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Validating Appetite Assessment Tools among Patients Receiving Hemodialysis

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Abstract

Objective—To test the performance of appetite assessment tools among patients receiving hemodialysis.

Design—Cross-sectional.

Setting—Seven dialysis facilities in Northern California.

Subjects—221 patients receiving hemodialysis.

Intervention—We assessed five appetite assessment tools [self-assessment of appetite, subjective assessment of appetite, visual analogue scale (VAS), Functional Assessment of Anorexia/Cachexia Therapy (FAACT) score and the Anorexia Questionnaire (AQ)].

Main outcome measures—Reported food intake, normalized protein catabolic rate (nPCR), and change in body weight were used as criterion measures, and we assessed associations among the appetite tools and biomarkers associated with nutrition and inflammation. Patients were asked to report their appetite and the percentage of food eaten (from 0% to 100%) during the last meal compared to usual intake.

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Results—Fifty-eight (26%) patients reported food intake ≤50% (defined as poor appetite). The prevalence of anorexia was 12% by self-assessment of appetite, 6% by subjective assessment of appetite, 24% by VAS, 17% by FAACT score, and 12% by AQ. All tools were significantly associated with food intake ≤50% ($p<0.001$), except self-assessment of appetite. The FAACT score and the VAS had the strongest association with food intake ≤50% (c-statistic 0.80 and 0.76). Patients with food intake ≤50% reported weight loss more frequently than patients without low intake (36% vs 22%) and weight gain less frequently (19% vs 35%; $p=0.03$). nPCR was lower among anorexic patients based on the VAS (1.1 ± 0.3 vs 1.2 ± 0.3, $p=0.03$). Ln IL-6 correlated inversely with food intake ($p=0.03$), but neither IL-6 nor CRP correlated with any of the appetite tools. Furthermore, only the self-assessment of appetite was significantly associated with serum albumin ($p=0.02$), prealbumin ($p=0.02$) and adiponectin concentrations ($p=0.03$).

Conclusions—Alternative appetite assessment tools yielded widely different estimates of the prevalence of anorexia in hemodialysis. When considering self-reported food intake as the criterion standard for anorexia, the FAACT score and VAS discriminated patients reasonably well.

Keywords

Anorexia; appetite assessment; body weight; nPCR; inflammation; hemodialysis

Introduction

Anorexia is defined as a reduction of the desire to eat (1). In patients receiving hemodialysis (HD), there is a robust relation between anorexia and poor health-related quality of life as well as higher risks of hospitalization and mortality (1). Considering the clinical relevance of anorexia, several tools have been proposed for screening in the general population, where questionnaires and visual analogue scale (VAS) are most commonly used (2). Since anorexia specifically reflects the loss of the *desire* to eat, food intake may not be affected in anorexic patients. Nevertheless, in daily practice, reduced food intake is frequently used as a surrogate marker of the presence of anorexia and its severity. Recent evidence obtained in a large European survey shows that hospitalized patients reporting reduction of food intake, as assessed by intake at each meal over the most recent day, were at higher risk of mortality within 30 days, even more than patients reporting involuntary body weight loss (3). More recently, patients who reported reduced food intake during the most recent lunch (eating half, a quarter, or nothing) were at particularly high risk of adverse outcomes (4). This evidence highlights the potential relevance of relating anorexia to patients' eating behavior, even if anorexia and inadequate nutritional intake are not identical constructs.

The primary aims of the present study were 1) to assess the prevalence of anorexia in a population of patients receiving HD using currently available appetite assessment tools (including questionnaires and VAS); and 2) to assess the relations among different tools and self-reports of food intake. In addition, we aimed to evaluate which of the appetite assessment tools were associated (and to what degree) with clinical parameters, including inflammatory and nutritional biomarkers.

Methods

POPULATION

In the period between November 2010 and July 2011, adult men and women on HD who were participants in the San Francisco Bay Area sites of the USRDS ACTIVE/ADIPOSE (A Cohort study To Investigate the Value of Exercise/Analyses Designed to Investigate the Paradox of Obesity in ESRD) study (5) were asked to additionally complete multiple appetite assessment tools and a self-report of food intake. According to the exclusion criteria for ACTIVE/ADIPOSE, patients not willing or unable to give informed consent or to complete study questionnaires (i.e., patients with dementia or cognitive impairment) were excluded. We also excluded patients with suboptimal understanding of English language and patients with diseases other than ESRD associated with wasting (i.e., cancer, acute or chronic infection).

We administered the anorexia questionnaires during a routine study visit. We measured body weight (kg) to the nearest 0.1 kg and height to the nearest 0.5 cm using a stadiometer (AYRTON model number S100) and calculated Quetelet's (body mass) index (BMI) in kg/m^2.

APPETITE

We assessed appetite using five different appetite assessment tools immediately before the beginning of a mid-week HD session (Table 1).

- In the *self-assessment of appetite changes* during a 30-day period, patients were asked to compare their present appetite to their appetite over the last month, rating it as increased, decreased, or unchanged. This is a qualitative tool that allows a rapid assessment of anorexia and tends to minimize the influence of recent flares of chronic diseases (6).
- The *subjective assessment of appetite* referred to the last week (increased, remained the same, or decreased) was performed according to the first question of the Appetite and Diet Assessment Tool, as previously performed in HD. This qualitative tool may prove effective in routine monitoring of the efficacy of anti-anorexia therapies (7, 8).
- The *VAS*, consisting of a line of 100 mm, the extremes anchored to "no hunger" (0 mm) and "hunger" (100 mm), was administered. Patients were asked to place a line on the VAS that corresponded to their current appetite. This tool allows a quantitative "measure" of appetite, but there is no defined cutoff value on the VAS for diagnosing anorexia. Zabel *et al*. have previously shown that the mean VAS score reported by patients receiving dialysis with poor appetite is ≤50mm, whereas the mean VAS score reported by patients receiving HD with good appetite is >50 mm (9). Therefore, we defined a VAS score ≤50mm as indicative of anorexia.
- The *Functional Assessment of Anorexia/Cachexia Therapy (FAACT) score*, recently developed by the European Society for Clinical Nutrition and Metabolism (ESPEN), is based on a subset of the FAACT, in particular the anorexia/cachexia

subscale (AC/S)-12 section (10). This FAACT-ESPEN score consists of 12 questions related to appetite and food intake and allows a qualitative and quantitative diagnosis of anorexia. Each question is on a 5-point Likert scale (i.e., not at all, a little bit, somewhat, quite a bit, very much), each conferring a score from 0 to 4. A total score ≤30 was considered to indicate the presence of anorexia (6).

- The *Anorexia questionnaire (AQ)* was developed as a rapid qualitative tool for the diagnosis of anorexia associated with chronic diseases, including ESRD (11). It investigates the presence of early satiety, taste/smell alterations, meat aversion, and nausea/vomiting. Patients reporting at least one of these symptoms are considered to have anorexia (11).

INTAKE

Patients were asked to report food intake at their most recent meal as a percentage of what was served, using simple categories. Specifically, they were asked to choose which of the following categories (i.e., 100%, 75%, 50%, 25%, 0%) came closest to their estimate (6). Food intake is considered insufficient when it meets <60–65% of energy and protein requirements (12). Therefore, for dichotomous analyses, we designated reported food intake of 0%, 25% and 50% as inadequate intake. We used the most recent meal in order to make the anorexia evaluation and food intake as close to simultaneous as possible. Considering that we aimed at relating appetite with the most recent meal, its standardization to the average of food intake of each patient was not performed.

We also used normalized protein catabolic rate (nPCR) (grams per kilogram per day) calculated from dialysis kinetic modeling during the month that body composition was measured as an estimate of dietary protein intake (13). In the course of evaluation, we also asked patients whether they had experienced any changes in body weight during the previous six months.

BIOMARKERS

Blood samples were collected at the participants' dialysis units during the same week as the appetite assessment and centrifuged at the University of California, San Francisco within 24 hours and the serum stored at −80°C. The serum specimens were then shipped to a central laboratory at the University of California, Davis for analyses. We measured serum albumin, prealbumin, and C-reactive protein (CRP) concentrations in duplicate on each sample with a Poly-Chem chemical analyzer (Polymedco Cortlandt Manor, NY). We measured interleukin-6 (IL-6), adiponectin, and leptin by ELISA (EMD Millipore Corporation. Billerica, MA). To account for the known strong associations between leptin and adiponectin with adiposity, we used leptin/BMI and adiponectin/BMI ratios in our analyses as previously described (14). Data presented here utilize the mean of two measurements.

STATISTICAL ANALYSES

We examined associations of the appetite assessment tools with three types of variables. The primary dependent variable was self-reported food intake (%) at the most recent meal.

Secondary dependent variables, expected to be directly related to anorexia and food intake over the short or longer term, included nPCR and body weight change over the prior six months. In addition to these "criterion measures," we also examined the association of anorexia with other markers, including CRP, IL-6, albumin, prealbumin, leptin/BMI and adiponectin/BMI, which might be causes or consequences of anorexia and poor nutritional intake.

Patient characteristics (demographic, clinical, nutritional and inflammatory) were described using mean (SD) or median (interquartile range) for continuous variables and proportions for categorical variables. Although some of the appetite assessment tools are qualitative and some quantitative, we treated them all as dichotomous, indicating the presence or absence of anorexia, as described above. Food intake was also dichotomized, considering those who consumed >50% of the meal as non-anorexic and patients with intake ≤50% of the meal as anorexic. We assessed how accurately the tools identified patients with inadequate food intake (≤50%), lower nPCR, and weight change in the previous 6 months based on sensitivity, specificity, and C-statistics (DeLong method); 95% confidence intervals were computed for proportions. The relationships between weight change and appetite assessment tools were assessed by chi-squared test or t-test (two-tailed), as appropriate. Furthermore, we analyzed the performance of each appetite assessment tool using categories of intake (100%, 75%, 50%, 25%, 0%).

Because inflammation may modulate appetite and food intake (8, 15), we also assessed the associations between anorexia (measured by the different tools) and inflammatory biomarkers. We determined correlations among the appetite assessment tools (as continuous variables) with inflammatory biomarkers, nPCR, leptin/BMI and adiponectin/BMI . Relations among these variables were assessed through chi-squared tests, t-tests, linear regression, ANOVA or Wilcoxon ranked sum tests, as appropriate. The Wald test was assessed to compare values of the concordance ("C") statistic. Kendall Tau correlation was used to determine relationships between appetite assessment tools and categories of percent of food intake. A two-tailed $p<0.05$ (adjusted according to Bonferroni to correct for multiple comparison for all the reported variables) was considered statistically significant. All analyses were performed using R (R Development Core Team) version 3.0.2.

Results

Two hundred sixty-eight patients from ACTIVE/ADIPOSE were due for initial or follow-up evaluation during the study period. Four patients were excluded because they underwent kidney transplantation, six patients because they moved during the study and two patients were excluded because of suboptimal understanding of English language. In addition, four patients refused to participate in the appetite study. We assessed appetite by the five anorexia tools in 252 patients receiving HD. However, serum biomarkers were not available for 31 patients. Therefore, 221 patients (134 men and 87 women; mean age 60.2±14.6 years) were included in the analytic sample. Patient characteristics are shown in Table 2.

Prevalence of anorexia by food intake and by appetite assessment tools

Insufficient food intake (≤ 50%) was reported by 58 of 221 patients (26%). The prevalence of anorexia varied according to the assessment tool: 12% by self-assessment of appetite (30-day period), 6% by subjective assessment of appetite (7-day period), 24% by VAS, 17% by FAACT score, and 12% based on the AQ.

Associations of appetite assessment tools with food intake

When food intake (%) was dichotomized, the appetite assessment tools had c-statistics >0.50 indicating that they were significantly associated with food intake ≤ 50%, except for the self-assessment of appetite (30-day period) (Table 3). Among the tools tested, the FAACT score showed high sensitivity and specificity, whereas the AQ and VAS also demonstrated high specificity but lower sensitivity (Table 3; Figure 1, panel A and Figure 1, panel B). Moreover, C statistic values were not significantly different between FAACT score and VAS (p=0.15). When food intake (%) was considered using categories, all five appetite assessment tools were significantly correlated with food intake (Table 3).

Association of appetite assessment tools with body weight change and nPCR

None of the five tools we tested was associated with weight change in the previous six months. By contrast, patients reporting food intake ≤50% had lost weight over the last six months more frequently than patients with food intake >50% (36% vs 22%) and had gained weight less frequently (19% vs 35%) (p=0.03).

Normalized protein catabolic rate (grams per kilogram per day) was lower among patients with anorexia based on the VAS score (1.1 ± 0.3 vs 1.2 ± 0.3, p=0.03). There were no statistically significant associations between nPCR and any of the other appetite assessment tools.

Association of intake and appetite assessment tools with inflammatory and nutritional serum biomarkers

Food intake (%) was inversely correlated with ln (IL-6) (p=0.03). Anorexia, as diagnosed by self-assessment of appetite (30-day period), was inversely correlated with nutritional biomarkers (serum albumin, prealbumin concentrations) and directly correlated with serum adiponectin concentrations. We also found significantly lower serum prealbumin concentrations among patients with anorexia diagnosed by VAS (Table 4). No associations were observed among serum CRP, IL-6, and leptin concentrations and any of the appetite assessment tools (Table 4).

Discussion

Our results indicate that the prevalence of anorexia varies considerably according to the appetite assessment tool used among patients on HD. Previous studies have estimated the prevalence to be approximately 25–30% (7,8), and our primary criterion measure (food intake ≤50%) indicated a similar prevalence (26%), as did the VAS (24%).

The FAACT score combined high sensitivity and specificity and had the highest C-statistic value for capturing low food intake. The VAS had a lower sensitivity but similar specificity as the FAACT score and an overall c-statistic that was not statistically different from the FAACT score. Furthermore, the VAS was also associated with nPCR, a more objective parameter related to protein intake, as well as with lower serum prealbumin concentrations, which have been associated with poorer survival in patients on dialysis (7, 15). Although four out of five of the appetite instruments were related to food intake, only the VAS was associated with nPCR. A potential explanation for the lack of association between most appetite tools and nPCR is the difference in time period of assessment, with appetite assessed at a single time and nPCR reflecting protein intake over a 48-hour period. Thus, variations in appetite over the period of nPCR would tend to limit correlations. In addition, protein intake may be affected by factors other than appetite, such as cost and availability of food.

The association of inflammation with anorexia has been previously described (16, 17). Tumor necrosis factor-α (TNF-α), CRP and IL-6 circulating levels were significantly higher among patients receiving dialysis with anorexia compared to those without (17). Pro-inflammatory cytokines induce anorexia, diminishing food intake during meals, meal frequency, and meal duration among healthy individuals and patients with ESRD (18). It has been proposed that cytokines might be delivered from the periphery to the central nervous system and release mediators acting on peripheral and brain specific sites. These cytokines exert direct actions on hypothalamic neurons involved in appetite regulation (18).

We found that patients who reported reduced food intake had higher serum IL-6 concentrations, confirming previous evidence indicating that plasma IL-6 levels were significantly higher among anorexic patients on dialysis (8). Moreover, our results are in line with those obtained in a similar clinical setting, where poor appetite was associated with higher IL-6 circulating concentrations (15, 19). In an experimental animal model, IL-6 administration reduced both food intake and gastric emptying (20). High CRP concentrations have also been associated with diminished appetite (17). However, we did not find a correlation between any of the anorexia tools and CRP or IL-6, which might be related to the relatively short half-life of these biomarkers, given that appetite and biomarkers assessment were not always on the same day.

Leptin has also been implicated in the control of appetite, inhibiting food intake and increasing energy expenditure via the central nervous system (21). Our study did not show any association between leptin, even when indexed to BMI, and the presence of anorexia based on any tool, confirming previous results indicating that anorexia in HD was not related to circulating leptin concentrations (2). We acknowledge that we cannot exclude a role for leptin in mediating anorexia in HD patients, since we did not measure its soluble receptor. However, since our present results expand previous observations obtained using only one appetite assessment tool (2), these and others' results suggest that leptin might not be directly implicated in the development of HD-related anorexia. In this light, based on the available data, it has been underlined that there is a lack of evidence that markedly increased circulating leptin levels in HD contributes clinically to anorexia in CKD and ESRD (22).

Most anorexia assessment tools were not associated with inflammatory markers, with the exception of self-assessment of appetite (30-day period), which was associated with lower serum albumin and prealbumin concentrations and higher serum adiponectin concentrations. These associations may reflect the long-term effects of anorexia on malnutrition (23). In particular, adiponectin exerts anti-inflammatory and anti-atherogenic properties in the setting of uremia (24), but experimental evidence suggests that adiponectin is also able to promote weight loss via increased energy expenditure (18). The role of adiponectin in the regulation of energy homeostasis in patients receiving HD should be better clarified in experimental settings and clinical trials.

Most of the available diagnostic tools for assessing anorexia are qualitative (present/absent) rather than quantitative (2). Although assessment of dietary intake may be quantitative, food diaries and dietary recalls appear to underestimate intake, suggesting that questionnaires may provide more accurate information (10, 25–27). A longer or more detailed assessment of dietary intake would have produced a more stable estimate (7,8) and might have been better suited to the time frame of some of the appetite assessment instruments we tested. We also included nPCR and changes in body weight over six months as longer-term estimates of protein and energy intake, in part to address the short-term intake measure.

The results of our study show that no single appetite assessment tool performs best in relation to all criterion measures and other related measures. Consequently, we cannot recommend one tool for routine use for all purposes. According to the goals of the investigation of anorexia, one tool may serve better than another. In this cohort, the FAACT score and VAS were most closely associated with food intake. The decision about which appetite assessment tool(s) are most useful in clinical practice may also be based on the time needed to complete each tool. Therefore, the VAS might be particularly useful in daily practice since it takes only a few seconds to perform, does not require specific competencies (6, 28), and we confirmed that it is associated with recent food intake. Our results may also suggest that simply assessing intake of the last meal as a percentage of usual intake is as useful as measuring appetite using a tool, given that intake was associated with at least as many variables as any of the appetite tools tested. However, dietary recall is associated with high degree of variability, which may lead to unreliable assessment of intake. Outcome studies are needed to determine whether assessing appetite adds any additional information beyond assessment of food intake.

We acknowledge several limitations of our study. First, appetite is not the only determinant of food intake, and we did not assess other factors, such as cost and availability of food or time to obtain and prepare food. Nevertheless, we used self-reported food intake as the primary criterion measure and nPCR and body weight changes over six months as additional longer-term indicators of intake as criterion measures because we do expect at least a modest correlation between appetite and food intake. However, the cross-sectional design may have lowered the chances of observing associations among some indicators. Specifically, obtaining all measures at the same study visit resulted in “shifting” the timeframes for some measures. For example, the subjective assessment of appetite refers to the last seven days, whereas the time frame for weight loss was over the last six months. Recent change in appetite might not be expected to have yet resulted in weight loss. Second,

although we chose to assess food intake based on the most recent meal in order to mitigate or eliminate a time shift for our primary criterion measure, assessing food intake based on the most recent meal only may not completely reflect patients' eating behavior. We used percentage of the meal consumed rather than absolute intake in order to address variations in typical caloric intake across breakfast, lunch, and dinner introduced by this approach. Third, we have not assessed the performance of any of these instruments in a prospective fashion to determine whether they are sensitive to changes in appetite or food intake or whether they are associated with survival, and in particular whether they add prognostic information beyond assessment of food intake. Most importantly, we used a self-reported estimate of food intake rather than capturing actual food intake, which would be more laborious but might limit subjective errors in self-report, or differences in an individual's expectation of what represents a full meal. We did not standardize food intake prior to administration of appetite questionnaires. Thus, variation in the size and content of the most recent meal and in time since patients last ate could have affected their appetite. However, such factors should affect all instruments similarly since they were administered at the same time.

In summary, we describe distinct performance characteristics of available appetite assessment tools, possibly owing to the large number of functional and psychological factors determining anorexia in HD. The FAACT score and VAS were approximately comparable at predicting reduced food intake, and they both appear to be suitable candidates to test the impact of anorexia on long-term clinical outcomes in prospective clinical studies. VAS also correlates with nPCR, reflecting protein intake. In this light, the VAS might be the best appetite instrument to capture current-moment anorexia. On the other hand, the self-assessment of appetite correlated with nutritional/inflammatory biomarkers, which might be a function of the 30-day time interval of the assessment or capturing of a different construct.

Practical Applications

No single appetite assessment tool corresponded best to all of the criterion measures and nutritional and inflammatory biomarkers. The FAACT and the VAS had the strongest association with low self-reported food intake, and the anorexia according to the VAS was also associated with low nPCR. These instruments may be useful in the clinical setting for assessment and monitoring of appetite in HD patients. However, these instruments were less associated with weight changes and an inflammatory biomarker profile, which are possibly more indicative of longer-term appetite problems.

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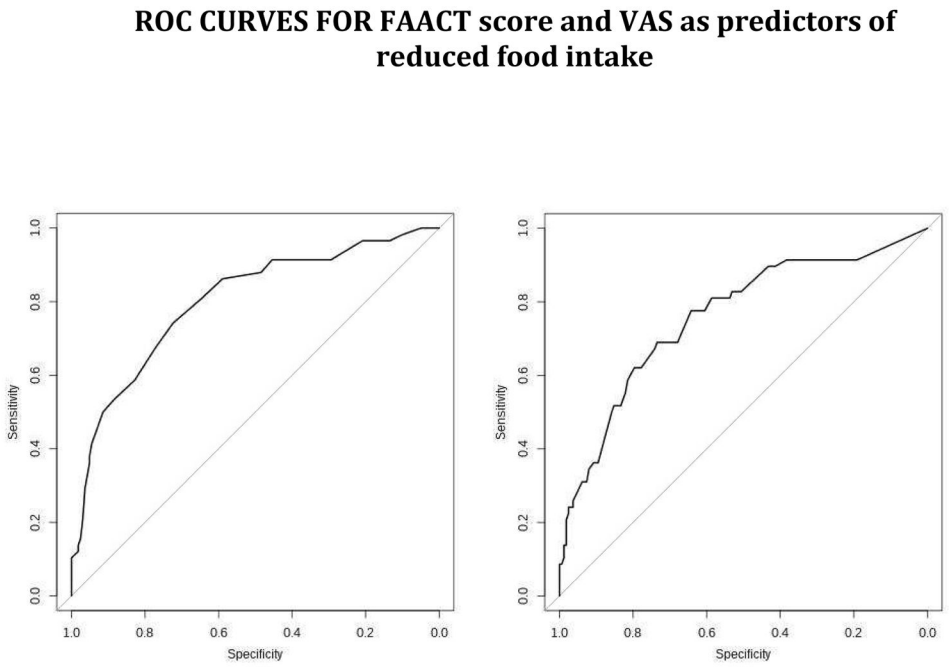

Figure 1.

Figure 1A (left side): ROC curve to assess Functional Assessment of Anorexia/Cachexia Therapy (FAACT) score as predictor of food intake ≤ 50%. FAACT score AUC: 0.80 (0.73–0.87)

Figure 1B (right side): ROC curve to assess visual analogue scale (VAS) as predictor of food intake ≤50%. VAS AUC: 0.76 (0.68–0.83)

Table 1

Characteristics of the 5 appetite assessment tools administered.

Appetite assessment tool	Time frame of reference	Description
Self-assessment of appetite changes	30 days	Present appetite vs appetite over the last month (increased, decreased, or unchanged).
Subjective assessment of appetite	7 days	Present appetite vs appetite last week (increased, decreased, or unchanged).
Visual analogue scale (VAS)	At the moment it is completed	Present appetite indicated with a line on a scale (scale extremities: “no hunger” (0 mm); “hunger” (100 mm).
Functional Assessment of Anorexia/ Cachexia Therapy (FAACT) score	At the moment it is completed	12 questions related to appetite and food intake. Each question allows for 5 answers (i.e., not at all, a little bit, somewhat, quite a bit, very much).
Anorexia questionnaire (AQ)	At the moment it is completed	4 questions on the presence of early satiety, taste/smell alterations, meat aversion, and nausea/vomiting.

Table 2

Demographic, clinical, nutritional and inflammatory characteristics of 221 hemodialysis patients studied.

Characteristic	Mean ± SD*
Gender (male:female)	134:87
Age (years)	60.2 ± 14.6
Race, (n)	
White	46
Black	62
Native American	2
Asian	60
Pacific islander	14
Other	31
Unknown	6
Height (cm)	165.6 ± 10.1
Weight (kg)	79.4 ± 20.8
BMI (kg/m^2)	28.8 ± 6.6
Body weight change (%) during the previous 6 months	0 (0, 1.77)
Kt/V	1.6 ± 0.3
nPCR (g/kg/d)	1.2 ± 0.3
Creatinine (mg/dL)	8.3 ± 3.1
Albumin (g/dL)	4.0 ± 0.3
Prealbumin (mg/dL)	30.4 ± 7.8
Tryglicerides (mg/dL)	159.9 ± 96.1
HDL (mg/dL)	46.9 ± 13.9
Uric Acid (mg/dL)	6.6 ± 1.6
Calcium (mg/dL)	9.1 ± 0.9
Phosphorus (mg/dL)	5.5 ± 1.8
CRP (mg/L)	3.0 (1.18, 8.63)
Log IL-6 (pg/mL)	2.49 ± 0.95
Leptin (pg/dL)	17091 (3978, 67149)

*Median (interquartile range) is shown for non-normally distributed variables (body weight change during the previous 6 months, CRP, leptin).
Abbreviations include: BMI, body mass index; CRP, Creactive protein; nPCR, normalized protein catabolic rate.

Table 3

Association of each appetite assessment tool with food intake.

	OUTCOME					
	Inadequate food intake (≤50%)				Food intake (continuous)	
APPETITE ASSESSEMENT TOOL	**Sensitivity**	**Specificity**	**C-statistic**	**P-value*†**	**r**	**P-value***
Self-assessment of appetite (30-day period)	0.48	0.77	0.45 (0.37–0.53)	0.22	0.17	**0.03**
Subjective Assessment of appetite (7-day period)	0.69	0.76	0.65 (0.58–0.73)	**<0.001**	0.28	**<0.001**
Visual Analogue Scale (VAS)	0.57	0.83	0.76 (0.68–0.83)	**<0.001**	0.32	**<0.001**
Functional Assessment of Anorexia/Cachexia Therapy (FAACT) score	0.70	0.83	0.80 (0.73–0.87)	**<0.001**	0.73	**<0.001**
Anorexia Questionnaire (AQ)	0.31	0.88	0.59 (0.54–0.65)	**<0.001**	0.23	**0.001**

*Significance levels are obtained as Bonferroni adjusted values.

r=Kendall Tau correlation.

†P-values indicate the significance of the C-index compared to 0.50.

Table 4

Associations of appetite assessment tools and nutritional and inflammatory biomarkers.

	Difference between anorexic and non-anorexic patients, mean (95% CI)					
	Albumin (g/dL)	**Prealbumin (mg/dL)**	**Adiponectin/BMI (μg/mL*m^2/kg)**	**Leptin/BMI (pg/mL*m^2/kg)**	**CRP (mg/L)**	**Ln IL-6 (pg/mL)**
Appetite assessment tool						
Self-assessment of appetite (30-day period)	−0.20 (−0.33; −0.07) **P=0.02**	−4.97 (−8.07; −1.88) **P=0.02**	7.73 (2.35; 13.12) **P=0.03**	−14663.9 (−29987.2; 659.3) P=0.30	5.18 (−3.1; 13.5) P>0.99	0.26 (−0.13; 0.65) P=0.92
Subjective Assessment of appetite (7-day period)	−0.20 (−0.39; −0.02) P=0.16	−5.32 (−9.67; −0.97) P=0.08	−2.09 (−9.72; 5.55) P>0.99	15134.6 (−6283.3; 36552.6) P=0.83	2.1 (−9.5; 13.7) P>0.99	0.43 (−0.11; 0.97) P=0.57
Visual Analogue Scale (VAS)	−0.13 (−0.24; −0.03) P=0.05	−3.47 (−5.87; −1.08) **P=0.02**	−3.70 (−7.94; 0.54) P=0.43	8814.3 (−3241.2; 20869.9) P=0.76	7.9 (1.5; 14.2) P=0.07	0.14 (−0.16; 0.44) P>0.99
Functional Assessment of Anorexia/Cachexia Therapy (FAACT) score	−0.06 (−0.18; 0.06) P>0.99	−1.69 (−4.5; 1.1) P>0.99	2.02 (−2.85; 6.88) P>0.99	5643.1 (−8162.3; 19648.6) P>0.99	8.3 (1.09; 15.5) P=0.12	0.17 (−0.17; 0.51) P>0.99
Anorexia Questionnaire (AQ)	0.01 (−0.09; 0.11) P>0.99	−0.31 (−2.64; 2.01) P>0.99	1.35 (−2.71; 5.41) P>0.99	1297.5 (−10177.3; 12772.3) P>0.99	2.43 (−3.7; 8.5) P>0.99	−0.04 (−0.33; 0.24) P>0.99

P-values for the anorexia tools are Bonferroni-corrected.

Abbreviations: CI, confidence interval; CRP, C reactive protein; IL-6, interleukin-6. In bold are indicated statistically significant p values.