ( $p<0.05$ ). The highest score was found in Group 1; however, there was no statistically significant difference among Group 1, Group 2, and Group 3 ( $p>0.05$ ) (Table 2).

The median BAI scores were significantly higher in Group 1, compared to the healthy

controls ( $p<0.05$ ). The highest score was found in Group 3; however, there was no statistically significant difference among Group 1, Group 2, and Group 3 ( $p>0.05$ ) (Table 2).

The point prevalence of fibromyalgia was 15 individuals in Group 1, three individuals in Group 2, five individuals in Group 3, and two individuals in the healthy group. There was a significant difference between the hemodialysis group and healthy controls ( $p<0.05$ ).

Among the hemodialysis patients, age, BMI, and time spent on dialysis were similar among the group with fibromyalgia ( $n=15$ , Group 1a) and the group without fibromyalgia ( $n=45$ , Group 1b). There were significant differences in the median WPI, SSS, FIQ, and BAI ( $p<0.05$ ). The laboratory data were similar in both groups ( $p>0.05$ ).

Age, BMI, and duration of dialysis were similar for patients with fibromyalgia ( $n=3$ , Group 2a) and without fibromyalgia ( $n=9$ , Group 2b) in the peritoneal dialysis group. There was a significant difference between the groups in terms of the median WPI, SSS, and BAI scores ( $p<0.05$ ), while the median FIQ, BDI, and laboratory data were similar ( $p>0.05$ ).

In the renal transplant patients, age, BMI, and time spent on the transplant waiting list were similar between the group with fibromyalgia ( $n=5$ , Group 3a) and the group without fibromyalgia ( $n=15$ , Group 3b). The median WPI, SSS, and FIQ scores were significantly different between the groups ( $p<0.05$ ), while the median BDI, BAI scores, and laboratory data were similar (Table 3).

When the patients with fibromyalgia were compared across the patient groups, their median

**Table 4.** Comparison of fibromyalgia patients among patient groups

	WPI	SSS	FIQ	BDI	BAI
Group 1a (n=15)	6 (4-7)	9 (7-12)	64.40 (58.57-68.21)	19 (7-30)	22 (11-28)
Group 2a (n=3)	4 (3.5-7)	9 (8.5-9)	41.91 (33.13-68.01)	10 (8-16.5)	30 (25.50-33.50)
Group 3a (n=5)	5 (4-7)	9 (6.5-9.5)	68.32 (36.37-71.32)	10 (2.50-20)	12 (9.50-29)
<i>p</i>	0.87	0.87	0.73	0.42	0.26

WPI: Widespread pain index; SSS: Symptom severity scale; FIQ: Fibromyalgia impact questionnaire; BDI: Beck depression inventory; BAI: Beck anxiety inventory; Group 1a: Hemodialysis patients with fibromyalgia; Group 2a: Peritoneal dialysis patients with fibromyalgia; Group 3a: Renal transplant patients with fibromyalgia; Kruskal-Wallis one-way analysis of variance on ranks, Median (25<sup>th</sup>-75<sup>th</sup> percentile).

**Table 5.** Relevant published literature

Related studies	Participant	Aim	Result	Discussion
Samimaghani et al. <sup>8</sup>	148 hemodialysis patients	To evaluate the prevalence of FMS in HD patients and its relationship with clinical symptoms and laboratory parameters	FMS was diagnosed in 12.2% of patients on hemodialysis	A higher prevalence of fibromyalgia was found in hemodialysis patients than in previous studies. Sleep disorders and depression levels were found to be associated with fibromyalgia.
Leblebici et al. <sup>9</sup>	221 chronic hemodialysis patients	To evaluate the frequency of FMS and its relationship with clinical and laboratory parameters.	FMS was diagnosed in 9% of patients on hemodialysis	While sleep disorders, fatigue and cognitive symptoms were associated with FMS, no correlation was found with laboratory parameters.
Cauto et al. <sup>7</sup>	311 hemodialysis patients	To determine the prevalence of FMS and to determine its effects on quality of life	FMS was diagnosed in 3.9% of patients on hemodialysis	The prevalence of FMS in HD patients was similar to the general population. HD patients had higher depression and anxiety and lower quality of life.
Yüçeturk et al. <sup>4</sup>	122 chronic HD patients and 89 healthy controls	To determine the prevalence of FMS in HD patients and to examine the relationship between clinical and laboratory parameters.	FMS was diagnosed in 7.4% of HD patients and 4.5% of the control group.	The prevalence of FS in chronic HD patients was similar to the general population. Clinical and laboratory findings were not related to FMS.
Berber et al. <sup>10</sup>	119 predialysis patients, 85 HD patients, 85 PD patients	To detect the prevalence of FMS in patients with chronic kidney disease	The prevalence of FMS was 19.3% in the predialysis, 17.6% in the PD and 9.4% in the HD group.	There was no significant difference between the groups in terms of FMS prevalence. Among all demographic and laboratory parameters, only female sex was a risk factor for FMS development.
Sargin et al. <sup>11</sup>	33 HD patients, 26 PD patients, and 30 healthy controls	To evaluate the frequency of FMS in patients with PD, HD and its relationship with clinical and laboratory parameters.	FMS was present in 12.1% of HD patients, 3.8% of PD patients and 3.3% of healthy individuals.	The lower incidence of FMS in patients with PD may be associated with active participation in treatment, less stress factor and better preservation of kidney function.
Erkmen Uyar et al. <sup>12</sup>	99 rTx patients	To investigate FMS prevalence and its relationship with clinical and laboratory parameters	The prevalence of FMS was 12.6% in RT patients	FMS in rTx patients was associated with hypertension, arterial stiffness, obesity and kidney allograft dysfunction.

FMS: Fibromyalgia syndrome; HD: Hemodialysis; PD: Peritoneal dialysis; rTx: Renal transplantation.

FIQ, BDI, and BAI scores were similar ( $p>0.05$ ) (Table 4). There was no significant relationship between fibromyalgia and any laboratory data, age, and time spent on dialysis ( $p>0.05$ ). The summary of the relevant previous studies published in the literature is tabulated in Table 5.

## DISCUSSION

In the current study, the point prevalence of fibromyalgia was significantly higher in

hemodialysis patients than the healthy group. The fibromyalgia point prevalence was highest in the hemodialysis group. The second highest point prevalence for fibromyalgia was found in renal transplant patients, and the lowest rate was found in patients on peritoneal dialysis. While a higher impact of fibromyalgia on QoL and depressive symptoms were the most common in the hemodialysis patients, anxiety was the most common in renal transplant patients. Patients with fibromyalgia had higher levels of depressive

symptoms and anxiety and higher impact on QoL than those without fibromyalgia.

Rheumatic disorders are frequently present in CKD patients, and the majority of hemodialysis patients experience various common musculoskeletal disorders, including fibromyalgia.<sup>8</sup> In previous studies evaluating the incidence of fibromyalgia in hemodialysis patients, the frequency of fibromyalgia was reported to be between 3.9 and 12.2%, and these rates were reported to be similar to the control group.<sup>4,7,9</sup> In the current study, the fibromyalgia point prevalence was found to be 14% among hemodialysis patients, which was significantly higher than the healthy controls.

According to the current study, the incidence of fibromyalgia was lower in patients on peritoneal dialysis, compared to the hemodialysis group. In a study evaluating of 119 predialysis, 85 hemodialysis, and 85 peritoneal dialysis patients, the prevalence of fibromyalgia was 19.3% in the predialysis group, 17.6% in the peritoneal dialysis group and 9.4% in the hemodialysis group.<sup>10</sup> In another study by Sargin et al.<sup>11</sup> including 33 hemodialysis patients, 26 peritoneal dialysis patients, and 30 healthy controls, fibromyalgia was diagnosed in 12.1% of patients on hemodialysis, 3.8% of patients on peritoneal dialysis, and 3.3% of healthy individuals. In the current study, fibromyalgia was detected in 5.9% of peritoneal dialysis patients. This may be related to active participation in treatment, decreased stress levels, and better protection of kidney function among patients on peritoneal dialysis. In addition, peritoneal dialysis provides patients with greater independence and a flexible lifestyle.<sup>11</sup>

According to the current study, the incidence of fibromyalgia was lower in patients on peritoneal dialysis compared to the hemodialysis group. In a study evaluating of 119 predialysis, 85 hemodialysis, and 85 peritoneal dialysis patients, the prevalence of fibromyalgia was 19.3% in the predialysis group, 17.6% in the peritoneal dialysis group, and 9.4% in the hemodialysis group.<sup>10</sup> In another study by Sargin et al.<sup>11</sup> including 33 hemodialysis patients, 26 peritoneal dialysis patients, and 30 healthy controls, fibromyalgia was diagnosed in 12.1% of patients on hemodialysis, 3.8% of patients on peritoneal dialysis, and 3.3%

of healthy individuals. In addition, Erkmen Uyar et al.<sup>12</sup> reported a fibromyalgia rate of 12.6% in 99 renal transplant patients. In the current study, the rate of fibromyalgia in renal transplant patients was 9.6% and it was not different from the control group. In the current study, fibromyalgia was diagnosed in 5.9% of peritoneal dialysis patients. This may be related to active participation in treatment, decreased stress levels, and better protection of kidney function among patients on peritoneal dialysis. Of note, peritoneal dialysis provides patients with greater independence and a flexible lifestyle.<sup>11</sup>

The prevalence of fibromyalgia varies between 0.5 and 6% in the general population, and men are less affected by the disease.<sup>4</sup> Samimagham et al.<sup>8</sup> reported that 66.7% of the patients with fibromyalgia were women, and also other studies with dialysis patients reported that women were more affected.<sup>4,7,11</sup> Similar to the literature, the majority of fibromyalgia patients were women in the current study.

Kidney failure patients have an increased physical inactivity, decreased QoL, and increased morbidity and mortality.<sup>8,9,20</sup> Quality of life is likely to be lower in hemodialysis patients than the general population.<sup>11,20</sup> In studies comparing hemodialysis patients with and without fibromyalgia, FIQ scores were found to be higher and QoL was lower in hemodialysis patients with fibromyalgia.<sup>4,7</sup> In the current study, the median FIQ scores were also higher in patients with fibromyalgia in the hemodialysis group. This difference in the FIQ score may be due to the fact that the items in the questionnaire are not only associated with fibromyalgia, but also represent general health and daily activities. Therefore, it can be speculated that fibromyalgia impairs the QoL and worsens general health in patients with end-stage renal failure.<sup>4</sup>

Dialysis, particularly hemodialysis, impairs the QoL and comfort and causes psychological problems.<sup>8,9,20</sup> Thus, psychiatric conditions such as depression are common in these patients.<sup>11,20</sup> Comparing hemodialysis patients with and without fibromyalgia in the literature, differences in sleep disturbance, fatigue and cognitive symptoms were reported, and anxiety and depression increase in hemodialysis patients in the presence of fibromyalgia.<sup>4,7,9</sup> In another study, fibromyalgia

was reported to increase the risk of depression for hemodialysis patients, but it did not affect the level of anxiety.<sup>8</sup> In the current study, higher levels of both depressive symptoms and anxiety were detected in patients with fibromyalgia in the hemodialysis group.

In a study with peritoneal dialysis patients, the frequency of fibromyalgia, depression and cognitive dysfunction were reported to be similar compared to healthy controls.<sup>11</sup> In our peritoneal dialysis group, depressive symptoms and FIQ scores were higher than in the healthy group. In addition, anxiety scores were higher in patients with fibromyalgia in the peritoneal dialysis group than for those without fibromyalgia.

Currently, there is no known diagnostic laboratory test for fibromyalgia; however, all patients should be evaluated at baseline with complete blood count and routine biochemistry tests, including muscle enzymes, thyroid-stimulating hormone (TSH) levels, and erythrocyte sedimentation tests. These tests are typical for fibromyalgia and are performed to exclude other diseases in differential diagnosis or to support differential diagnosis in suspected cases.<sup>21</sup> Chronic musculoskeletal pain may be associated with Ca, phosphate, uric acid levels, and imbalances. Higher serum PTH and Ca levels in hemodialysis patients are associated with chronic pain.<sup>9</sup> Studies conducted in hemodialysis patients with fibromyalgia reported that time spent on hemodialysis, the etiology of renal failure, the dialysis adequacy index (kt/V), and albumin, Ca, P, PTH, and ALP levels are not associated with fibromyalgia.<sup>4,7,9,11</sup> In another study, Ca and P levels in hemodialysis patients with and without fibromyalgia did not significantly differ, but PTH levels were higher in the fibromyalgia group.<sup>8</sup> In the current study, Ca, P, PTH, ALP, and CRP levels were similar between hemodialysis patients with and without fibromyalgia. Time spent on dialysis and the (kt/V) ratio were not associated with fibromyalgia.

There is no significant relationship between secondary hyperparathyroidism and fibromyalgia in patients on peritoneal dialysis.<sup>11</sup> In the current study, PTH levels were similar in patients with and without fibromyalgia in the peritoneal dialysis group. In this patient group, time spent on dialysis, and the (kt/V) ratio were not associated with fibromyalgia.

Erkmen Uyar et al.<sup>12</sup> showed that fibromyalgia findings were not affected by Ca metabolism in patients undergoing renal transplant, and they demonstrated that inflammation could trigger fibromyalgia. In the current study, Ca, PTH, ALP, and CRP levels were not affected by the presence of fibromyalgia in the group of patients with kidney transplantation, and the amount of time spent on the transplant list was not associated with fibromyalgia.

The age and weight are the main factors affecting the clinical situation in all chronic pain conditions such as fibromyalgia.<sup>22</sup> One of the limitations of our study is that we included patients with a wide age and BMI range, as we focused on certain clinical situations while forming our groups. The 2010 ACR criteria were used for diagnostic purposes in our study. However, it is recommended that the 2010 ACR criteria should be used for primary fibromyalgia. Therefore, the use of 2010 ACR criteria can be stated as a limitation of the study. The small sample size is another limitation. Further large-scale, prospective studies are needed.

In conclusion, the point prevalence of fibromyalgia was significantly higher in hemodialysis patients than the healthy population. In patients with peritoneal dialysis and kidney transplantation, the rate of fibromyalgia was higher than the normal population; however, this did not reach statistical significance. The presence of fibromyalgia is related to depressive symptoms, anxiety, and higher impact on QoL of the patients with CKD. The current study is the first to compare hemodialysis, peritoneal dialysis, and kidney transplant patients with each other and healthy individuals.

#### **Declaration of conflicting interests**

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