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RESEARCH ARTICLE (ORIGINAL)

Medication adherence in chronic kidney disease patients on hemodialysis

Adesão ao regime terapêutico medicamentoso da pessoa com doença renal crónica em programa de hemodiálise

Adherencia al régimen farmacoterapéutico en personas con enfermedad renal crónica en programa de hemodiálisis

Anabela Martins Ferreira [1]
https://orcid.org/0000-0002-8989-4412

Carlos Pires Magalhães [2, 3]
https://orcid.org/0000-0003-0170-8062

[1] *Terra Quente* Hospital, Mirandela, Portugal

[2] Polytechnic Institute of Bragança, Bragança, Portugal

[3] Health Sciences Research Unit: Nursing (UICISA: E), Nursing School of Coimbra, Coimbra, Portugal

Corresponding author
Carlos Pires Magalhães
E-mail: cmagalhaes@ipb.pt

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Abstract
Background: The person with chronic kidney disease (CKD) on hemodialysis has a complex drug therapy regimen to follow, both in the control of the symptoms caused by the disease and in the control of comorbidities.
Objective: To assess the level of adherence to the drug treatment in CKD patients on a hemodialysis program.
Methodology: Quantitative, descriptive-correlational and cross-sectional study, based on the application of the Measure of Treatment Adherence scale (MTA), to a sample of 101 people with CKD, undergoing hemodialysis.
Results: The sample had a mean score of adherence to the drug treatment regimen of 5.32 ± 0.47, with a maximum value of 6. The dichotomous pattern of the scale, based on the median, classifies 82.18% of the sample (n = 83) as adherent and 17.82% (n = 18) as non-adherent. A statistically significant relationship of adherence was found as a function of some clinical variables: number of pathologies and daily medication.
Conclusion: The percentage of non-adherents to the drug therapy regimen calls for improvement actions and highlights the importance of continuous assessment of adherence levels.

Keywords: end stage renal disease; hemodialysis; medication adherence

Resumo
Enquadramento: A pessoa com doença renal crónica (DRC) em hemodiálise apresenta um regime terapêutico medicamentoso complexo a seguir, seja no controlo da sintomatologia provocada pela mesma, seja no controlo de comorbilidades.
Objetivo: Avaliar o nível de adesão ao regime terapêutico medicamentoso da pessoa com DRC em programa de hemodiálise.
Metodologia: Estudo quantitativo, descritivo-correlacional e transversal, com aplicação da Escala de Medida de Adesão aos Tratamentos (MAT) a uma amostra de 101 pessoas com DRC, em programa de hemodiálise.
Resultados: A amostra revelou uma pontuação média de adesão ao regime terapêutico medicamentoso de 5,32 ± 0,47, para um valor máximo de 6. O padrão dicotómico da escala, baseada na mediana, classifica 82,18% da amostra (n = 83) como aderente e 17,82% (n = 18) como não aderente. Encontrou-se uma relação estatisticamente significativa da adesão em função de algumas variáveis clínicas: número de patologias e de medicamentos diários.
Conclusão: A percentagem de não aderentes ao regime terapêutico medicamentoso reclama ações de melhoria e releva a importância da avaliação continua dos níveis de adesão.

Palavras-chave: doença renal terminal; hemodiálise; adesão à medicação

Resumen
Marco contextual: Una persona con enfermedad renal crónica (ERC) en hemodiálisis tiene que seguir un complejo régimen de terapia farmacológica, tanto en el control de los síntomas causados por la enfermedad como en el control de las comorbilidades.
Objetivo Evaluar el nivel de adhesión al régimen terapéutico de medicamentos de la persona con ERC en programa de hemodiálisis.
Metodología: Estudio cuantitativo, descriptivo-correlacional y transversal, basado en la aplicación de la Escala de Medición de Adhesión a los Tratamientos (MAT) a una muestra de 101 personas con ERC, en programa de hemodiálisis.
Resultados: La muestra reveló una puntuación media de adherencia al régimen terapéutico de medicamentos de 5,32±0,47, para un valor máximo de 6. El patrón dicotómico de la escala, basado en la mediana, clasificó al 82,18% de la muestra (n = 92) como adherente y al 17,82% (n = 18) como no adherente. Se encontró una relación estadísticamente significativa de la adherencia según algunas variables clínicas: número de patologías y medicación diaria.
Conclusión: El porcentaje de no adherentes al régimen farmacoterapéutico reclama acciones de mejora y pone de manifiesto la importancia de la evaluación continua de los niveles de adherencia.

Palabras clave: enfermedad renal terminal; diálisis renal; cumplimiento de la medicación

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Introduction

The World Health Organization (WHO, 2003) defines therapeutic adherence as a degree or the extent to which a patient's behavior – taking medication, following a diet, and/or executing lifestyle changes, corresponds to the health professionals' recommendations.
Chronic kidney disease (CKD) is particularly relevant among the diseases affecting kidneys, given the degree of suffering and disability it can cause. For Butyn et al. (2021, p. 2786), CKD "is a public health problem that alters patients' daily life and directly affects their quality of life."
Patients with CKD on hemodialysis usually need three weekly sessions of 3-4 hours and must adopt lifestyle habits that imply fluid and dietary restrictions. Also, they must comply with a complex medication regime. However, many patients show low adherence to the medication regime (Alves et al., 2018).
In 2016, the *Ordem dos Enfermeiros* (OE- Portuguese Nursing Regulator) published a best practice guide on care delivery to patients with end-stage renal disease on hemodialysis, addressing the technical-scientific requirements necessary for nursing practice in this area, safe nurse staffing, patients' admission to hemodialysis programs and vascular accesses. Care delivery to patients on hemodialysis and infection prevention and control were also addressed. Considering patients' initial welcome to the hemodialysis unit, it is highlighted that health education programs should address, among others, the prescribed medication.
Planning and implementing evidence-based nursing interventions to improve medication adherence entails its correct assessment. However, the qualitative study conducted by Pinto (2020) within the scope of the medication regime of CKD patients on regular hemodialysis demonstrates that, as a rule, nurses do not use instruments to assess the level of adherence to the medication regime. This assessment is usually performed based on nurses' subjective perceptions.
Hence, this study aimed to examine the level of adherence to the medication regime of patients with CKD on hemodialysis and demonstrate the relationship between this adherence and other socio-demographic and clinical variables, using the Measure Treatment Adherence (MTA) scale, adapted and validated by Delgado and Lima (2001) for the Portuguese population.

Background

In the second half of the 20th century, Haynes used the term "compliance" to refer to the extent to which the patient's behavior complies with medical or health advice, such as taking medication or following dietary recommendations (Haynes et al., 1979). Nevertheless, in 2001, Vermeire et al. (2001) observed the preference for the term "adherence" over "compliance," as the former incorporates the notions of concordance, cooperation, and partnership.
Adherence to medication regimes constitutes a relevant area in nursing, integrating the International Classification for Nursing Practice - ICNP (ICN, 2019, p. 3) as a focus of attention, being defined as:
Positive Status: Self-initiated action to promote wellness, recovery, and rehabilitation, following directions without deviation, devoted to a set of actions or behaviors. Compliant with treatment regime, taking medicine as instructed, behavior change for the better, signs of healing, collection of medicine on due date, internalization of the value of health care behavior, and obeying instructions regarding treatment. (Often associated with support from family and significant others, knowledge about supplied drugs and the disease process, client motivation, client--health worker relationship.)
The WHO (2003) classifies the main determinants of adherence into five groups: social/ economic factors; health system/ HTC (health care team) -related factors; condition-related factors (disease); therapy-related factors (treatment); and patient-related factors (perceptions and expectations).
For Bargman and Skorecki (2017, p. 1811), CKD "encompasses a spectrum of pathophysiologic processes associated with abnormal kidney function and a progressive decline in glomerular filtration rate (GFR)." The classification of CKD stages (stages 1, 2, 3a, 3b, 4, and 5) is based on GFR and the amount of albuminuria. These are closely associated with the risk of CKD progression. The last stage, corresponding to end-stage renal disease (CKD stage 5), implies the need for dialysis or a kidney transplant. At this stage, the accumulation of toxins, fluids, and electrolytes can result in uremic syndrome and even death if these are not eliminated. As a result of renal dysfunction, multiple disorders may arise, such as fluid, electrolyte, and acid-base disorders, disorders of calcium and phosphate metabolism, and cardiovascular abnormalities, among others. Chronic dialysis can reduce the incidence and severity of several CKD disorders. However, not even optimal dialysis treatment is as effective as renal replacement therapy, as "some disturbances resulting from impaired kidney function fail to respond to dialysis" (Bargman & Skorecki, 2017, p. 1814). Complying with the medication regime is essential when facing CKD to control many of the disorders, symptoms, and concomitant diseases, which may even have caused it (such as diabetes mellitus and hypertension, among others). Nielsen et al. (2018) consider that non-adherence to the medication regime can have serious consequences, increasing the risk of morbidity, hospitalization, and mortality.
Moreover, CKD can have negative repercussions at the biopsychosocial level, affecting patients' and their families' quality of life (QoL) (Jesus et al., 2019). Pereira and Leite (2019) demonstrate that socio-demographic, clinical, and therapeutic characteristics interfere with the health-related QoL of hemodialysis patients.
Using a qualitative, descriptive, and exploratory study, Pinto (2020) sought to assess the nurses' contributions to the medication regime adherence of CKD patients on regular hemodialysis. The author conducted semi-structured

interviews with 12 nurses working in a hemodialysis unit and identified the following main factors contributing to non-adherence to the medication regime: patient-related factors - illiteracy, advanced age, low levels of education, and lack of awareness and volition regarding the disease and medication; social and family environment-related factors - lack of family support; and organization-related factors – inadequate nurse staffing ratios, lack of educational programs, and lack of definition of responsibilities/roles.

Pretto et al. (2020) examined the relationship between health-related QoL of CKD patients on hemodialysis and socio-demographic, clinical, depression, and medication adherence variables, involving a sample of 183 patients. The study demonstrated the association between low medication adherence and reduced QoL, impacting 10 of the 20 dimensions assessed. Based on this finding, the authors concluded "that not using the medication properly increases the perception of the symptoms of the disease and the occurrence of damage to physical, psycho-emotional and social well-being" (p. 8).

Furthermore, Camarneiro (2021) highlights that the complexity of the different adherence-related variables will determine the degree of difficulty of nursing interventions, and the proposed changes must take into account "the context, the health system, and individual factors" (p. 5).

Research questions

What is the level of adherence to the medication regime of CKD patients on hemodialysis?; What is the relationship between the level of adherence to the medication regime and socio-demographic and clinical variables?

Methodology

This is a quantitative, descriptive-correlational, and cross-sectional study with a sample of CKD patients on hemodialysis at a private clinic in the northern region of Portugal. The inclusion criteria for participating in the present study were to have CKD, to be on a hemodialysis program, to be 18 years or older, and to follow a medication regime. CKD patients with cognitive impairment were excluded from the study. After using a non-probability sampling technique (convenience) and applying the criteria, the study's initial sample consisted of 110 individuals. However, the decision was made to exclude from the study nine CKD patients living in *Estruturas Residenciais para Pessoas Idosas* (ERPI - Residential Structures for the Elderly), given that health professionals manage users' medication in these institutions, and their inclusion could bias the results. Thus, the study's final sample consisted of 101 individuals. A Data Collection Instrument (DCI) with two sections was administered. The first section considered the independent variables (socio-demographic and clinical), including questions to characterize the sample in terms of "gender," "age," "marital status," "education," "place of residence," "employment," "household," the "existence of other diseases," the "number of other diseases," and the "number of medications per day." The second section focused on the dependent variable and consisted of the MTA scale, adapted and validated for the Portuguese population by Delgado and Lima (2001). The MTA scale assesses the individual's adherence to the medication regime (or also adherence to the treatment regime). The MTA scale includes seven questions (items) with six Likert-type possible answers: *always* (1); *almost always* (2); *frequently* (3); *sometimes*; *rarely* (5); and *never* (6). The sum of the values of each item and its division by the number of items allows for obtaining the level of adherence, with higher values corresponding to a higher level of adherence. The conversion to dichotomous variables was carried out based on the median, with the answers *rarely* (5) and *never* (6) being converted to *no* (1) and the remaining answers to *yes* (0). This conversion allowed classifying patients regarding their medication regime adherence as *adherent* or *non-adherent*.

Authorization was asked of the authors that adapted and validated the MTA scale for the Portuguese population. The study protocol was submitted to an Ethics Committee, and a favorable opinion (no. 74/2022) was obtained. Authorization was also received from the hemodialysis clinic where the study was conducted.

Free participation was assured, with the participants signing informed consent forms. They were previously informed that they could withdraw from the study at any time without needing to provide any explanation. The confidentiality and anonymity of the data collected were ensured. Data were collected in February and March 2022, during the participants' dialysis sessions, whenever the conditions for maintaining privacy were met.

Statistical analyses were performed using the IBM SPSS Statistics software, version 28.0. Descriptive statistics - absolute and relative frequencies, measures of central tendency, and dispersion - were used to analyze the variables characterizing the sample. Cronbach's Alpha coefficient was calculated to determine the scale's internal consistency. Non-parametric tests were used to analyze the relationship (inferential analysis) between adherence values and the other socio-demographic and clinical variables, as the assumptions for applying parametric tests were not met, namely regarding the data normality. The Mann-Whitney test was applied when there were two independent groups, and the Kruskal-Wallis test was applied when there were three or more independent groups. Dunn's post hoc test for pairwise comparisons was applied when statistically significant values were obtained. Results were considered statistically significant when p value < .05.

Results

The present study's sample, consisting of 101 CKD patients, was predominantly male (63.4%; n = 64), aged between 65 and 84 years (67.3%; n = 68), married or in a *de facto* union (68.3%; n = 69), and with 1st cycle education (53.5%; n = 54). Most of the participants lived

in rural areas (60.4%; *n* = 61), were retired (75.2%; *n* = 76), and lived with their spouse or partner (72.3%; *n* = 73). The sample presented a mean age of 71.47 ± 11.46 years. Table 1 further describes the sample's socio-demographic data.

Table 1

Absolute and relative distribution of the sample's socio-demographic variables (gender, age group, marital status, education, place of residence, employment, household)

Socio-demographic variables	***n***	**%**
Gender		
Male	64	63.4
Female	37	36.6
Age group		
Under 65 years	22	21.8
65 - 74 years	40	39.6
75 - 84 years	28	27.7
85 years or over	11	10.9
Min. = 30 years; Max. = 95 years; *M* ± *SD* = 71.47 ± 11.46 years		
Marital status		
Single	5	5.0
Married/in a "de facto" union	69	68.3
Divorced/Separated	5	5.0
Widowed	22	21.8
Education		
Unable to read or write	8	7.9
Able to read and write	12	11.9
1st cycle	54	53.5
2nd cycle	12	11.9
3rd cycle	4	4.0
Secondary education	9	8.9
Higher education	2	2.0
Place of residence		
Urban	40	39.6
Rural	61	60.4
Employment		
Active	10	9.9
Retired	76	75.2
Other	15	14.9
Household		
Spouse/Partner	73	72.3
Relatives	16	15.8
Alone	12	11.9
Total	101	100

Note. n = number of individuals in the sample; Min. = Minimum; Max. = Maximum; *M* = Mean; *SD* = Standard deviation.

The present study's participants received two types of treatment: oral medication and hemodialysis. Of the sample's 101 individuals, 38 (37.62%) did not suffer from other diseases. The remaining 63 (62.38%) had a "number of other diseases" varying between one and five, with the category of three diseases being the most predominant (*n* = 28). Considering the "number of medications per day," 47 patients (46.53%) took between one and four, 48 (47.52%) took between four and six, and 6 (5.94%) took ten or more medications per day. The mean number of medications per day was 5.26 ± 2.62. These data are presented in Table 2.

Table 2

Absolute and relative distribution of the sample's clinical variables (existence of other diseases, number of other diseases, number of medications per day)

Clinical variables		***n***	**%**
Existence of other diseases			
	Yes	63	62.38
	No	38	37.62
Number of other diseases (*n* = 63)			
	1	13	20.63
	2	28	44.44
	3	14	22.22
	4	5	7.94
	5	3	4.76
Number of medications per day			
	Up to 4 meds.	47	46.53
	5 - 9 meds.	48	47.52
	10 meds. or more	6	5.94
Min. = 2 meds.; Max. = 13 meds.; *M* ± *SD* = 5.26 ± 2.62 meds.			

Note. *n* = number of individuals in the sample; meds. = Medications; Min. = Minimum; Max. = Maximum; *M* = Mean; *SD* = Standard deviation.

Regarding the reliability of the MTA scale, Cronbach's Alpha was 0.805, indicating good internal reliability, according to Vilelas (2020). This value was higher than that of Delgado and Lima (2001), who obtained a Cronbach Alpha of 0.74. Table 3 shows the participants' answers regarding their adherence to the medication regime. The sample's distribution of the items was concentrated in the higher categories (*rarely* and *never*). Most participants (64.4%; *n* = 65) reported *rarely* or *never* forgetting to take their medications, but 27.7% reported *sometimes* forgetting, 6.9% *frequently* forgetting, and 1.0% reported *almost always* forgetting to take their medications. As for being careless with the time of taking medication, most were *rarely* or *never* careless. However, 22.8% of the sample responded that they were *sometimes* careless about the time, 6.9% were *frequently* careless, 2.0% were *almost always* careless, and 1.0% were *always* careless about when to take their medication. When asked about ceasing to take their medications because they felt better, 62.4% *never* did it, 28.7% *rarely* did it, and 8.9% *sometimes* did it. When asked about stopping their medications because they felt worse, 80.2% *never* did it, 13.9% *rarely* did it, and 5.9% *sometimes* did it. As for taking more medication than prescribed because they felt worse, 91.1% *never* did it, 5.9% *rarely* did it, and 2.0% *sometimes* did it. Regarding having to stop their medications because they ran out, 2.0% answered that it happened *frequently*, 17.8% declared it happened *sometimes*, 65.3% reported it happened *rarely*, and 14.9% *never* allowed their medications to run out. Finally, when asked about stopping their medication for some reason other than medical indication, 4.0% pointed out they *sometimes* did it, 10.9% *rarely* did it, and 85.1% *never* did it.

Table 3

Absolute and relative frequencies according to the Measure Treatment Adherence (MTA) Scale

Item	Always (1)	Almost always (2)	Frequently (3)	Sometimes (4)	Rarely (5)	Never (6)
Have you ever forgotten to take your medications?	0 (0.0)	1 (1.0%)	7 (6.9%)	28 (27.7%)	51 (50.5%)	14 (13.9%)
Have you ever been careless with the time to take your medications?	1 (1.0%)	2 (2.0%)	7 (6.9%)	23 (22.8%)	56 (55.4%)	12 (11.9%)
Have you ever stopped taking medication on your own initiative because you felt better?	0 (0.0)	0 (0.0)	0 (0.0)	9 (8.9%)	29 (28.7%)	63 (62.4%)
Have you ever stopped taking your medication on your own initiative because you felt worse?	0 (0.0)	0 (0.0)	0 (0.0)	6 (5.9%)	14 (13.9%)	81 (80.2%)
Have you ever taken more medication than prescribed on your own initiative because you felt worse?	1 (1.0%)	0 (0.0)	0 (0.0)	2 (2.0%)	6 (5.9%)	92 (91.1%)
Have you ever stopped taking medication because you ran out?	0 (0.0)	0 (0.0)	2 (2.0%)	18 (17.8%)	66 (65.3%)	15 (14.9%)
Have you ever stopped taking medication for any reason other than that given by your doctor?	0 (0.0)	0 (0.0)	0 (0.0)	4 (4.0%)	11 (10.9%)	86 (85.1%)

Table 4 shows the mean and standard deviation values and the variation and median for each item of the MTA scale. The mean values obtained were all high, reflecting high levels of adherence. The first two items regarding participants' forgetfulness and carelessness regarding the time to take medication had the lowest mean values (4.69 and 4.65, respectively). The median values of the items were 5 or 6. The low standard deviation reflected a high concordance in the participants' answers. Globally, the mean value obtained in the seven items of the MTA scale was 5.32, with a standard deviation of 0.47 and a median of 5.43.

Considering the dichotomous variables based on the median, 82.18% of the sample (n = 83) had a median equal to or greater than five and was considered "adherent." In comparison, 17.82% (n = 18) had a median below five and were considered "non-adherent."

Table 4

Measures of central tendency and dispersion of the Measure Treatment Adherence Scale

Item	Min.	Max.	*M*	*SD*	Median
Have you ever forgotten to take your medications?	2	6	4.69	0.83	5
Have you ever been careless with the time to take your medications?	1	6	4.65	0.92	5
Have you ever stopped taking medication on your own initiative because you felt better?	4	6	5.53	0.66	6
Have you ever stopped taking your medication on your own initiative because you felt worse?	4	6	5.74	0.56	6
Have you ever taken more medication than prescribed on your own initiative because you felt worse?	1	6	5.85	0.61	6
Have you ever stopped taking medication because you ran out?	3	6	4.93	0.64	5
Have you ever stopped taking medication for any reason other than that given by your doctor?	4	6	5.81	0.48	6
MTA	4	6	5.32	0.47	5.43

Note. MTA = Measure Treatment Adherence; Min. = Minimum; Max. = Maximum; *M* = Mean; *SD* = Standard deviation

Table 5 shows the mean and median adherence values according to the socio-demographic and clinical variables and the p-value for the hypothesis test to answer the second question. Considering the variable "gender," the MTA score was higher in female participants (median = 5.57). Still, the differences were not statistically significant ($p > 0.05$). In terms of the variable "age," CKD patients with lower median values (5.29) in the MTA scale belonged to the age groups of 75 - 84 years and 85 years or older, but without statistical significance ($p > 0.05$). As for the variable "marital status," the "single" group had the highest median score (5.57), while the "divorced/separated" group had the lowest (5.29). However, the differences were not statistically significant ($p > 0.05$). Regarding the variable "education," the group of participants who were "unable to read or write" obtained the lowest median score (5.0), whereas the groups "able to

read and write" and "1st cycle or more" obtained the highest scores, both with 5.43, but with no statistically significant differences. As for the variable "place of residence," those living in urban areas had the highest median scores (5.57), with no statistical significance. Participants living with relatives presented the lowest score for adherence level (median = 5.21), and those living alone presented the highest value (5.57). However, the differences were not statistically significant (p = 0.055). As for the existence of other diseases apart from CKD, the group "with 3 or more" concomitant diseases had the lowest measure of adherence. Considering that the p-value obtained in the Kruskal-Wallis test was less than 5% (p = .021), Dunn's test was applied, and a statistically significant difference was found between the group with "no" concomitant diseases and the group with "3 or more" concomitant diseases (p = .006).

Regarding the "number of medications per day," adherence was calculated based on two categories ("less than 5 medications" and "more than 5 medications" - the latter commonly used as a criterion for polymedication). Most of the sample taking "5 or more" medications (53.47%; n = 54) had the lowest median score (5.29) compared to those taking "less than 5" medications (5.57), a difference with statistical significance (p = 0.011).

Table 5

Relationship between the mean/median values of adherence (total MTA) and the socio-demographic and clinical variables

Variable		*n*	*M*	Median	*SD*	Test	*p*-value
Gender	Male	64	5.28	5.57	0.47	*Mann-Whitney*	0.207
	Female	37	5.39	5.43	0.46		
Age group	Under 65 years	22	5.37	5.57	0.43	*Kruskal-Wallis*	0.131
	65 - 74 years	40	5.41	5.57	0.37		
	75 - 84 years	28	5.27	5.29	0.52		
	85 years or over	11	5.01	5.29	0.61		
Marital status	Single	5	5.20	5.57	0.53	*Kruskal-Wallis*	0.814
	Married/in a "de facto" union	69	5.35	5.43	0.46		
	Divorced/Separated	5	5.31	5.29	0.26		
	Widowed	22	5.22	5.43	0.53		
Education	Unable to read or write	8	5.02	5.0	0.77	*Kruskal-Wallis*	0.295
	Able to read and write	12	5.48	5.43	0.40		
	1st cycle or more	81	5.32	5.43	0.43		
Place of residence	Urban	40	5.33	5.57	0.47	*Mann-Whitney*	0.650
	Rural	61	5.31	5.43	0.46		
Household	Spouse/Partner	73	5.34	5.43	0.44	*Kruskal-Wallis*	0.055
	Relatives	16	5.08	5.21	0.55		
	Alone	12	5.46	5.57	0.42		
Other diseases apart from CKD	No	38	5.45	5.57	0.38	*Kruskal-Wallis*	0.021
	1 or 2	41	5.31	5.43	0.43		
	3 or more	22	5.09	5.29	0.59		
Number of meds. per day	Less than 5 meds.	47	5.44	5.57	0.37	*Mann-Whitney*	0.011
	More than 5 meds.	54	5.21	5.29	0.52		

Note. n = number of individuals in the sample; Min. = Minimum; Max. = Maximum; *M* = Mean; *SD* = Standard deviation; meds. = Medications.

Discussion

The socio-demographic characterization of the present study's sample is partially similar to that studied by Barros (2020) of 47 Portuguese patients with CKD stage 5 on hemodialysis. This sample consisted of a majority of male participants with primary education and a mean age slightly lower (68 ± 13) than the present study (71.47 ± 11.46). Based on the 2020 annual report by the *Sociedade Portuguesa de Nefrologia* (Portuguese Society of Nephrology; 2020), on 31 December 2020, of the 12458 patients on hemodialysis treatment in Portugal, most were male (60.09%) and belonged to the 65 or older age group (65.19%). This study's mean number of medications per day was 5.26 ± 2.62. These medications were used to control possible disorders/symptoms associated with CKD or concomitant disease(s), which are present in 62.38% of the sample.

Regarding the first research question, the sample had a mean MTA score of 5.32 ± 0.47. Based on the dichotomous variables, 82.18% of the present study's sample was considered "adherent," and 17.82% (n = 18) was "non-adherent." This mean score is higher than the study

of Barros (2020), as it obtained 4.3 ± 0.29. In Brazil, Santos (2018), using the same scale in a sample of CKD patients on hemodialysis, obtained a mean score of 5.06 ± 0.09, with 65% of the sample classified as adherent. Bearing in mind the maximum achievable limits, there is room for improvement concerning the mean score and the maximum percentage of adherents. As Pinto (2020) states, patients with "CKD on hemodialysis have complex therapeutic regimes, particularly regarding their medication regime. Due to the nature of their care, nurses are in a privileged position to empower patients, providing them with knowledge and skills to self-manage their clinical condition" (p. 26). As Martins et al. (2017) point out, nurses can adopt several educational, behavioral, and motivational strategies aimed at the patient and/or family to improve adherence, both at the level of the medication regime and the therapeutic regime as a whole. These strategies should include the "explanation of the disease and the importance of adopting a healthy lifestyle, enhancing the patients' motivation" (p. 15). It is worth noting that forgetfulness and carelessness regarding the time to take medication were two of the MTA scale questions with lower mean scores. Nielsen et al. (2018) emphasize the vital role of health professionals in CKD patients' medication adherence, helping them to adopt strategies, such as mapping their daily activities and associating them with medication routines, using memory aids, demystifying erroneous beliefs about medication, and providing support to manage medication side effects. Given the study's results, these strategies implemented in a person-centered approach with the patient's proactive involvement can improve adherence levels. Also, continuously monitoring medication adherence levels will provide evidence of the strategies' effectiveness.

It was possible to observe statistically significant differences in the relationship between medication adherence and the independent variables (socio-demographic and clinical) when considering the "number of other diseases" and the "number of medications per day." Most of the sample had at least one concomitant disease and a daily prescription of more than five medications, corresponding to the group whose adherence score was lower. According to Pinto (2020, p. 33), "the medication regime for patients with CKD on hemodialysis is extremely complex, not only because of the number of medications taken but also due to the difficulty of harmonizing it with dialysis." The time and frequency of hemodialysis sessions can constitute a window of opportunity for nurses to develop some of the abovementioned strategies.

Considering the small size and the sampling technique (non-probability), the present study's sample cannot be considered representative.

Conclusion

The present study allowed for assessing the adherence to the medication regime of CKD patients on hemodialysis and identifying its relationship with socio-demographic and clinical variables using a DCI validated for the Portuguese population. The aim is to achieve the adherence of the entire sample to the medication regime, improving patients' QoL and controlling CKD-related disorders, as well as other comorbidities affecting them. The percentage of non-adherents to the medication regime and the relationship between adherence and the "number of other diseases" and the "number of medications per day" stress the significance of the multidisciplinary team's vigilance and adoption of strategies. Nurses are key players in accurately diagnosing medication adherence using validated and cross-culturally adapted instruments. Based on the most current scientific evidence, the results will allow for the design of strategies to be implemented (at the psychoeducational and motivational levels, among others). Further research involving representative samples from other regions of Portugal is suggested. Similarly, conducting a comparative study between countries would be essential, integrating new variables, such as patients' monthly income, beliefs about medication, and the duration of patients' hemodialysis treatment.

Author contributions

Conceptualization: Ferreira, A. M., Magalhães, C. P.
Data curation: Magalhães, C. P., Ferreira, A. M.
Formal analysis: Magalhães, C. P., Ferreira, A. M.
Investigation: Ferreira, A. M.
Methodology: Magalhães, C. P., Ferreira, A. M.
Supervision: Magalhães, C. P., Ferreira, A. M.
Validation: Magalhães, C. P.
Visualization: Magalhães, C. P., Ferreira, A. M.
Writing – Original draft: Magalhães, C. P.
Writing – Review & editing: Magalhães, C. P.

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