Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Eating Attitudes and Perceived Stress in Relation to Dialysis Adequacy and Clinical Parameters in Chronic Hemodialysis Patients: An Exploratory Cross-Sectional Study

Ahmet Yeşiltaş
Recep Tayyip Erdoğan University
Elif Zeynep Gündoğdu
Recep Tayyip Erdoğan University
Erol Karavar
Recep Tayyip Erdoğan University
Leyla Koç
Recep Tayyip Erdoğan University
Ekrem Kara
ekrem.kara@erdogan.edu.tr
Recep Tayyip Erdoğan University

Research Article

Keywords: Hemodialysis, Eating attitudes, Eating Attitudes Test-26, Perceived stress, Dialysis adequacy

Posted Date: November 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11271043/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Patients receiving chronic hemodialysis (HD) follow restrictive diets and are exposed to uremic anorexia and psychological stress yet eating attitudes and perceived stress are rarely measured alongside dialysis adequacy. We described eating attitudes and perceived stress in chronic HD patients and tested their relation to dialysis adequacy and clinical parameters.

Methods

In this single-center cross-sectional study, 46 of 60 screened patients completed the Turkish Eating Attitudes Test-26 (EAT-26) and 10-item Perceived Stress Scale (PSS-10). Prespecified associations of the EAT-26 score with dialysis adequacy (Kt/V) and with the PSS-10 score were tested with Spearman correlation and Holm correction. Exploratory analyses used Spearman, Mann–Whitney U, or Fisher exact tests with false discovery rate (FDR) correction.

Results

Mean age was 67 ± 15 years; 56.5% were men. An EAT-26 score of 20 or more was found in 17.4% (95% confidence interval [CI] 9.1–30.7%) and was not associated with body mass index, albumin, or C-reactive protein. The EAT-26 score was not associated with Kt/V (ρ = −0.07, 95% CI − 0.38 to 0.26) or with the PSS-10 score (ρ = −0.01, − 0.33 to 0.29). No exploratory association survived FDR correction. Nominally, binge eating was more frequent at higher Kt/V and PSS-10 values, and weight loss of 9 kg or more was reported by 35% of women and 3.8% of men (*P* = 0.01).

Conclusions

A positive EAT-26 screen was common but unrelated to dialysis adequacy, perceived stress, or nutritional markers, and its meaning in HD requires validation. Exploratory signals are hypothesis-generating.

Background

Patients receiving chronic hemodialysis (HD) carry a heavy burden of comorbidity, inflammation, and nutritional compromise. The 2020 KDOQI Clinical Practice Guideline for Nutrition in CKD recommends that nutritional assessment in this population includes dietary intake alongside biochemical and anthropometric measures, and it sets out the potassium, phosphate, and sodium targets that shape daily eating in HD [1].

Anorexia is among the most frequent uremic symptoms. About one third of patients on maintenance dialysis report a fair or poor appetite, which has been attributed to retained uremic solutes, inflammatory cytokines, and altered appetite regulation [2]. In non-dialysis chronic kidney disease (CKD), untargeted metabolomic profiling has identified circulating solutes associated with the severity of uremic symptoms, one of which was anorexia [3]. In maintenance HD, however, a large metabolomic analysis found such metabolite-symptom associations to be inconsistent across cohorts [4]. In a recent cross-sectional study of 190 HD patients, anorexia was reported by 25.3% and was associated with protein-energy wasting, as was sarcopenia [5].

Disordered eating attitudes, meaning cognitions and behaviors such as dietary restriction, preoccupation with food, binge eating, and compensatory behaviors, are usually screened with the 26-item Eating Attitudes Test (EAT-26). Its cut-off score of 20 was derived in women with anorexia nervosa and female comparison subjects [6], and the Turkish version was validated in a university sample, with good internal consistency (Cronbach's $\alpha = 0.84$) and test–retest reliability ($r = 0.78$) [7]. Research on disordered eating in CKD is sparse. A 2024 study of 108 Lebanese patients with CKD examined disordered eating symptoms together with body appreciation and optimism but did not address dialysis-specific or laboratory correlates [8]. The reverse relationship is better documented, since purging-type eating disorders can cause hypokalemic nephropathy and progression to kidney failure [9]. How the EAT-26 performs in patients on HD, whose prescribed diet overlaps with several of its items, is unknown.

Perceived stress is commonly measured with the Perceived Stress Scale (PSS) [10] and is frequent in HD, where patients face a rigid treatment schedule, dietary and fluid restrictions, and accumulating comorbidity. The Turkish 10-item version (PSS-10) has good internal consistency ($\alpha = 0.82$) and 1-month test–retest reliability ($r = 0.88$) [11]. In a Turkish HD cohort, higher perceived stress was associated with lower treatment adherence, an effect buffered by patient health engagement [12], and in another HD cohort perceived stress correlated strongly with depressive symptoms [13]. In a large Turkish adult sample, higher perceived stress predicted more emotional eating [14].

To our knowledge, no study has assessed EAT-26 and PSS-10 scores in conjunction with dialysis adequacy in a chronic hemodialysis cohort. Before data collection, we hypothesized that lower dialysis adequacy and higher perceived stress would each be associated with a higher EAT-26 score. The study aimed (1) to describe eating attitudes and perceived stress in patients on chronic HD, (2) to test these two hypotheses, and (3) to explore, with correction for multiple testing, associations with other demographic, clinical, and laboratory parameters.

Methods

Study design and ethics committee approval

This single-center, cross-sectional study was conducted in the Hemodialysis Unit of Rize Educational and Research Hospital, Faculty of Medicine, Recep Tayyip Erdoğan University, Rize, Türkiye, and is

reported in accordance with the STROBE statement for cross-sectional studies. The study was approved by the Recep Tayyip Erdoğan University Health Sciences Ethics Committee (approval no. 2026/50; 14 April 2026) and was conducted in accordance with the Declaration of Helsinki. All participants gave written informed consent. Data was collected between 27 April and 17 May 2026.

Inclusion and exclusion criteria

Adults (≥ 18 years) on maintenance hemodialysis for at least 3 months were eligible if they were non-hospitalized, free of active infection, able to communicate, and capable of giving informed consent. Exclusion criteria were cognitive impairment, a DSM-5 defined psychiatric disorder, active malignancy, or a previously diagnosed eating disorder. Of the 60 patients on the unit's maintenance HD roster, 14 were excluded (recent hospitalization, n = 4; psychiatric disorder or cognitive impairment, n = 4; active infection, n = 3; active malignancy, n = 2; dialysis vintage < 3 months, n = 1). All 46 eligible patients agreed to participate (Supplementary file: Figure S1).

Hemodialysis

All patients received high-flux hemodialysis three times weekly, using biocompatible hemodialysis membranes with a dialysate containing standard bicarbonate and 140 mEq/L sodium. Blood flow rate was 300 to 350 mL/min, and dialysate flow rate was 500 mL/min. To calculate the delivered dialysis dose (urea reduction ratio [URR] and single-pool Kt/V [spKt/V]), pre- and post-dialysis plasma urea levels were measured in the same dialysis session.

Assessment of Eating Attitudes and Perceived Stress

Eating attitudes were assessed with the Turkish version of the EAT-26 [6, 7]. Part A collects demographic and anthropometric information and is not scored; age, sex, and body mass index were taken from medical records. The EAT-26 score is the Part B total: 26 items rated on a six-point frequency scale and scored 3, 2, 1, 0, 0, and 0 from the most to the least symptomatic option, with item 26 reverse-scored, giving a range of 0–78. A score of 20 or more was recorded as a positive screen. Part C, which is not included in the score, contains five behavioral questions on the previous 6 months: (A) binge eating with a feeling of being unable to stop, (B) self-induced vomiting to control weight or shape, (C) use of laxatives, diet pills, or diuretics, (D) exercise for more than 60 minutes a day to lose or control weight, and (E) weight loss of 9 kg (20 lb) or more. Items A–D are answered on a six-point frequency scale, and item E as yes or no. Because most patients gave the lowest response, each Part C item was analyzed as a binary variable (reported at any frequency vs. never).

Perceived stress was measured with the Turkish version [11] of the PSS-10 [10], which covers the previous month. Its ten items are rated from 0 (never) to 4 (very often), with the four positively worded items reverse-scored, giving a total of 0–40. The PSS-10 has performed well in chronic-illness

populations [15, 16]; it has no validated categorical cut-off and was analyzed as a continuous score. Both questionnaires were administered face-to-face by a member of the study team during a routine dialysis session.

Clinical and laboratory data

Age, sex, dialysis vintage, primary kidney disease, diabetes, hypertension, vascular access, dry weight, body mass index, and ultrafiltration volume were obtained from medical and dialysis records. Comorbidity was summarized with the Charlson Comorbidity Index [17]. Patients were classified as care-dependent if poor general condition left them unable to meet their own daily needs or live without assistance; most of these patients were bedridden. Venous blood samples were drawn after an overnight fast, before the mid-week dialysis session. Laboratory values were measured in the hospital's central laboratory. spKt/V was calculated with the Daugirdas formula [18] from pre- and post-dialysis urea, session length, ultrafiltration volume, and post-dialysis weight, and the urea reduction ratio (URR) as the percentage fall in urea during the session; a Kt/V of at least 1.2 was taken as the minimum adequate dose [19].

Statistical analysis

Continuous variables are reported as mean ± standard deviation (SD) or median (interquartile range [IQR]) according to the Shapiro–Wilk test, and categorical variables as n (%), with Wilson 95% confidence intervals (CIs) for proportions. The two prespecified hypotheses were tested as Spearman correlations of the EAT-26 score with Kt/V and with the PSS-10 score, with Holm correction. Sensitivity analyses used partial Spearman correlations adjusted for sex and dry weight (Kt/V) or sex and age (PSS-10), and URR in place of Kt/V.

Exploratory analyses formed two families. The correlation family related five eating outcomes (the EAT-26 score and binary Part C items A, C, D, and E; item B was invariant) and the PSS-10 score to 29 demographic, clinical, and laboratory variables, with Part C item A as an additional correlate of the PSS-10 score (175 tests; Supplementary file: Table S1). The subgroup family compared the EAT-26 and PSS-10 scores (Mann–Whitney U test) and the binary Part C items (Fisher's exact test) by sex, diabetes, hypertension, vascular access (fistula vs. catheter), age (< 65 vs. ≥65 years), and care dependency (36 tests; Supplementary file: Table S2).

Because ties were frequent, Spearman *P* values were obtained by permutation (100 000 permutations) and 95% CIs by bootstrap (2000 resamples). Subgroup effect sizes are rank-biserial correlations or risk differences with 95% CIs. The false discovery rate (FDR) was controlled with the Benjamini–Hochberg procedure [20] within each family and, as a sensitivity analysis, across all 211 tests. The two strongest nominal correlations and the sex difference in reported weight loss were re-examined with partial Spearman correlations adjusted for sex and dry weight, sex and age, or dry weight. Multivariable models were not fitted because of the small sample size.

No sample-size calculation was performed; all eligible patients were included. The sample provided 80% power to detect $|\rho| \geq 0.40$ ($\alpha = 0.05$) or ≥ 0.44 ($\alpha = 0.025$), and a Cohen's d of 0.85 between men and women. Analyses were performed with Python 3.11 (Python Software Foundation, Wilmington, DE, USA) and R 4.3.3 (R Foundation for Statistical Computing, Vienna, Austria). Claude Opus 5.5 (Anthropic, San Francisco, CA, USA) was used to assist with statistical programming, checking of reference details, and language editing; the authors reviewed and edited all output and take full responsibility for the content.

Results

Participant characteristics

The 46 patients had a mean age of 67 ± 15 years; 26 (56.5%) were men, and 25 (54.3%) were aged 65 years or older. Hypertensive nephropathy (n = 20, 43.5%) and diabetic kidney disease (n = 12, 26.1%) were the most common primary kidney diseases. Median dialysis vintage was 42 months (IQR 24–83). Mean Kt/V was 1.38 ± 0.20, and 41 patients (89.1%) had a Kt/V of 1.2 or more. Nine patients (19.6%) were care dependent (Table 1).

Table 1
Demographic, Clinical, Dialysis-Adequacy, and Laboratory Characteristics

Characteristic	Value (N = 46)
Age, years[a]	67 ± 15
Age ≥ 65 years	25 (54.3)
Male sex	26 (56.5)
Dialysis vintage, months[b]	42 (24–83)
Primary kidney disease	
Hypertensive nephropathy	20 (43.5)
Diabetic kidney disease	12 (26.1)
Chronic glomerulonephritis	4 (8.7)
Polycystic kidney disease	3 (6.5)
Other	5 (10.9)
Unknown	2 (4.3)
Comorbidities and care dependency	
Diabetes mellitus	20 (43.5)
Hypertension	35 (76.1)
Charlson Comorbidity Index[b]	7 (5–8)
Care-dependent	9 (19.6)
Hemodialysis adequacy and vascular access	
Urea reduction ratio, %[a]	70.9 ± 7
Kt/V[a]	1.38 ± 0.20
Kt/V ≥ 1.2	41 (89.1)
Catheter / AVF / AVG	23 (50) / 22 (47.8) / 1 (2.2)
Anthropometry and ultrafiltration	
Dry weight, kg[a]	72.8 ± 18.1
Body mass index, kg/m²[b]	22.5 (18.2–25)

Values are n (%) unless otherwise indicated. [a] Mean ± SD. [b] Median (interquartile range). AVF, arteriovenous fistula; AVG, arteriovenous graft; Kt/V, dialysis adequacy; LDL, low-density lipoprotein.

Characteristic	Value (N = 46)
Ultrafiltration volume, mL[a]	2691 ± 818
Laboratory	
Urea, mg/dL[b]	63.1 (42.8–157.2)
Creatinine, mg/dL[b]	4.76 (2.64–8.36)
Uric acid, mg/dL[a]	6.2 ± 1.1
Sodium, mmol/L[a]	137 ± 4
Potassium, mmol/L[b]	4.59 (3.55–5.42)
Calcium, mg/dL[a]	8.76 ± 0.76
Phosphate, mg/dL[b]	5.7 (4.3–7.33)
Parathyroid hormone, pg/mL[b]	468.9 (140.4–783.3)
Total protein, g/L[a]	69 ± 4.7
Albumin, g/L[a]	39.5 ± 3.3
Hemoglobin, g/dL[b]	11.5 (10.7–12.2)
Hematocrit, %[b]	36.7 (34.6–38.3)
Platelets, ×10³/μL[b]	202 (161–243)
Transferrin saturation, %[b]	32.7 (22.1–54.6)
Ferritin, ng/mL[b]	328 (167.2–518.8)
Total cholesterol, mg/dL[a]	177.2 ± 45.6
Triglycerides, mg/dL[b]	152 (109–188)
LDL cholesterol, mg/dL[a]	104.8 ± 41.1
C-reactive protein, mg/L[b]	10 (6–21.9)

Values are n (%) unless otherwise indicated. [a] Mean ± SD. [b] Median (interquartile range). AVF, arteriovenous fistula; AVG, arteriovenous graft; Kt/V, dialysis adequacy; LDL, low-density lipoprotein.

Eating attitudes and perceived stress

The mean EAT-26 score was 14 ± 7.7, and 8 patients (17.4%; 95% CI 9.1–30.7%) had a score of 20 or more (Table 2, Fig. 1). Patients with and without a positive screen did not differ in body mass index, dry weight, albumin, or C-reactive protein (all $P \geq 0.80$), although total protein was lower in screen-positive patients (median 65 vs. 70.5 g/L; $P = 0.01$) (Supplementary file: Table S3). In Part C, binge eating and laxative, diet pill, or diuretic use were each reported by 8 patients (17.4%), exercise for more than 60 minutes a day to control weight by 9 (19.6%), and weight loss of 9 kg or more by 8 (17.4%) (Table 2). No patient reported self-induced vomiting (0%; upper 95% confidence limit 7.7%). Twenty-seven patients (58.7%) reported at least one Part C behavior, and 6 (13%) reported two. The mean PSS-10 score was 15.5 ± 5.8 (observed range 4–27).

Table 2
Eating Attitudes and Perceived Stress

Measure	Value (N = 46)	95% CI, %
EAT-26 score, Part B total (0–78)[a]	14 ± 7.7	
Score ≥ 20 (positive screen)	8 (17.4)	9.1–30.7
EAT-26 Part C behaviors in the previous 6 months[b]		
A. Binge eating	8 (17.4)	9.1–30.7
B. Self-induced vomiting	0 (0)	0–7.7
C. Laxative, diet pill, or diuretic use	8 (17.4)	9.1–30.7
D. Exercise > 60 min/day to control weight	9 (19.6)	10.7–33.2
E. Weight loss ≥ 9 kg	8 (17.4)	9.1–30.7
Any Part C behavior	27 (58.7)	44.3–71.7
PSS-10 score (0–40)[a]	15.5 ± 5.8	
Observed range	4–27	

Values are n (%) unless otherwise indicated; 95% CIs by the Wilson method. [a] Mean ± SD. [b] Reported at any frequency (items A–D) or answered yes (item E). The PSS-10 has no validated categorical cut-off and was analyzed as a continuous score. CI, confidence interval; EAT-26, Eating Attitudes Test-26; PSS-10, 10-item Perceived Stress Scale.

Prespecified hypotheses

The EAT-26 score was not associated with Kt/V ($\rho = -0.07$, 95% CI − 0.38 to 0.26; $P = 0.65$) or with the PSS-10 score ($\rho = -0.01$, 95% CI − 0.33 to 0.29; $P = 0.95$), and Holm-adjusted P values were > 0.99 for both tests (Table 3, Fig. 2). The estimates were unchanged after adjustment for sex and dry weight or for sex and age, and when URR replaced Kt/V.

Table 3
Prespecified Associations of the EAT-26 Score with Dialysis Adequacy and Perceived Stress

Analysis	ρ (95% CI)	P	Holm *P*
Primary analyses			
EAT-26 score vs. Kt/V	−0.07 (− 0.38 to 0.26)	0.65	> 0.99
EAT-26 score vs. PSS-10 score	−0.01 (− 0.33 to 0.29)	0.95	> 0.99
Sensitivity analyses			
EAT-26 score vs. Kt/V, adjusted for sex and dry weight[a]	−0.10 (− 0.39 to 0.21)	0.53	–
EAT-26 score vs. PSS-10 score, adjusted for sex and age[a]	−0.03 (− 0.34 to 0.29)	0.86	–
EAT-26 score vs. URR	−0.02 (− 0.33 to 0.27)	0.90	–

ρ, Spearman's rank correlation coefficient with bootstrap 95% CI (2000 resamples); *P* values by permutation (100 000 permutations) for unadjusted correlations. [a] Partial Spearman correlation (rank-based residuals), with *P* from the t distribution. Holm correction was applied to the two primary tests. EAT-26, Eating Attitudes Test-26 (Part B total); Kt/V, dialysis adequacy; PSS-10, 10-item Perceived Stress Scale; URR, urea reduction ratio.

Exploratory analyses

Of the 175 correlations, 11 (6.3%) reached nominal significance, compared with 8.8 expected by chance, and none survived FDR correction (adjusted $P \geq 0.66$; Table 4 and Supplementary file: Table S1). Binge eating was reported more often by patients with a higher PSS-10 score (ρ = 0.39, 95% CI 0.08 to 0.63; $P = 0.006$) and a higher Kt/V (ρ = 0.39, 95% CI 0.06 to 0.62; $P = 0.008$), and the PSS-10 score itself correlated with Kt/V (ρ = 0.34; $P = 0.02$). Kt/V correlated inversely with dry weight (ρ = −0.49, 95% CI − 0.70 to − 0.21; $P < 0.001$) and was higher in women than in men (median 1.45 vs. 1.30; $P = 0.009$) (Supplementary file: Figure S2). The association of binge eating with Kt/V persisted after adjustment for sex and dry weight (partial ρ = 0.42, 95% CI 0.08 to 0.66; $P = 0.004$), and that with the PSS-10 score after adjustment for sex and age (partial ρ = 0.39, 95% CI 0.05 to 0.63; $P = 0.008$) (Supplementary file: Table S4).

Table 4
Exploratory Associations with Nominal Significance

Outcome	Variable	ρ (95% CI)	P (nominal / FDR)
PSS-10 score	C-A, binge eating	0.39 (0.08 to 0.63)	0.006 / 0.66
C-A, binge eating	Kt/V	0.39 (0.06 to 0.62)	0.008 / 0.66
PSS-10 score	Kt/V	0.34 (0.08 to 0.59)	0.02 / 0.76
C-E, weight loss	Dialysis vintage, months	−0.33 (− 0.58 to 0.01)	0.02 / 0.76
C-E, weight loss	Parathyroid hormone, pg/mL	−0.33 (− 0.54 to − 0.08)	0.03 / 0.76
C-A, binge eating	Parathyroid hormone, pg/mL	−0.32 (− 0.53 to − 0.06)	0.03 / 0.76
C-D, exercise	Platelets, ×10³/μL	−0.31 (− 0.53 to − 0.06)	0.04 / 0.76
EAT-26 score	LDL cholesterol, mg/dL	0.31 (0 to 0.56)	0.043 / 0.76
EAT-26 score	Total cholesterol, mg/dL	0.30 (0.03 to 0.53)	0.046 / 0.76
PSS-10 score	Triglycerides, mg/dL	0.30 (0.01 to 0.57)	0.046 / 0.76
C-C, laxatives/diuretics	Creatinine, mg/dL	0.29 (0.05 to 0.51)	0.048 / 0.76

The 11 correlations with nominal $P < 0.05$ among the 175 tested are shown; all tests are listed in supplementary file: Table S1, and adjusted estimates are given in Table S4. None remained significant after Benjamini–Hochberg FDR correction. Part C items were coded as reported vs. not reported, so for these outcomes ρ compares patients who did and did not report the behavior. ρ, Spearman's rank correlation coefficient with bootstrap 95% CI (2000 resamples); nominal P by permutation (100 000 permutations). C-A to C-E, EAT-26 Part C items; FDR, false discovery rate; Kt/V, dialysis adequacy; LDL, low-density lipoprotein; PSS-10, 10-item Perceived Stress Scale.

Of the 36 subgroup comparisons, one reached nominal significance: weight loss of 9 kg or more was reported by 7 of 20 women (35%) and 1 of 26 men (3.8%), a difference of 31.2 percentage points (95% CI 8.5 to 53.1; Fisher $P = 0.01$; FDR-adjusted $P = 0.51$). Women had a lower median dry weight than men (66 vs. 77.3 kg), and the difference persisted after adjustment for dry weight (partial ρ = 0.41, 95% CI 0.14 to 0.63; $P = 0.006$). Care-dependent patients had a higher median PSS-10 score than independent patients (18 vs. 15; r = 0.34, 95% CI − 0.02 to 0.65; P = 0.12). When all 211 exploratory tests were corrected as a single family, the smallest FDR-adjusted P value was 0.80.

Discussion

In this cross-sectional study of 46 patients on chronic HD, neither prespecified hypothesis was supported: the EAT-26 score was unrelated to dialysis adequacy and to perceived stress, and the confidence intervals excluded strong correlations. One in six patients screened positive on the EAT-26, but a positive screen did not track body mass index, albumin, or inflammation, and only total protein differed. None of the 211 exploratory tests survived FDR correction.

These data raise the question of what the EAT-26 measures in patients on HD. The cut-off of 20 was derived in young women with anorexia nervosa [6], and the Turkish version was validated in university students [7]. Several EAT-26 items, such as awareness of the content of foods, avoidance of particular foods, and the sense that food controls one's life, describe the dietary restrictions that patients on HD are asked to follow [1]. Part C, item C counts diuretics and laxatives, which many patients use for medical reasons, and item D asks about exercise in a population with limited mobility. A positive screen in this setting may therefore reflect adherence to a prescribed diet rather than disordered eating, and the absence of any association with nutritional markers is consistent with this reading. We regard the 17.4% figure as the frequency of a positive EAT-26 screen, not as a prevalence of disordered eating, and the instrument should be validated against a clinical interview, with medication histories, before it is used for screening in HD.

The null results for dialysis adequacy should be read against the narrow range of Kt/V in this well-dialyzed cohort, in which 89.1% had a Kt/V of 1.2 or more; the hypothesis that inadequate dialysis worsens eating attitudes could not be tested properly. With 46 patients, correlations below 0.40 could not be reliably detected, so weak associations remain possible.

Among the exploratory findings, binge eating was reported more often by patients with a higher Kt/V, the opposite of the direction we had expected. Because Kt/V is scaled to body water, it was higher in smaller patients and in women, but the association persisted after adjustment for sex and dry weight. Better solute clearance could relieve uremic appetite suppression [2], but this explanation is post hoc, the finding rests on eight patients who reported binge eating, and it may be a chance result.

The nominal association between perceived stress and binge eating agrees with the link between perceived stress and emotional eating in Turkish adults [14]. Experimental studies show that acute stress can increase food intake and the urge to binge, although they examine laboratory-induced stress rather than stress perceived over the past month [21]. Clinically significant depressive symptoms affect about 25% to 30% of dialysis patients when assessed by structured interview [22], and depression, anxiety, and somatic symptoms are closely inter-related in HD [23]. Because we did not measure depression or anxiety, the association cannot be attributed to perceived stress itself.

Weight loss of 9 kg or more was reported far more often by women. The EAT-26 asks about weight loss as a yes-or-no question with a fixed 9 kg threshold, so the item does not capture the amount lost. Women had a lower dry weight, and the difference persisted after adjustment for dry weight. In patients

on HD, however, such weight loss may reflect intercurrent illness, protein-energy wasting, or the removal of excess fluid after dialysis initiation, and the nominal inverse association of this item with dialysis vintage fits the last explanation. Serial dry-weight records would be needed to separate these possibilities, and the finding did not survive FDR correction. Similarly, the absence of self-induced vomiting is compatible with a true frequency of up to 7.7%, and under-reporting on a face-to-face questionnaire is possible.

Care dependency was not significantly associated with eating-attitude or stress scores, but care-dependent patients had a higher median PSS-10 score, and the wide confidence interval does not exclude a meaningful difference in this group of nine patients. Physical dependency and financial strain can add to the psychosocial load of HD [24]. This burden may be expressed more in adherence-related outcomes such as interdialytic weight gain [25], which a community health worker intervention addressing social needs modestly reduced in a randomized trial [26].

This study has several strengths. Eating attitudes, perceived stress, dialysis adequacy, and a broad laboratory panel were measured in the same patients within a three-week window, and all eligible patients took part. The two hypotheses were stated before data collection and tested separately from the exploratory screens, all tests are reported, and effect sizes are given with confidence intervals.

The study also has limitations. First, the EAT-26 has not been validated in patients on HD, and some of its items overlap with the renal diet and with medical use of diuretics and laxatives. Second, the sample was small and drawn from a single center, and the narrow range of Kt/V limited the test of the adequacy hypothesis. Third, the number of exploratory tests was large relative to the sample size. Fourth, no multivariable models were fitted, so residual confounding cannot be excluded. Fifth, the cross-sectional design does not allow causal inference. Sixth, the cohort consisted of prevalent patients well enough to complete interviews, and patients with a known eating disorder, psychiatric disorder, or cognitive impairment were excluded. Seventh, Part C behaviors were self-reported in a face-to-face interview, which may lead to under-reporting of stigmatized behaviors, and the weight-loss item records only whether a fixed 9 kg threshold was exceeded. Eighth, we did not record medication use, residual urine output, educational level, dietary intake, appetite, or measures of depression and anxiety. Ninth, the internal consistency of the questionnaires was not assessed in this sample. Finally, the results may not apply to HD populations with a different case mix, dialysis practice, or cultural background.

Conclusions

In this chronic HD cohort, the EAT-26 score was not associated with dialysis adequacy or perceived stress, and a positive EAT-26 screen, found in 17.4% of patients, was unrelated to nutritional markers. Because several EAT-26 items overlap with the prescribed renal diet, the instrument should be validated against clinical interview in HD before it is used for screening. The exploratory associations of binge eating with Kt/V and perceived stress, and the higher frequency of reported weight loss in women, did

not survive correction for multiple testing and should be tested in larger studies that also measure medication use, appetite, and depressive symptoms.

Abbreviations

AVF
arteriovenous fistula
AVG
arteriovenous graft
CI
confidence interval
CKD
chronic kidney disease
DSM-5
Diagnostic and Statistical Manual of Mental Disorders,Fifth Edition
EAT-26
Eating Attitudes Test-26
FDR
false discovery rate
HD
hemodialysis
IQR
interquartile range
KDOQI
Kidney Disease Outcomes Quality Initiative
Kt/V
dialysis adequacy
LDL
low-density lipoprotein
PSS
Perceived Stress Scale
PSS-10
10-item Perceived Stress Scale
SD
standard deviation
spKt/V
single-pool Kt/V
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
URR

urea reduction ratio

Declarations

Competing interests:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics approval and consent to participate:

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Recep Tayyip Erdoğan University Health Sciences Ethics Committee (approval no. 2026/50; 14 April 2026). Written informed consent was obtained from all participants before enrollment.

Consent for publication:

Not applicable.

Competing interests:

The authors declare no competing interests.

Funding

This study received no funding.

Use of Artificial Intelligence

During the preparation of this work, the authors used Claude Opus 5.5 (Anthropic, San Francisco, CA, USA) for statistical programming, checking of reference details, and language editing. No figures, data, or results were generated by the tool. The authors reviewed and edited all output and take full responsibility for the content of the publication.

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contribution

Ahmet Yeşiltaş, Elif Zeynep Gündoğdu, and Erol Karavar: conceptualization, investigation, data curation, writing – review and editing. Leyla Koç: resources, methodology, investigation, writing – review and editing. Ekrem Kara: formal analysis, writing – original draft, writing – review and editing, supervision. All authors read and approved the final manuscript.

Acknowledgments:

None.

Clinical trial number:

Not applicable.

Data Availability

The dataset used and analysed during the current study is available from the corresponding author on reasonable request.

References

1. Ikizler TA, Burrowes JD, Byham-Gray LD, Campbell KL, Carrero JJ, Chan W, et al. KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. Am J Kidney Dis. 2020;76(3 Suppl 1):S1–107. 10.1053/j.ajkd.2020.05.006.
2. Chazot C. Why are chronic kidney disease patients anorexic and what can be done about it? Semin Nephrol. 2009;29(1):15–23. 10.1016/j.semnephrol.2008.10.003.
3. Wulczyn KE, Shafi T, Anderson A, Rincon-Choles H, Clish CB, Denburg M, et al. Metabolites associated with uremic symptoms in patients with CKD: findings from the Chronic Renal Insufficiency Cohort (CRIC) Study. Am J Kidney Dis. 2024;84(1):49–e611. 10.1053/j.ajkd.2023.11.013.
4. Al Awadhi S, Myint L, Guallar E, Clish CB, Wulczyn KE, Kalim S, et al. A metabolomics approach to identify metabolites associated with uremic symptoms in patients receiving maintenance hemodialysis. Kidney360. 2026;7(2):353–61. 10.34067/KID.0000000838.
5. Chaviaras E, Nikolakopoulou K, Karayiannis D, Triantafyllis G, Gkinis V, Kalaitzakis E, et al. Phase angle from bioelectrical impedance analysis predicts protein-energy wasting independently of anorexia and sarcopenia in patients on hemodialysis: the Hemodialysis Anorexia Sarcopenia Protein-Energy Wasting study. J Ren Nutr. 2026. 10.1053/j.jrn.2026.07.005. Epub ahead of print.

6. Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: psychometric features and clinical correlates. Psychol Med. 1982;12(4):871–8. 10.1017/s0033291700049163.
7. Ergüney-Okumuş FE, Sertel-Berk HÖ. Yeme Tutum Testi Kısa Formunun (YTT-26) üniversite örnekleminde Türkçeye uyarlanması ve psikometrik özelliklerinin değerlendirilmesi [The psychometric properties of the Eating Attitudes Test Short Form (EAT-26) in a university sample]. Psikoloji Çalışmaları. 2020;40(1):57–78. 10.26650/SP2019-0039.
8. Hajj-Moussa M, El Hachem N, El Sebaaly Z, Moubarak P, Kahwagi RM, Malaeb D, et al. Body appreciation is associated with optimism/pessimism in patients with chronic kidney disease: results from a cross-sectional study and validation of the Arabic version of the Optimism-Pessimism Short Scale-2. PLoS ONE. 2024;19(9):e0306262. 10.1371/journal.pone.0306262.
9. Puckett L. Renal and electrolyte complications in eating disorders: a comprehensive review. J Eat Disord. 2023;11(1):26. 10.1186/s40337-023-00751-w.
10. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983;24(4):385–96.
11. Eskin M, Harlak H, Demirkıran F, Dereboy Ç. Algılanan Stres Ölçeğinin Türkçeye uyarlanması: güvenirlik ve geçerlik analizi [The adaptation of the Perceived Stress Scale into Turkish: a reliability and validity analysis]. Yeni Symposium. 2013;51(3):132–140.
12. Usta D, Acampora M, Graffigna G. Patient health engagement as a moderator between perceived stress and treatment adherence among kidney failure patients undergoing hemodialysis: a cross-sectional analysis. J Behav Med. 2025;48(5):848–59. 10.1007/s10865-025-00591-w.
13. Bossola M, Di Giovanni M, Mariani I, Di Stasio E, Angioletti L, Balconi M. Post-dialysis fatigue is not associated with perceived stress in patients on hemodialysis. Hemodial Int. 2025;29(2):214–21. 10.1111/hdi.13209.
14. Aslan B, Tamer F, Önal Ö. Emotional eating in Turkish adults: behavioural and psychological determinants with a psychometric evaluation of the Comprehensive Emotional Eating Scale. Br J Nutr. 2026. 10.1017/S0007114526107491. Epub ahead of print.
15. Lee EH, Chung BY, Suh CH, Jung JY. Korean versions of the Perceived Stress Scale (PSS-14, 10 and 4): psychometric evaluation in patients with chronic disease. Scand J Caring Sci. 2015;29(1):183–92. 10.1111/scs.12131.
16. Mills SD, Azizoddin D, Racaza GZ, Wallace DJ, Weisman MH, Nicassio PM. The psychometric properties of the Perceived Stress Scale-10 among patients with systemic lupus erythematosus. Lupus. 2017;26(11):1218–23. 10.1177/0961203317701844.
17. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987;40(5):373–83. 10.1016/0021-9681(87)90171-8.
18. Daugirdas JT. Second generation logarithmic estimates of single-pool variable volume Kt/V: an analysis of error. J Am Soc Nephrol. 1993;4(5):1205–13. 10.1681/ASN.V451205.

19. National Kidney Foundation. KDOQI Clinical Practice Guideline for Hemodialysis Adequacy. 2015 update. Am J Kidney Dis. 2015;66(5):884–930. 10.1053/j.ajkd.2015.07.015.
20. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. J R Stat Soc Ser B Stat Methodol. 1995;57(1):289–300. 10.1111/j.2517-6161.1995.tb02031.x.
21. Fuentes N, Cabezas MF, Nazar G. Affect-induction techniques and psychophysiological response in human studies of eating behavior. A systematic review of recent studies. Appetite. 2026;226:108688. 10.1016/j.appet.2026.108688.
22. Malhotra K, Fangue-Nelon J, Singh G. Mental health disorders in end-stage kidney disease: a narrative review of clinical considerations for integrated management. Hemodial Int. 2026. 10.1111/hdi.70102. Epub ahead of print.
23. Krishna A, O'Donnell K, Dolata J, Figueroa M, Sajatovic M, Sehgal AR, et al. Evaluating the inter-relationships among depression, anxiety and somatic symptoms in haemodialysis patients: a cross-sectional structural equation modelling study. BMJ Open. 2026;16(6):e113939. 10.1136/bmjopen-2025-113939.
24. Akhtar T, Pienaar AJ, Asmat K, Sikander S. Lived realities of symptom burden among haemodialysis patients: a phenomenological study from rural Pakistan. BMJ Open. 2025;15(11):e106937. 10.1136/bmjopen-2025-106937.
25. Bossola M, Mariani I, Strizzi CT, Piccinni CP, Di Stasio E. How to limit interdialytic weight gain in patients on maintenance hemodialysis: state of the art and perspectives. J Clin Med. 2025;14(6):1846. 10.3390/jcm14061846.
26. Cervantes L, Juarez-Colunga E, Powe NR, Flythe JE, Steiner JF, Cukor D, et al. Community health worker support for Hispanic and Latino individuals receiving hemodialysis: the Navigate-Kidney randomized clinical trial. JAMA Intern Med. 2026;186(1):56–66. 10.1001/jamainternmed.2025.5305.

Figures

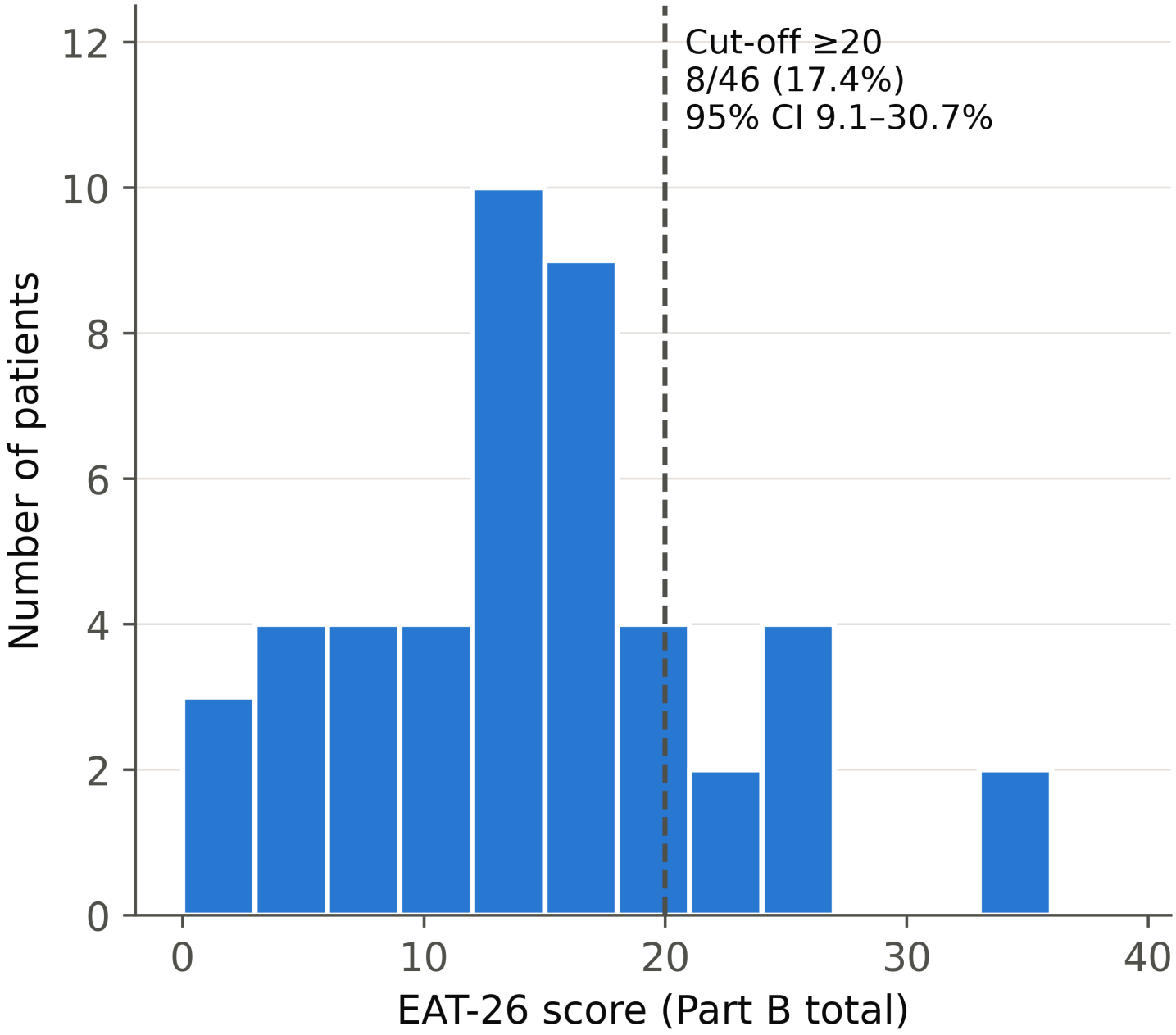

Figure 1

Distribution of EAT-26 scores (Part B total) in the 46 patients. The dashed line marks the screening cut-off of 20; 8 patients (17.4%) scored 20 or more. EAT-26, Eating Attitudes Test-26.

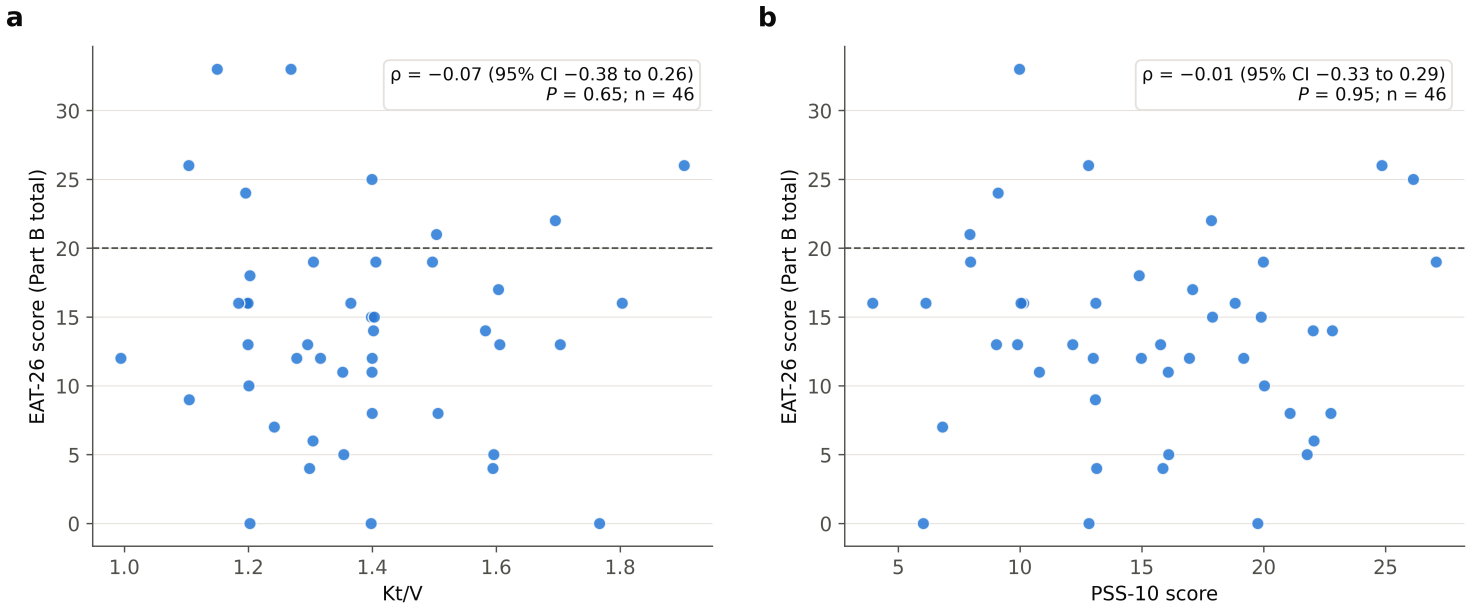

Figure 2

Prespecified associations of the EAT-26 score with Kt/V and the PSS-10 score. EAT-26 score (Part B total) versus (a) Kt/V and (b) PSS-10 score. The text boxes show Spearman's ρ with bootstrap 95% CI and the permutation *P*value. The dashed line marks the EAT-26 screening cut-off of 20. Points are slightly jittered horizontally where values overlap; no trend lines are fitted. CI, confidence interval; EAT-26, Eating Attitudes Test-26; PSS-10, 10-item Perceived Stress Scale.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- HDEATPSSSupplementaryFile.docx