End-stage renal disease adherence questionnaire: translation and validation to the Portuguese language

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ABSTRACT
Non-adherence to medical plans is recognized as an important problem in dialysis patients, since it has been associated with increased morbidity and mortality, resulting in disproportionately high costs of care. The success of renal replacement therapy depends on the adherence of patients to the different aspects of the therapeutic strategy, which includes a complex drug regimen involving a wide variety of drugs and doses, several prescribed dialysis sessions with different durations, dietetic recommendations and restriction of fluid intake. In this work, we aimed to translate and validate a previously described self-reported end-stage renal disease questionnaire (ESRD-AQ) to the Portuguese language (PESRD-AQ). After ESRD-AQ translation, a validation was performed by experts and by using a cohort of 185 Portuguese dialysis patients. PESRD-AQ reliability analysis showed strong test-retest stability across all items, with an intra-class correlation of 0.931. The average of the item-level content validity index by experts for the 46 items was 0.98, ranging from 0.94 to 1. Moreover, we found that PESRD-AQ scores indicative of non-adherence were associated with alterations in some biological and biochemical markers of non-adherence, including interdialytic weight gain. In conclusion, our results showed that PESRD-AQ, which presented an acceptable reliability and validity, is a valid tool to be used for adherence evaluation by Portuguese-speaking dialysis patients.

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Introduction
End-stage renal disease (ESRD) is a growing public health problem, given the increasing prevalence worldwide. It is estimated that by 2020 the number of ESRD patients will increase by ~60% when compared with the number of patients registered in 2005. Data from 150 countries showed that over 3 million patients were treated for ESRD worldwide by the end of 2012 and that the number of patients is growing faster than the world population (growth rate: 7%). ESRD patients show a high mortality rate, which far exceeds the mortality rate found in the general population. Currently, knowledge of the mechanisms leading to increased mortality in this context is incomplete. In spite of the significant technological and therapeutic advances observed in this medical field over the last decades, the survival of these patients is still low. Cardiovascular diseases have been considered the most common cause of morbidity and mortality in these patients.

Adherence and persistence to medical plans is recognized as an important problem in dialysis patients, since it has been associated with increased morbidity and mortality, resulting in disproportionately high costs of care. The success of renal replacement therapy depends on patients’ adherence and persistence to the different aspects of the therapeutic strategy, which includes a complex drug regimen involving a wide variety of drugs at different doses, several prescribed dialysis sessions with different durations, dietetic recommendations and restriction of fluid intake. A high variability in the degree of adherence to therapeutic regimens in dialysis patients has been described. Non-adherence to prescribed medication has been found in 15.4–50.2% of dialysis patients, while non-adherence to...
liquid restriction ranges from 9.7–49.5% and non-adherence to the recommended diet ranges between 9 and 22.1%. The non-adherence to treatment regimens is associated with poor treatment outcomes, such as bone demineralization, pulmonary edema, and metabolic alterations that favor cardiovascular injury, leading to an increase in the number of hospitalizations and deaths.

Treatment adherence of the ESRD patient under dialysis can be monitored by biological and biochemical markers, namely through dialysis adequacy through urea kinetics level, residual kidney function, and blood pressure control. Furthermore, missing or shortening of the dialysis treatment can be noted by the dialysis staff. These factors, together, allow for the measurement of the dialysis treatment can be noted by the dialysis staff. These factors, together, allow for the measurement of patient adherence to, and outcomes of, the dialysis strategy. Medication and dietetic adherence can be correlated to serum potassium and serum phosphate concentrations, blood urea nitrogen and interdialytic weight gain, and serum albumin concentration provides a characterization of dietetic status, although several others factors can affect these parameters. However, these biomarkers seem to be more effective and reliable in the evaluation of clinical outcomes than non-adherence.

There are currently several self-report scales used to assess patient adherence, but there are a lack of scales that can be used in dialysis patients who require a complex therapeutic regime, including diet and fluid controls. Thus, we considered it important to translate the self-reported end-stage renal disease questionnaire (ESRD-AQ) to be used in Portugal. In this context, we aimed to translate the ESRD-AQ to the Portuguese language and to validate this questionnaire by experts and by using potential biological and biochemical markers of non-adherence in a cohort of Portuguese dialysis patients.

**Material and methods**

The original English version of the self-report ESRD-AQ instrument was developed to assess all components of adherence behaviors in dialysis patients, including adherence to dialysis sessions, prescribed medication, fluid and dietary intake restrictions. In the original version, ESRD-AQ validity, calculated using the item-level content validity index (I-CVI) was 0.99 and test-retest stability with an intra-class correlation (ICC) ranging from 0.83 to 1.00.

The ESRD-AQ instrument is divided into five sections and comprises 46 items: the first five items collect data about general clinical information; 14 items are about dialysis attendance; nine items are about medication use; 10 items ask about fluid restrictions; and the last eight items inquire about diet. Likert scales, multiple choice questions and binary responses were used to respond to the ESRD-AQ. The overall adherence score is obtained by summing the responses of questions number 14, 17, 18, 26, 31, and 46, higher punctuation indicated better adherence behavior. Furthermore, questions 11, 12, 22, 23, 32, 33, 41, and 42 measure patients’ knowledge and perceptions about treatment.

**Translation of the ESRD-AQ into Portuguese**

First, a bilingual pharmacist and a physician conducted the translation of the original English version separately. Then, the two translators and a facilitator compared the two translations to synthesize and generate the first Portuguese version of the ESRD-AQ (PESRD-AQ). Second, the PESRD-AQ was subjected to a process of blind back-translation conducted by another bilingual pharmacist. To follow, the facilitator identified the translate imperfections and created the second version of PESRD-AQ. Furthermore, nine dialysis patients evaluated and identified the items they considered confusing, very technical or inadequate to the Portuguese culture. Finally, a team of seven bilingual speaking health professionals consisting of two nephrologists, four renal nurses and a nutritionist reviewed, commented on and approved the final version of the tool (Supplemental file 1). The original ESRD-AQ score system has been used in the Portuguese version of the questionnaire.

**Validation of the instrument**

To validate the instrument, an interdisciplinary team was asked to review and evaluate every group of items of the PESRD-AQ, using a 4-point Likert-type scale that scored from 1–4 (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, and 4 = highly relevant).

We also evaluated 185 Portuguese ESRD patients undergoing online-hemodiafiltration (OL-HDF) from three dialysis clinics (50.3% female, mean age of 66.44 ± 14.29 years old and an average dialysis vintage of 62.53 ± 58.04 months). Patients were under therapeutic dialysis three times per week for a duration of 3–5 h. The etiology of ESRD was diabetes in 71 (38.4%) patients, hypertension in 115 (62.2%) and both diabetes and hypertension in 49 (26.5%). For the OL-HDF procedure, synthetic high-flux polysulfone dialyzers (Fresenius Medical Care, Bad Hamburg, Germany) were used. This study has been approved by the ethics committees of the involved dialysis clinics. The patients were informed about the aim of this study and signed consent.
The inclusion criteria were: (i) Portuguese nationality, (ii) receiving OL-HDF for ≥3 months, (iii) ≥18 years of age, and (iv) independent with self-care activities.

PESRD-AQ was self-administered to all patients who agreed to take part in this study, meaning the questionnaire was completed by the patients themselves. For the evaluation of interclass correlation coefficients, 10 dialysis patients were evaluated at two different time points over a two-day period. Moreover, potential biological and biochemical markers of non-adherence, including percentage of urea reduction ratio, Kt/V, blood glucose concentration (in diabetic patients), hemoglobin concentration, ferritin, albumin, potassium and phosphorus serum levels, diastolic and systolic pressures and interdialytic weight gain (in kilogram and in percentage of dry weight) were used for questionnaire validation. Analysis of these markers was performed in the same week as the PESRD-AQ self-administration.

Patients were considered to be adherent to the prescribed dialysis sessions if they responded “during the last months, I did not miss any dialysis treatment, and have not shortened my dialysis time in the last month” to questions 14, 17 and 18; adherent to the drug regimen if they responded “I did not miss my medicines during the past week” to question 26; adherent to fluid intake restrictions if they responded “all the time followed the fluid restriction recommendations during the past week” to question 31; and adherent to dietetic recommendations if they responded “all the time followed the diet recommendations during the past week” to question 46. Finally, patients that achieved the maximum total score of 1200 on the PESRD-AQ were considered globally adherent.

**Statistical analysis**

Expert validation and reliability of PESRD-AQ were measured using item-level content validity indexes for each item (total 46 items) and intraclass correlation coefficients, respectively.

All variables are reported as mean ± standard deviation, median (interquartile range) or proportions. Data were analyzed using the program SPSS 21.0 for Windows (SPSS, Inc., Chicago, IL). The normality of data was tested using the Kolmogorov–Smirnov test. Differences between groups were analyzed by using a $t$-test or Mann–Whitney test, according to the results obtained in the Kolmogorov–Smirnov test. The association between categorical variables was evaluated using the chi-squared test or Fisher’s exact test. Pearson or Spearman’s rank correlation coefficients were used to evaluate relationships between sets of data. $p < 0.05$ was accepted as statistically significant.

**Results**

The results were analyzed in order to assess the reliability and validity of the PESRD-AQ by experts and through the establishment of the association between PESRD-AQ scores and potential biological and biochemical markers of non-adherence.

PESRD-AQ reliability analysis showed strong test-retest stability across all items, with an ICC of 0.931 (Table 1). The average of the item-level content validity index by experts for the 46 items was 0.98, ranging from 0.94 to 1 (Table 2).

Using the PESRD-AQ results, and considering the criteria established in the material and methods section, we showed that 6.5% of our group of ESRD patients were not adherent to dialysis treatment, 15.7% were not adherent to medication, 50.3% were not adherent to fluid restrictions and 56.2% were not adherent to diet restrictions. Globally, 72.4% of our ESRD patients were classified as non-adherent to at least one aspect of the therapeutic strategy.

When we compared the potential biological and biochemical markers of non-adherence between patients adherent to dialysis treatment and those considered to be non-adherent, we only found a trend for higher diastolic pressure ($p = 0.085$) in the non-adherent group of patients. ESRD patients classified as non-adherent to fluid restrictions showed a lower proportion of males, and higher Kt/V and interdialytic weight gain (kg and percentage of dry weight), when compared with those considered to be adherent to fluid restrictions. Moreover, ESRD patients classified as non-adherent to dietary restrictions showed higher ferritin serum levels, and lower hemoglobin concentrations when compared with those considered to be adherent to dietary restrictions. ESRD patients classified as non-adherent to at least one aspect of the therapeutic strategy also showed lower hemoglobin concentrations (Table 3), when compared with those classified as adherents.

We also found significant correlations between fluid restriction scores and interdialytic weight gain in kg ($r = -0.227; p = 0.002$) and in percentage of dry weight ($r = -0.202; p = 0.007$); and between dietary restrictions and hemoglobin concentration ($r = 0.150; p = 0.049$).

Concerning the attitude/perception PESRD-AQ questions, the percentage of each response is shown in Supplementary File 2. The percentage of patients that

| Table 1. Results of ICC analysis, showing strong test–retest stability for all items. |
|----------------------------------|---------------------------------|------------------|------------------|------------------|
| ICC | Lower bound | Upper bound | F-value | df1 | df2 | Sig. |
| 0.931 | 0.694 | 0.984 | 14.5 | 8 | 8 | 0.001 |
responded “highly important” to the questions “Question #11: how important do you think it is your dialysis schedule” and “Question # 22: how important do you think it is to take your medicines as scheduled?” was significantly higher in the group of patients classified as adherent to medicines, when compared with those who were non-adherent (39.1 vs 10.3%, p = 0.003; 33.3 vs 13.8%, p = 0.046, respectively). We also found a trend towards a higher proportion of patients that responded “highly important” to the question “Question #32: how important do you think it is to limit your fluid intake” in the group of patients adherent to dialysis treatment (26.6 vs 0%, p = 0.068), to medicines (27.6 vs 10.3%, p = 0.061) and to fluid restrictions (30.4 vs 19.4%, p = 0.090), when compared with the non-adherent group. Moreover, we also observed a trend towards a higher proportion of patients that responded “highly important” to the question “Question #41: how important do you think it is to watch the type of food you eat each day?” in the group of patients adherent to fluid restrictions, when compared with those patients that were non-adherent to fluid restrictions (28.3 vs 16.1%, p = 0.053).

**Discussion**

There are no effective scales for evaluating adherence to medical plans in dialysis patients which measure adherence to dialysis sessions, drug prescriptions and fluid and dietary restrictions. In this work, we translated and validated the ESRD-AQ to Portuguese. This is the only published scale currently available for assessing dialysis patient’s adherence behavior. Our results showed that PESRD-AQ is an effective and useful tool that can be used in dialysis patients in the Portuguese speaking community.

Internal consistency reliability (Cronbach’s α) has not been evaluated since the instrument’s design does not possess homogeneous items to address internal consistency reliability, as described in the original description of the questionnaire. PESRD-AQ analysis shows strong test-retest stability and a high level of concordance between experts for the 46 items of the scale. Given the lack of a well-established and standardized measurement tools for comparison, for PESRD-AQ validation, a cohort of 185 patients under OL-HDF treatment were studied. Patients were surveyed in order to identify associations between some previously described biological and biochemical markers of non-adherence and PESRD-AQ scores.

Considering the PESRD-AQ total score, we found that 72.4% of the dialysis patients described themselves as non-adherent to one or more aspects of the therapeutic strategy, such as dialysis sessions, prescription medicines, and/or fluid and nutritional recommendations. These dialysis patients classified as non-adherent to one or more aspects of therapeutic strategy showed lower hemoglobin concentrations, a biochemical change, which was also related with diet non-adherence. Indeed, anemia is the most frequent complication associated with dialysis. The introduction of recombinant human erythropoietin therapy has led to a significant reduction in anemia and its associated complications. However, dialysis patients are at risk of developing iron deficiency anemia, which can be related, at least in part, to nutritional deficiencies.13,19 These results suggest that PESRD-AQ total score can be an important tool to detect non-adherence to dietary recommendation in dialysis patients.

Missing and shortening dialysis sessions occurred among 6.5% of our dialysis patients, showing that adherence to dialysis treatment is not a major problem for most of these patients. These results are very similar to those found in previously published studies, namely, in the DOPPS study20, which report a prevalence of 1% in skipped dialysis sessions and of 9% in shortened dialysis sessions in five European countries. In our study, when adherents and non-adherents to dialysis session were compared, only a trend (p = 0.085) to high diastolic pressure was found in the non-adherent group of patients. High blood pressure in dialysis patients is associated with non-adherence to salt and liquid restrictions, non-adherence to blood pressure medications and missing or shortening of dialysis treatments.21

This study showed that 15.7% of the patients considered themselves as non-adherent to medication. This prevalence is slightly higher than that found in a
Table 3. Comparison of sociodemographic data, and biological and biochemical markers of non-adherence between dialysis patients who were adherent and non-adherent to the different aspects of the therapeutic strategy, based on PESRD-AQ scores.

|                    | Adherents (n = 156) | Non-adherents (n = 29) | p-Value |
|--------------------|---------------------|------------------------|---------|
| Age, years         | 66.45 ± 14.2        | 67.0 ± 15.7            | 0.899   |
| Gender, male       | 50.3 ± 6.4          | 52.8 ± 6.7             | 0.122   |
| Time under dialysis, months | 60.0 ± 1.6 | 60.0 ± 1.6 | 0.132   |
| URR, %             | 79.6 ± 5.3          | 79.7 ± 5.4             | 0.964   |
| Serum creatinine, mg/dl | 11.6 ± 2.7 | 11.7 ± 2.7 | 0.558   |
| Diastolic pressure, mmHg | 63.6 ± 13.7       | 70.6 ± 10.0            | 0.085   |
| Systolic pressure, mmHg | 135.8 ± 21.2       | 133.4 ± 10.1           | 0.478   |
| Glucose, mg/dl     | 159.8 ± 61.5        | 176.0 ± 103.3          | 0.625   |
| Interdialytic weight gain, kg | 2.1 ± 0.6 | 1.9 ± 0.6 | 0.268   |
| % of dry weight    | 31.1 ± 1.2          | 31.1 ± 1.2             | 0.070   |
| Hemoglobin, g/dl   | 11.6 ± 1.5          | 11.6 ± 1.5             | 0.518   |
| Ferritin, ng/mL    | 394.0 ± 80.3        | 366.2 ± 78.0           | 0.001   |
| Albumin, g/L       | 40.3 ± 0.0          | 40.3 ± 0.0             | 0.930   |
| Potassium, mmol/L  | 5.3 ± 0.7           | 5.3 ± 0.7              | 0.001   |
| Phosphorus, mg/dl  | 4.4 ± 1.2           | 4.1 ± 1.1              | 0.191   |

Significant differences between groups are presented in bold. URR: Urea reduction ratio.

**Data presented correspond only to diabetic dialysis patients.**

**Disclosure statement**

The authors declare no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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