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The Effects of Socio-Economic Status and Medical Treatments on Mortality in Long Term Peritonal Dialysis Patients: Retrospective Cross-Sectional Research

Sosyoekonomik Durumun ve Tıbbi Tedavinin Uzun Dönemde Periton Diyaliz Hastalarında Mortalite Üzerine Etkisi: Retrospektif Kesitsel Araştırma

Refika BÜBERCİ[a], Semahat KARAHİSAR ŞİRALİ[a], Murat DURANAY[a]

[a]Clinic of Nephrology, Ankara Training and Research Hospital, Ankara, Türkiye

ABSTRACT Objective: Despite technical advances in peritoneal dialysis (PD), mortality rates are still very high. Factors affecting mortality have been the aim of many studies. However, there are not enough studies investigating the effects of socio-economic status (SES) and medical treatments on mortality. The aim of our study is to investigate the long-term effects of SES and medical treatments on mortality in PD patients. **Material and Methods:** The study included 145 patients. Demographic characteristics, laboratory data, and medical treatments were recorded. Three main variables play a role in the SES indices. These variables are education, income level and occupation. These variables were questioned in PD patients. Cox regression analysis was used to determine the factors affecting mortality. **Results**: The mean age of the patients was 57.51±15.73 years, and 14% had a low income level. After 3.8±3.6 years of follow-up, 27.6% of the patients had died. The income level was lower, the tendency to infection was higher in the non-survivor group. There was no difference between survivor and non-survivor group in terms of gender, age, marital status, PD duration. Factors affecting mortality were low income [hazard ratio (HR): 2.272, 95% confidence interval (CI): 1.12-4.812, p=0.001], using high peritoneal dialysate glucose concentration solution, and low use of phosphorus-binding drugs and calcitriol (HR: 2.812, 95% CI: 1.160-6.818 and HR: 3.632, 95% CI: 1.665-7.291, p=0.001, respectively). **Conclusion:** Low income level in PD patients increases mortality by creating a tendency to infections. Lack of volume control and malnutrition are other factors affecting mortality.

Keywords: Hypervolemia; malnutrition; mortality; peritoneal dialysis; socio-economic status

ÖZET Amaç: Periton diyalizinde teknik gelişmelere rağmen mortalite oranları hâlâ yüksektir. Mortaliteyi etkileyen faktörler birçok çalışmanın amacı olmuştur. Ancak sosyoekonomik düzeylerin (SED) ve tıbbi tedavinin mortalite üzerine etkisi ile ilgili yeteri kadar araştırma yapılmamıştır. Bu çalışmanın amacı, SED ve tıbbi tedavinin uzun dönemde periton diyaliz hastalarında mortalite üzerine etkisini araştırmaktır. **Gereç ve Yöntemler:** Çalışmaya 145 hasta alındı. Demografik özellikler, tıbbi tedaviler ve laboratuvar verileri kaydedildi. SED endekslerinde 3 ana değişken rol oynamaktadır. Bu değişkenler eğitim, gelir düzeyi ve meslektir. Bu değişkenler, periton diyaliz hastalarında tek tek sorgulandı. Mortaliteyi etkileyen faktörlerin tespiti için Cox regresyon analizinden yararlanıldı. **Bulgular:** Hastaların yaş ortalaması 57,51±15,73 yıl olup, %14'ü düşük gelir düzeyine sahipti. Hastaların %27,6'sı 3,8±3,6 yıllık takip sonrası öldü. Yaşamayan hasta grubunda gelir düzeyi daha düşük ve enfeksiyona eğilim daha fazlaydı. Yaşayan ve yaşamayan hasta gruplar arasında yaş, cinsiyet, medeni durum ve periton diyaliz süresi açısından anlamlı bir fark yoktu. Mortaliteyi etkileyen faktörler ise düşük gelir düzeyi "tehlike oranı [hazard ratio (HR)]: 2,272, %95 güven aralığı [confidence interval (CI)]: 1,12-4,812, p=0,001", yüksek glukoz konsantrasyonlu periton diyaliz solüsyonu kullanma, fosfor bağlayıcı ajan ve kalsitriol kullanımının az olmasıydı (sırasıyla HR: 2,812, %95 CI: 1,160-6,818 ve HR: 3,632, %95 CI: 1,665-7,291, p=0,001). **Sonuç:** Periton diyaliz hastalarında düşük gelir düzeyine sahip olmak, enfeksiyona eğilim yaratarak mortaliteyi etkilemektedir. Volüm durumunu yeteri kadar kontrol altına alamama ve malnütrisyon mortaliteyi etkileyen diğer faktörlerdir.

Anahtar Kelimeler: Hipervolemi; malnütrisyon; mortalite; periton diyalizi; sosyoekonomik düzey

Since the prevalence of chronic kidney disease (CKD) is increasing rapidly worldwide, the number of patients receiving renal replacement therapy (RRT) is also increasing rapidly. According to Annual Data 2020 report, much larger was the number of patients who initiated peritoneal dialysis (PD) for the treatment of end-stage renal disease (ESRD), which reached 14,334-the largest number ever ob-

Correspondence: Refika BÜBERCİ
Clinic of Nephrology, Ankara Training and Research Hospital, Ankara, Türkiye
E-mail: refikakaraer@gmail.com

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served and an increase of approximately 11% since 2017.[1] Although dialysis is the most preferred method for ESRD patients to maintain their lives, 25% of patients die within a year, and 65% of them die within 5 years.[2] In addition to traditional risk factors, CKD-related factors such as inflammation, calcium-phosphorus metabolism disorders, anemia, and malnutrition also play roles in increased mortality.

The association between socio-economic status (SES) and ESRD has been well-studied. Home dialysis creates fewer lifestyle disruptions while providing similar or better outcomes than in-center hemodialysis (HD). Socioeconomically advantaged patients are more likely to commence home dialysis (PD and home HD) in many developed countries.[3-5] Various studies have been conducted on mortality in PD patients. However, there are not enough studies investigating the effects of long-term follow-up data and SES on mortality. The aim of our study is to investigate the long-term effects of SES and medical treatments on mortality in PD patients.

MATERIAL AND METHODS

STUDY DESIGN

The study included 157 patients over the age of 18 who underwent continuous ambulatory PD and followed up in the PD unit between January 1, 2010 and December 31, 2020. The primary endpoint of the study was death of patients, and the secondary endpoint was transfer to HD or renal transplantation. Patients who had PD for less than three months did not come to the last control in the year prior to the endpoints, had a severe lack of data, and did not consent to participate in the study were excluded from the study. The study continued with 145 patients. All procedures performed in studies involving human participants were in accordance with ethical standards of Ankara Training and Research Hospital Ethics Committee and with the Helsinki Declaration (approval date: November 10, 2021, approval number: E-767).

PATIENTS DATA

Three main variables play a role in the SES indices applied in our country. These variables are education, income level and occupation. According to the survey conducted taking these variables into account, the patients were divided into 5 groups according to their education level (illiterate, primary school, middle school, high school, college) and 3 groups according to their income level [low (monthly income <750 $) middle (monthly income: 750-1250 $), high (monthly income >1250 $)] and occupational characteristics (self-employment, private sector employee, public servant). The numbers stated at the monthly income level are the information announced by the statistics institution of our country in 2020. Demographic characteristics (age, gender), etiology of CKD, concomitant diseases [diabetes mellitus (DM), hypertension (HT), coronary artery disease (CAD), congestive heart failure (CHF)], marital status (married, single), type of heating in the house (stove, radiator), whether there is a private room in the house, number of weekly baths, smoking, whether the patient received other RRT before PD started, PD preference status (on patient's own request, doctor's recommendation, necessity), PD onset status (starting PD within 15 days of insertion of the peritoneal catheter is early onset, starting PD after 15 days is late onset), whether an assistant is needed while performing PD, whether an assistant is needed while performing basic care services, the solutions used at the time of starting PD and at the last control, number of changes, and PD time were recorded. Last control refers to the most recent examination of patients near the primary or secondary endpoint or study end date (December 31, 2020). The drugs used when they began PD and under their last control [renin angiotensin aldosterone system (RAAS) blocker, calcium channel blocker, beta-blocker, diuretic, phosphorus-binding drugs, and proton pump inhibitor (PPI)], whether there was residual renal function, the amount of residual urine, the development of PD complications, the reasons why it was switched to HD, death status, causes of death, and which RRT the patients received at the end of the study period were noted.

LABORATORY ANALYSES

The creatinine, hemoglobin, calcium, phosphorus, parathormone (PTH), glucose, triglyceride, high density lipoprotein, low density lipoprotein (LDL), and albumin values at the time the patients began PD and at the last control were recorded.

STATISTICAL ANALYSES

Kolmogorov-Smirnov and Shapiro-Wilk tests were used for the normality of data distribution. Normally distributed data were presented as mean±standard deviation, and non-normally distributed data were presented as median (interquartile range). Independent samples t-test and Mann-Whitney U test were performed to compare parametric variables and non-parametric variables, respectively between groups. Pearson's c^2 or Fisher's exact test was used for categorical variables. Univariate and multivariate Cox regression analyses were performed to find the causes that affect mortality. The backward conditional method was used in multivariate Cox regression analysis. A significant difference was considered when $p<0.05$. Analyses were conducted using SPSS Statistics for Windows (version 22.0; IBM Corp, Armonk, NY, United States).

RESULTS

DEMOGRAPHIC DATA

The mean age of patients was 57.51±15.73 years, 49.7% were women, and 90.3% were married. 14% of the patients had a low-income level, and 53.8% were heating their homes with a stove. The number of baths taken per week was 1.75±0.85. 66.9% of the patients were primary school graduates. 4.8% were illiterate (Table 1).

PD catheter was inserted voluntarily in 72.4% of the patients. Fifteen days after insertion, 69.7% of the patients started to perform PD. 42.1% of patients were started on 4 exchanges. At the beginning of the treatment, 94.5% of the patients had a residual renal function, and the residual urine amount was 817±583 mL. The rate of patients using icodextrin initially was 38.6%, and the rate of patients using high peritoneal dialysate glucose concentration (PDGC) solution was 22.1%. The distribution of all drugs used by the patients is shown in Table 2. While 80% of the patients could do PD themselves, 20% needed an assistant. The percentage of patients who needed help in all kinds of care was 17.9%.

In the CKD etiology of the patients, DM was first with a rate of 34.5%. This was followed by HT (27.6%), glomerulonephritis (11.7%), other (19.3%),

TABLE 1: Basic features of patients.

Parameters	
Age (years)	57.51±15.73
Gender (female) (%)	49.7
Marital status (married) (%)	90.3
Education (%)	
Illiterate	4.8
Primary school	66.9
Middle school	16.6
High school	10.3
Collage	1.4
Income (%)	
Low	14.5
Middle	85.5
Occupation (%)	
Self-employment	84
Private sector employee	10.8
Public servant	5.1
Home heating (radiator) (%)	46.2
Private room (%)	97.9
Bathing per week	1.7±0.87
PD choice (%)	
Patient choice	72.4
Doctor suggestion	26.9
Mandatory	0.7
PD implementation (%)	
Patient	80
Assistance	20
Need for assistant for basic care (%)	17.8
CKD etiology (%)	
DM	34.5
HT	27.6
Glomerulonephritis	11.7
Other	19.3
PCKD	3.4
Unkown	3.4
Comorbid disease (%)	
DM	35.9
HT	82.1
CAD	33.8
CHF	31
PD duration (years)	3.8±3.66
PD onset status (late) (%)	30.3
PD complications (%)	
Peritonitis	19.6
Hernia	15.7
Dialysis failure	2.5
UF failure	2.5
Encapsulated peritonitis	0.8

PD: Peritoneal dialysis; CKD: Chronic kidney disease; DM: Diabetes mellitus; HT: Hypertension; PCKD: Polycystic kidney disease; CAD: Coronary artery disease; CHF: Congestive heart failure; UF: Ultrafiltration.

TABLE 2: Medical treatments and laboratory data of patients in initial and last control.

Parameters	Initial control	Last control
Number of PD changes (%)		
One change	17.9	14.5
Two changes	22.1	20.1
Three changes	13.1	18.9
Four changes	42.1	40.8
Five changes	4.8	5.7
Icodextrin use (%)	38.6	57.2
High PDGC use (%)	22.1	41.4
RRF (%)	94.5	73.1
Amount of residual urine (mL)	817.9±583.6	558.6±935
Drugs (%)		
RAAS blocker	22.8	35.2
Calcium channel blocker	46.2	48.3
Beta blocker	38.6	48.3
Diuretic	32.4	34.5
Proton pump inhibitor	53.8	26.2
PBD	53.8	58.6
Calcitriol	18.6	35.2
Creatinine (mg/dL)	5.9±3	6.98±3.35
Hemoglobin (g/dL)	9.96±1.87	10.5±1.97
Sodium (mmol/L)	137.9±3.6	134.8±1.14
Calcium (mg/dL)	8.48±1	8.43±0.95
Phosphorus (mg/dL)	4.96±1.6	4.7±1.4
PTH (ng/L)	321.1±257.8	423.3±407.4
Albumin (g/dL)	3.53±0.7	3.36±0.64
Glucose (mg/dL)	125.2±58	128.7±66
Triglyceride (mg/dL)	157.1±90	161.8±94.3
HDL (mg/dL)	42.7±13.25	42.67±20.2
LDL (mg/dL)	106.7±50.3	104.4±52.7

PD: Peritoneal dialysis; PDGC: Peritoneal dialysate glucose concentration; RRF: Residual renal function; RAAS: Renin angiotensin aldosterone system; PBD: Phosphorus binding drug; PTH: Parathormone; HDL: High density lipoprotein; LDL: Low density lipoprotein.

polycystic kidney disease (3.4%), and unknown (3.4%), respectively. While 9.7% of the patients had HD before starting PD, 2.1% had a renal transplant. At the end of 3.8±3.66 years of follow-up, 57.9% of the patients-maintained PD, 11.1% passed to HD, 3.4% were transplanted, and 27.6% died. The causes for HD transition of the patients were frequent peritonitis attacks in 41.5%, ultrafiltration (UF) failure in 25%, dialysis insufficiency in 25%, and encapsulated peritonitis in 8.5%. Cardiovascular diseases were the first cause of death with a rate of 35%, followed by infections with a rate of 25%. During the follow-up of PD patients, 19.6% developed peritonitis, 15.7% hernia, 2.5% UF failure, 2.5% dialysis failure, and 0.8% encapsulated peritonitis.

COMPARISON OF SES AND LABORATORY DATA OF LIVING AND NON-LIVING GROUP

There was no significant difference between the 2 groups in terms of age, gender, and duration of PD. However, it was determined that in the non-living group the income level was lower, the method of heating the house was mostly by the stove, the number of weekly baths was lower, and they were more prone to infection.

Patients who died were more often affected by DM, CAD, and CHF. These patients needed more assistants in both PD and primary care services (Table 3). It was determined that the use of diuretics and high PDGC solutions in the patients who died was high. These patients had lower residual urine volume when they started treatment compared to the surviving group. It was determined that the use of phosphorus-binding drugs and calcitriol was less in deceased patients. The phosphorus and PTH levels of these patients were significantly lower. In addition, significantly lower levels of calcium, creatinine and albumin were detected (Table 3).

THE EFFECTS OF DEMOGRAPHIC CHARACTERISTICS ON MORTALITY

When the univariate Cox regression analysis of all demographic characteristics was performed, it was found that the heating type of the house (stove), low-income level, DM, CAD, CHF, need for help both in PD and primary care services, and the number of weekly baths was associated with mortality. However, in the multivariate regression analysis, it was determined that low-income level affected mortality 2,272 times [hazard ratio (HR): 2.272, 95% confidence interval (CI): 1.112-4.812, p=0.001] and heating the house with a stove 3,063 times (HR: 3.063, 95% CI: 1.431-6.555, p=0.001) (Table 4).

THE EFFECTS OF MEDICAL TREATMENTS ON MORTALITY

In the regression analysis, it was determined that the use of high PDGC solution (HR: 0.357, 95% CI: 0.183-0.695, p=0.002) and the increased need for di-

TABLE 3: The comparison of socio-economic status, medical treatments and laboratory data between survivor and non-survivor group.

Parameters	Survivor (n=105)	Non-survivor (n=40)	p value
Age (years)	57.3±14.81	58±18.1	0.818
Gender (female) (%)	48.6	52.5	0.931
Marital status (married) (%)	90.5	90	0.931
BMI (kg/m^2)	25.9 (5.8)	26.6 (6.7)	0.359
PD duration (years)	2.5 (5)	1.5 (3.7)	0.061
Income (low) (%)	9.5	27.5	0.015
Home heating (stove) (%)	25	54.3	0.001
Need for assistant for basic care (%)	10.5	37.5	<0.001
Need for assistant for PD (%)	12.4	40	<0.001
Smoking (%)	8.6	15	0.256
HT (%)	82.9	80	0.428
DM (%)	29.5	52.5	0.012
CAD (%)	25.7	55	0.001
CHF (%)	24.8	47.5	0.015
Bathing per week	2 (1)	1 (1)	0.004
Amount of residual urine-first (mL)	900 (750)	500 (650)	0.007
Amount of residual urine-last (mL)	400 (975)	200 (500)	0.081
Infections (%)	11.4	25	0.041
Calcitriol-first (%)	18.1	20	0.814
PBD-first (%)	62.9	30.3	0.001
RAAS-first (%)	24.8	17.5	0.386
Calcium channel blocker-first (%)	47.6	42.5	0.710
Beta blocker-first (%)	37.1	42.5	0.572
Diuretic (%)	26.7	47.5	0.028
PPI-first (%)	15.2	27.5	0.1
Icodextrin-first (%)	37.1	42.5	0.572
High PDGC-first (%)	14.3	42.5	<0.001
Calcitriol-last (%)	41.9	17.5	0.006
PBD-last (%)	69.5	30	<0.001
RAAS-last (%)	24.8	15	0.265
Calcium channel blocker-last (%)	52.4	37.5	0.137
Beta blocker-last (%)	35.1	40.5	0.498
Diuretic-last (%)	29.5	47.5	0.051
PPI-last (%)	21	40	0.033
Icodextrin-last (%)	57.1	57.5	0.561
High PDGC-last (%)	34.3	60	0.008
Hemoglobin-first (g/dL)	9.6 (2.25)	10.4 (3.18)	0.160
Creatinine-first (mg/dL)	6.3 (3.7)	3.9 (3.8)	<0.001
Calcium-first (mg/dL)	8.6 (0.76)	8.43 (0.94)	0.015
Phosphorus-first (mg/dL)	4.9 (2.78)	3.94 (0.94)	0.023
PTH-first (ng/L)	2533 (305)	180 (335)	0.013
Albumin-first (g/dL)	3.6 (0.8)	3.28 (0.96)	0.028
Glucose-first (mg/dL)	101 (36)	129.5 (102.5)	0.233
Triglyceride-first (mg/dL)	143 (101.5)	113 (92.5)	0.90
HDL-first (mg/dL)	42 (16)	38 (14.75)	0.054
LDL-first (mg/dL)	99 (62)	86.5 (58.5)	0.237
Hemoglobin-last (g/dL)	10.3±1.83	10.8±2.27	0.263
Creatinine-last (mg/dL)	7.9 (3.91)	5.38 (5.52)	0.001
Calcium-last (mg/dL)	8.56 (0.9)	8.46 (1.04)	0.250
Phosphorus-last (mg/dL)	4.5 (2)	2.9 (1.87)	0.023
PTH-last (ng/L)	332.7 (417.8)	176 (253.5)	0.004
Albumin-last (g/dL)	3.6 (0.8)	3.1 (0.94)	0.001
Glucose-last (mg/dL)	101 (47)	114 (76)	0.021
Triglyceride-last (mg/dL)	138 (100)	117 (78)	0.058
HDL-last (mg/dL)	40 (18)	36 (16)	0.123
LDL-last (mg/dL)	96 (70)	83.5 (34)	0.026

BMI: Body mass index; PD: Peritoneal dialysis; HT: Hypertension; DM: Diabetes mellitus; CAD: Coronary artery disease; CHF: Congestive heart failure; PBD: Phosphorus binding drug; RAAS: Renin angiotensin aldosterone system; PPI: Proton pump inhibitor; PDGC: Peritoneal dialysate glucose concentration; PTH: Parathormone; HDL: High density lipoprotein; LDL: Low density lipoprotein.

TABLE 4: The effect of demographic characteristics on mortality in regression analysis.

	Univariate			Multivariate		
Parameters	**HR**	**95% CI**	**p value**	**HR**	**95% CI**	**p value**
Home heating	3.393	1.643-7.008	0.001	3.063	1.431-6.555	0.004
Bathing per week	0.595	0.367-0.964	0.035			
Need for assistant for PD	0.315	0.166-0.599	<0.001			
Need for assistant for basic care	0.324	0.169-0.619	0.001	0.245	0.119-0.506	<0.001
DM	0.333	0.172-0.641	0.001	0.292	0.135-0.630	0.002
CAD	0.247	0.128-0.476	<0.001	0.222	0.135-0.630	0.002
CHF	0.287	0.149-0.550	<0.001			
Income	2.471	1.242-4.913	0.01	2.272	1.112-4.812	0.001

HR: Hazard ratio; CI: Confidence interval; PD: Peritoneal dialysis; DM: Diabetes mellitus; CAD: Coronary artery disease; CHF: Congestive heart failure.

uretic use (HR=0.289, 95% CI: 0.149-0.504, p=0.011) were independent risk factors for all causes of mortality. It was found that the decrease in the use of phosphorus-binding drugs and calcitriol affected mortality 2,812 times (HR: 2.812, 95% CI: 1.160-6.818) and 3,632 times (HR: 3.632, 95% CI: 1.665-7.291, p=0.001), respectively (Table 5). The effects of other PD solution types, antihypertensive drugs, and PPI use on mortality could not be determined.

THE EFFECTS OF LABORATORY PARAMETERS ON MORTALITY

When the univariate Cox regression analysis of all laboratory parameters was performed, it was found that creatinine-first, creatinine-last, phosphorus-first, PTH-first, PTH-last, glucose-first, glucose-last, albumin-first, albumin-last, LDL-first, LDL-last were associated with mortality. However, in the multivariate regression analysis, it was determined that creatinine-first, PTH-first, and PTH-last affected mortality (Table 6).

DISCUSSION

The present study seeks to answer 2 questions. First, how does SES affect mortality in PD patients?

SES is a potential risk factor for the incidence and progression of CKD.[6,7] SES can be determined by income, education level, occupation, etc.[8,9] Many studies conducted with different SES indicators have identified the relationship between SES and mortality in dialysis patients. In a recently published meta-analysis, it was determined that only low-income level and occupation affect mortality in HD patients, while low-income level, education status, and occupation were risk factors for mortality in PD patients.[10] Sandhu et al. found in their study that dialysis population with higher Social Adaptability Index calculated on education, employment, income, marital status and substance abuse, had lower mortality rates.[11] In epidemiological studies conducted in the general population related to SES, it was found that

TABLE 5: The effect of medical treatments on mortality in regression analysis.

	Univariate			Multivariate		
Parameters	**HR**	**95% CI**	**p value**	**HR**	**95% CI**	**p value**
PBD-first	3.931	1.982-7.796	<0.001			
Diuretic-first	0.297	0.152-0.568	<0.001	0.289	0.149-0.504	0.011
PPI-first	0.485	0.240-0.981	0.044			
High PDGC-first	0.222	0.115-0.429	<0.001			
Calcitriol-last	4.516	1.958-10.418	<0.001	2.812	1.160-6.818	0.022
Diuretic-last	0.282	0.142-0.561	<0.001			
PBD-last	5.923	2.947-11.906	<0.001	3.632	1.665-7.921	0.001
High PDGC-last	2.241	1.042-4.818	0.039	0.357	0.183-0.695	0.002

HR: Hazard ratio; CI: Confidence interval; PBD: Phosphorus binding drug; PPI: Proton pump inhibitor; PDGC: Peritoneal dialysate glucose concentration.

TABLE 6: The effect of laboratory parameters on mortality in regression analysis.

	Univariate			Multivariate		
Parameters	**HR**	**95% CI**	**p value**	**HR**	**95% CI**	**p value**
Creatinine first	0.753	0.668-0.849	0.000	0.658	0.453-0.996	0.048
PTH first	1.005	1-1.009	0.034	0.997	0.996-0.999	0.004
Phosphorus first	0.741	0.594-0.925	0.008			
Albumin first	0.504	0.303-0.837	0.008			
Glucose first	1.005	1.002-1.009	0.004			
LDL first	0.992	0.984-0.999	0.025			
Creatinine last	0.783	0.712-0.860	0.000			
PTH last	0.997	0.996-0.999	0.002	0.997	0.994-1	0.031
Albumin last	0.497	0.339-0.729	0.000			
Glucose last	1.005	1.001-1.008	0.004			
LDL last	0.986	0.975-0.997	0.011			

HR: Hazard ratio; CI: Confidence interval; PTH: Parathormone; LDL: Low density lipoprotein.

low-income level is associated with injury, disability, and illness.[12,13] Therefore, it was stated that mortality and morbidity increased. While the effect of education status on mortality was not determined in the current study, it was determined that low-income level increased all-cause mortality 2,272 times. We think that the effect of low-income level on mortality may be due to increased infections such as peritonitis and sepsis due to impaired hygiene conditions. The method of heating the houses of the patients with low-income level was the stove. The number of weekly baths was significantly lower and the incidence of infection was significantly higher in the low-income group than in the middle-income group.

Another social condition affecting mortality in our study was that mortality was higher in patients who needed assistants for basic care services. In this patient group, it was found that CAD and CHF were more common, and the patients were older. One of the most important problems of the elderly population is frailty syndrome. Nutritional deficiency, oxidative stress, increased inflammation, and mitochondrial dysfunction constitutes the pathophysiology of this syndrome. The decrease in muscle mass and muscle strength causes deterioration in physical performance. An individual's functional independence is impaired, and they need someone's help.[14] The prevalence of frailty among dialysis patients is 3.0 to 10 times higher than among the elderly in the normal population.[15] The relationship between frailty and mortality was demonstrated in CKD patients as well as in many diseases.[16,17] In a meta-analysis evaluating 127,373 patients, frailty was found to increase the risk of mortality 1.47 times in CKD patients not on dialysis and 2.19 times in dialysis patients.[18]

The second question we investigated in the current study is how medical treatment affects mortality. In our study, it was found that the increase in the use of high PDGC solution over time affected the mortality. Glucose is the traditional osmotic agent in PD solutions due to its low price and efficiency.[19] However, a high PDGC may induce hyperglycemia, dyslipidemia, overweight, and HT.[20,21] Furthermore, using higher PDGC in PD solution often reflects worse fluid control in the PD patient. Fluid overload is considered a contributor to mortality among PD patients due to its association with complications such as HT, heart failure, increased cardiovascular event, arterial stiffness, and peritonitis, as well as inflammation, malnutrition and loss of residual renal function.[22-30] Similar to these data, in our study, it was found that our patients using high PDGC solution were more likely to be affected by CAD and CHF, and the amount of residual urine was less.

When the effects of other medical treatments were examined, the use of RAAS blocker, calcium channel blocker, beta-blocker, diuretic, or PPI did not have any effect on mortality. However, it was deter-

mined that the decrease in the use of phosphorus-binding drugs and calcitriol over time affected mortality by 3,632 and 2,812 times, respectively. In fact, the effect is not due to the decrease in the use of drugs by the patients, but to the decrease in the phosphorus and PTH levels of the patients to levels that do not require the use of drugs. The low levels of creatinine and albumin, as well as low levels of phosphorus, which we detected in our patients, reflect the nutritional deficiencies of the patients. Adynamic bone disease is a common type of renal osteodystrophy in patients with CKD and is closely associated with vascular calcification and mortality. Low PTH levels, malnutrition, inflammation, and DM are important triggers of adynamic bone disease.[31] Malnutrition status and low PTH in our patients may have affected mortality by increasing the tendency to adynamic bone disease.

Many studies have been conducted on calcium-phosphorus metabolism, which is one of the CKD-related factors affecting mortality. It was found that high levels of calcium, phosphorus, and PTH affect mortality.[32,33] However, over time, it was understood that the low levels of these parameters also affected mortality. It was determined that these parameters were associated with mortality in the form of a J or U-shaped curve.[34,35] Its height causes an increase in arterial stiffness and pulse pressure, creating a tendency for vascular calcification. Its low level reflects malnutrition.

The low number of patients, the lack of objective tests to evaluate malnutrition and hypervolemia of the patients and the failure to re-evaluate the medications and SES of the patients during the follow-up period are the limitations of our study.

CONCLUSION

The number of patients with PD is increasing rapidly worldwide. Mortality rates are still very high. A low-income level of patients increases mortality with an increased tendency to infection. Use of high PDGC solutions in patients in whom volume control cannot be achieved and malnutrition are other factors affecting mortality.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Refika Büberci, Murat Duranay;* ***Design:*** *Refika Büberci, Murat Duranay;* ***Control/Supervision:*** *Murat Duranay;* ***Data Collection and/or Processing:*** *Refika Büberci, Semahat Karahisar Şirali;* ***Analysis and/or Interpretation:*** *Refika Büberci, Semahat Karahisar Şirali, Murat Duranay;* ***Literature Review:*** *Refika Büberci, Semahat Karahisar Şirali;* ***Writing the Article:*** *Refika Büberci, Semahat Karahisar Şirali;* ***Critical Review:*** *Murat Duranay.*

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