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The impact of education on knowledge, adherence and quality of life among patients on haemodialysis

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Abstract

Purpose The purpose of the study was to assess the impact of an educational intervention on the level of knowledge, quality of life (QoL) and adherence to the treatment regimen among haemodialysis (HD) patients as well as to describe the association between these variables.

Methods In this quasi-experimental interventional study, 50 HD patients at a HD centre in Western Attica were randomly assigned into intervention ($N = 25$, received education and a booklet) and control ($N = 25$, received only the booklet) groups. Knowledge, adherence and quality of life were measured pre- and post-intervention using the Kidney Disease Questionnaire, the GR-Simplified Medication Adherence Questionnaire-HD and Missoula Vitas Quality of Life Index—15, respectively. The statistical analysis of the data was performed with the help of the Statistical Program SPSS version 19.0. The statistical significance level was set up at 0.05.

Results The increase of knowledge, adherence and QoL levels in the intervention group was significantly higher compared to the control group. There was no significant correlation between knowledge and adherence scores after the intervention. However, a significant positive correlation was found between the change in the overall QoL and the changes in the total adherence score as well as the adherence to the fluids and dietary behaviour.

Conclusions An educational intervention can improve knowledge, adherence and QoL among HD patients. The increase of knowledge level is not associated with increased adherence. However, the increase of adherence may improve some dimensions of QoL.

Keywords Adherence · Hemodialysis · Educational intervention · Knowledge · Quality of life

Introduction

Renal replacement therapy for patients undergoing haemodialysis (HD) is associated with strong physical and mental stressors such as pain [1], fluid restrictions, pruritus [2, 3], physical activity limitations, fatigue, lack of self-care, feelings of inadequacy, and mood disasters [4]. These patients are not only treated for complications associated with HD, such as left ventricular hypertrophy, atherosclerosis [5], and secondary hyperparathyroidism, but also for changes in self-perception and sometimes for reversal of roles in the family [6]. It is not surprising, therefore, that End Stage Renal Disease (ESRD) under HD affects the quality of life (QoL) more than heart failure, diabetes mellitus, arthritis, and cancer [7].

The management of these health issues requires multiple variations in the patient's lifestyle. The success of treatment depends to a large extent on the adherence to the strictly recommended therapeutic regimen. According to the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) [8], non-adherence among HD patients includes the following: (a) omitting or shortening the duration of HD session; (b) excessive intake of fluids and foods containing potassium and phosphorus; and (c) non-adherence to medication. Non-adherence to therapeutic

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recommendations may have unpleasant effects on the QoL and increased morbidity and mortality. According to studies [9], the prevalence of non-adherence varies and depends on the domain of HD regimen which is being considered. For example, skipping of ≥ 1 HD sessions is estimated to be at 8.0% (for a period ≥ 1 month), shortening ≥ 1 HD sessions (for ≥ 10 min) at 49% and non-adherence to fluid restrictions at 9% (Interdialytic Weight Gain (IDWG) ≥ 5.7% of the dry weight) [9]. Systematic reviews refer to the prevalence rate of non-adherence to phosphate binders at 22–74% [10]. According to Dialysis Outcomes and Practice Patterns Study (DOPPS), it is estimated that 9.7% of US patients skipped ≥ 1 HD sessions (for over a month), while the rate for both Japanese and European patients was 0.6% [11]. Varying rates of non-adherence may be due to different measurement methods (self-reported methods, pill counting, electronic monitoring). However, there is no doubt that non-adherence is associated with increased mortality in patients undergoing HD. Incomplete adherence to fluid restrictions can cause dyspnoea, hypertension and pulmonary edema, while continuous periods of excess fluid intake burden the cardiovascular system. Non-adherence to diet and medication recommendations can lead to increased serum phosphate levels, leading to secondary hyperparathyroidism and renal osteodystrophy. High phosphate levels are a risk factor for coronary heart disease and, consequently, pose an increased risk of mortality [12]. On the other hand, the skipping of one HD session per month has been shown to be associated with high prevalence of death, while the shortening of HD session for 10 min (3 times/month) is related to increased mortality [13]. Although the phenomenon of non-adherence to the haemodialysis regimen could be determined through objective measurements such as body weight measurement before the initiation of the HD session and biochemical markers (potassium, sodium, phosphorus), it would be useful to point out that there is no "gold recipe" to measure adherence and no tool to detect all types of adherence.

The importance of educational programs

Some studies have shown that patient knowledge on disease and treatment is associated with increased level of adherence [14–16]. Until 1963, the role of the nephrology nurses consisted mainly of palliative measures for patients. Over the years, this role included patient education. Patient education focused on increasing the level of patient knowledge. It makes sense to think that the well-informed patient is more adherent. Patients are not expected to adhere to a therapeutic plan, which they do not understand. However, studies have shown that this is not always the case. Although the knowledge about the requirements of treatment is closely related to adherence, acquiring knowledge does not necessarily mean increased adherence [17, 18].

In addition to adherence, international literature has shown that nurse-led education can, also, improve the health-related QoL [19]. According to Orem, as patients are unable to take care of themselves, nurses can make positive changes in the QoL through appropriate educational strategies [20]. Patient-centred education leads to self-efficacy and is one of the primary elements of nursing and occupational duties of nurses. Research studies [21, 22] carried out in this field have revealed the positive impact of education on self-care, independence, prolonged lifespan, and the increase of disease-related knowledge to prevent the secondary negative effects.

The aim of this study was to test the hypothesis that a nurse-led educational intervention may affect the levels of knowledge, adherence to treatment regimen, and QoL among patients with ESRD undergoing HD. Based on prior research findings [14, 19, 23], highlighting the effect of such intervention on these variables, we decided to investigate this effect and how these variables interact with each other. This study is not only the first one on this topic (either internationally or in Greece), examining the relationship between all the aforementioned variables after an educational intervention (or without educational intervention), but it is also the only one measuring these variables among Greek HD patients.

Methods

Design and sample

From August 2017 to December 2017, a two-group quasi-experimental design was performed with a convenience sample of HD patients at a HD unit named "Iatriko Therapeutirio Iliou Medifil A.E.", which is one of the large HD centres of Attica (the most populated county of Greece) with a patient population of 134 HD patients. Among the 134 HD patients at the HD centre, 120 patients were eligible. The criteria for selecting the sample were as follows: (i) HD program three times a week for at least 6 months; (ii) age between 18 and 65 years; (iii) ability to write, read and understand the Greek language; (iv) ability to read and sign the consent; (v) time- and space-oriented. Patients with cognitive and psychological disorders, eye or hearing problems, and limited self-care were excluded. The study population was randomly divided into two groups: The intervention group (received an educational intervention and a booklet) and the control group (received only a booklet). A stratification test was performed based on the demographic and clinical features, so that both groups could be equivalent as far as their characteristics were concerned. Patients, after accepting their participation in the study, were classified into one of

the two groups, without knowing in which of the groups they would belong. Finally, fifty (50) patients participated in the study. Each group consisted of 25 patients (Fig. 1). The educational session was conducted by the researchers, who are clinical nurses and maintain daily contact with HD patients.

To conduct the study, licenses from the Authority for Personal Data Protection and Scientific Council of HD Unit of West Attica "Iatriko Therapeutirio Iliou Medifil A.E." (Athens) were secured. The participants were informed about the purposes of the study that the data would only be used for research purposes and their participation in the study is voluntary. In addition, they were informed that data would not be shared with anyone and their identity would remain confidential. They were also informed that they could withdraw from the study anytime they pleased. The participants were provided information and consent forms.

Phase I

After the inclusion of the patients into one of the two groups, the following questionnaires were followed (In Phase I, all questionnaires were provided to both patient groups):

(a) Patients were given a questionnaire on sociodemographic and clinical characteristics in order to characterize patients and identify their background information.

(b) The Greek version of Kidney Disease Questionnaire (KDQ) [24]. The KDQ scale explores the level of knowledge of HD patients in 8 areas of ESRD: kidney anatomy, kidney function, nutrition, peritoneal dialysis, haemodialysis, fluid intake, transplantation, and medication. It consists of two forms (Form A and Form B), each of which consists of 13 multiple choice questions (total number of items: 26). Each correct answer is scored by 1 and each wrong answer by 0. The total

Fig. 1 Flow diagram for the patients' selection process
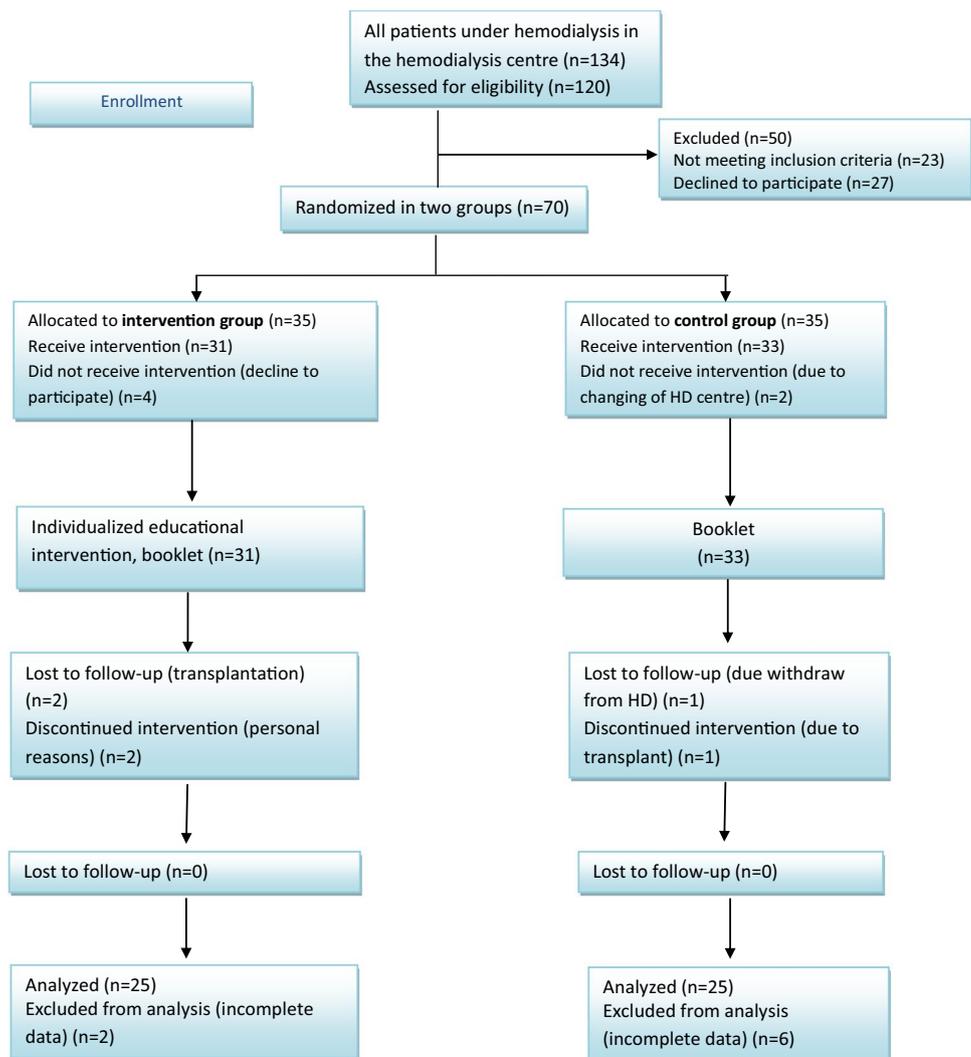
score can range between 0 and 26 for both forms. The higher the score, the higher the level of knowledge. The KDQ can discriminate between well-informed HD patients about ESRD and its therapeutic regimen from those who are not well-informed. It was first used by Devins et al. (1990) for measuring Canadian HD patients' knowledge [25].

(c) The GR-Simplified Medication Adherence Questionnaire-HD (GR-SMAQ-HD) [26] is a self-administered questionnaire that consists of eight items, of which three are dichotomous (Yes/No) and five items are scored on a five-point Likert-type scale. It explores all dimensions of HD patient adherence: (i) medication (items 1–4), (ii) attendance at HD session (items 5 and 6), and (iii) diet and fluid restrictions (items 7 and 8). The score ranges between 0 and 8. Higher scores indicate higher adherence to HD regimen. It takes only 4 min to complete. The internal consistency was studied using Cronbach's Alpha Index and the total score of GR-SMAQ-HD was 0.751. The scores for the dimensions of "Medication Adherence", "Attendance at HD Session", and "Diet/Fluid Restrictions" were 0.749, 0.83, and 0.76, respectively. GR-SMAQ-HD is the only scale for measuring adherence among Greek HD patients.

(d) The Greek version of the Missoula VITAS Quality of Life Index-15 [27] is a tool measuring patient information with regard to QoL during the end stage of a disease. It consists of five dimensions (symptoms, functionality, interpersonal relationships, well-being, transcendent). In each dimension (domain), three types of information are collected: Assessment (scoring -2 to $+2$), Satisfaction (scoring -4 to $+4$) and Importance (scoring 1–5). (Assessment + Satisfaction) × Importance = QoL in each dimension. Responses were recorded using a five-point Likert-type scale, so that the lowest score indicates the least desirable condition and vice versa. The final score in each dimension corresponds to the overall effect of this dimension on the patient's QoL. The internal consistency of the questionnaire was satisfactory in this study, with Cronbach's Alpha 0.74. The scale has been used in other studies [28] as well.

Identifying the educational needs of patients

The educational needs of patients were identified through the international literature [29, 30]. To individualize the educational needs of each patient, an analysis of data—generated from patient's history, answers to KDQ, and the needs that each patient perceive that they will help him to deal with the problems—was performed.

Then, the implementation of the nursing educational intervention (only for the intervention group) and the administration of the booklet (for both groups) were followed. The booklets were freely given to each patient separately after the intervention to take home.

The educational intervention and the booklet

Immediately after the completion of the pre-test, a one-time personalized (face-to-face) educational intervention was carried out by the researchers. It took place during the HD session (approximately 40 min after the initiation of the HD session until the patient's vital signs are stabilized) and lasted for approximately 45 min for each patient. The duration of the educational intervention was shaped keeping in mind the patient's educational level, the level of knowledge about Chronic Kidney Disease (CKD), and his ability to adequately understand the terminology relating CKD. The nursing educational intervention included (a) the booklet "Dialysis. Answers to common questions", edited by the basic researcher [31], which contained the following issues: anatomy and kidney function, CKD, diet and fluids restrictions, medication, laboratory tests (haematocrit, potassium, sodium), CKD-related conditions, transplantation, and peritoneal dialysis. The above issues are also included in the KDQ. The content validity of the booklet was tested through the Content Validity Index (CVI) and was confirmed by seven teachers belonging

Table 1 Short list of the tools used, the time point applied and the interventions for each group

Phases	Instruments (for both groups)	Intervention group	Control group
Phase I (baseline)	Questionnaire of sociodemographic and clinical characteristics KDQ, GR-SMAQ-HD, MVQoLI-15	Educational session and booklet	Booklet
Phase II (follow-up, 1 month after the educational session)	KDQ, GR-SMAQ-HD		
Phase III (follow-up, 2 months after the educational session)	MVQoLI-15		

to nursing school. Two independent nephrologists and two renal nurses reviewed the training module. Participants answered to a four-point Likert Scale related to the relevance, the necessity and the agreement with current knowledge: (1) irrelevant, (2) little relevant, (3) relevant, (4) very relevant. The Content Validity Index (CVI) was found to be higher than 0.9 for all the items. The total CVI of the booklet was 0.97. Following an exchange of views with the experts, the educational sections were considered valid for educational purposes. (b) The intervention also included the time allocated to patients in order to study the booklet, express any questions, counselling and emphasize the points that were not well understood.

Phase II

It took place a month after the second phase in both groups and was carried out during the HD session. The patients were given the KDQ and GR-SMAQ-HD (not MVQoLI-15). According to the literature, the assessment of adherence after educational intervention is proposed to be 1–2 months after the educational intervention [14, 32].

Phase III

It took place two months after the educational intervention in both groups and aimed at assessing the QoL levels. During the HD session, patients were given the Missoula—Vitas Quality of Life Index-15. According to the literature [22, 23], the assessment of QoL is proposed to be 2–8 months after the educational intervention.

The following table explains the study instruments used and the time point they were applied (Table 1).

Statistical analysis

The mean values and standard deviations were used to describe the quantitative variables. Absolute (N) and relative (%) frequencies were used to describe the qualitative variables. The analysis of variance for repeated measures (ANOVA) was used in order to test differences in scales between groups and time. The above method was also used to evaluate whether the degree of change in time of the studied parameters was different between the two groups. Due to the asymmetry of distributions in the adherence scale, logarithmic transformations of the variables were used in the ANOVA repeat measurement method. To test the relationship of two quantitative variables, the correlation coefficients of Pearson or Spearman (r) were used. The correlation was considered low when the correlation coefficient (r) ranged between 0.1 and 0.3, moderate when the correlation coefficient ranged between 0.31 and 0.5, and high when the

coefficient was greater than 0.5. The statistical significance was set at 0.05, and the statistical program IBM SPSS 19.0 was used for the analysis.

Results

The majority of patients cited lack of interest in the educational session as the reason for not participating in the study. The participants' age ranged between 18 and 65 years with a mean age of 50 years. Sixty percent (60%) of the total sample were male. The majority (44% for the intervention group and 60% for control group) were high school graduates. Ninety-nine patients (from both groups) suffered

Table 2 Demographic and clinical characteristics of patients

	Group			
	Control ($N=25$)		Intervention ($N=25$)	
	N	%	N	%
Age, mean (SD)	49.8 (8.5)		51.2 (11.5)	
Gender				
Male	15	60.0	15	60.0
Female	10	40.0	10	40.0
Marital status				
Unmarried	14	56.0	5	20.0
Married	10	40.0	14	56.0
Divorced	0	0.0	4	16.0
Widow/er	1	4.0	2	8.0
Educational level				
Illiterate	2	8.0	0	0.0
Primary school	2	8.0	1	4.0
Secondary school	4	16.0	3	12.0
High school	11	44.0	15	60.0
University student	0	0.0	2	8.0
University graduate	6	24.0	4	16.0
Occupational status				
Unemployed	7	28.0	1	4.0
Household	1	4.0	2	8.0
Self-employed	2	8.0	0	0.0
Private employee	5	20.0	4	16.0
State employee	3	12.0	1	4.0
Retired	7	28.0	17	68.0
Etiology of ESRD				
Diabetes mellitus	11	44.0	5	20.0
Hypertension	8	32.0	9	36.0
Glomerulonephritis	4	16.0	6	24.0
Polycystic disease	1	4.0	1	4.0
Other	1	4	1	4.0
Daily number of pills, mean (SD)	7.2 (4.7)		8.9 (3.7)	

SD standard deviation

Table 3 Mean scores of Knowledge and adherence before and after intervention

Group	Pre Mean (SD)	Post Mean (SD)	Change Mean (SD)	P**	P‡
Knowledge score					
Control	15.96 (5.08)	17.56 (4.48)	1.6 (1.17)	**0.005**	**< 0.001**
Intervention	15.88 (4.76)	20.2 (3.75)	4.32 (2.98)	**< 0.001**	
P*	0.956	**0.018**			
GR-SMAQ-HD total score					
Control	6.28 (1.43)	6.32 (1.46)	0.04 (0.2)	0.683	**0.014**
Intervention	7.04 (1.08)	7.38 (0.82)	0.33 (0.56)	**< 0.001**	
P*	**0.044**	0.004			
Medication					
Control	3.04 (1.02)	3.04 (1.02)	0 (–)	1.000	0.322
Intervention	3.64 (0.76)	3.68 (0.63)	0.04 (0.2)	0.164	
P*	**0.043**	0.012			
Attendance at HD session					
Control	1.84 (0.37)	1.84 (0.37)	0 (–)	–	–
Intervention	1.96 (0.2)	1.96 (0.2)	0 (–)	–	
P*	0.178	0.178			
Diet/fluid restrictions					
Control	1.4 (0.71)	1.44 (0.71)	0.04 (0.2)	0.696	**0.044**
Intervention	1.48 (0.71)	1.76 (0.52)	0.28 (0.54)	**0.002**	
P*	0.756	0.094			

Bold values indicate the statistically significant

SD standard deviation

*Difference between groups (using logarithmic transformations)

**Difference between measurements (using logarithmic transformations)

‡Repeated ANOVA measurements. Differences in the change from one measurement to the other among the groups (using logarithmic transformations)

from diabetes mellitus as co-morbid disease, while the daily number of pills consumed was 7.2 for control group and 8.9 for intervention group. There were no major slight differences with respect to group comparison of demographics (Table 2).

The following table summarizes knowledge and adherence scores before and after the intervention in each group. Higher scores indicate better knowledge and adherence level. The results indicated that there was a significant difference in both knowledge and adherence scores for intervention group (Table 3).

Table 4 gives the participants' QoL scores before and after intervention in each group. Higher scores indicate better QoL.

Correlations

The following table gives the correlation between the scale of knowledge and the dimensions of adherence (Spearman's correlation test) and between the scale of knowledge and QoL (Pearson's correlation test) pre- (both groups included, $N = 50$) and post-intervention (intervention group included, $N = 25$) (Table 4). Prior to the intervention, there was no significant correlation between the knowledge and adherence or between knowledge and QoL. Even after the intervention, there was no significant correlation between the changes in the scale of knowledge and the changes in the dimensions of the adherence scale or the changes in the scale of knowledge and the dimensions of QoL (Table 5).

The following table gives the Spearman correlation coefficients between the dimensions of adherence and QoL pre- (both groups included, $N = 50$) and post-intervention (intervention group included, $N = 25$) (Table 6). Prior to the intervention, there was a significant positive correlation between the "Symptoms" dimension and the total adherence score as well as adherence to "Attendance at HD Session" and "Diet/Fluid Restrictions" scores. After the intervention, there was a significant positive correlation between the change in total QoL score and the changes in total adherence and "Diet/Fluid Restrictions" scores.

Table 4 Mean scores of quality of life before and after intervention

Group	Pre Mean (SD)	Post Mean (SD)	Change Mean (SD)	$P**$	$P^{\ddagger}$
Symptoms					
Control	5.44 (9.34)	7.32 (10.13)	1.88 (3.14)	0.062	0.475
Intervention	7.08 (8.7)	9.96 (6.46)	2.88 (6.19)	**0.005**	
$P*$	0.524	0.278			
Functionality					
Control	4.52 (9.47)	4.32 (9.29)	−0.2 (1)	0.714	**<0.001**
Intervention	10.52 (11.12)	15.04 (10.78)	4.52 (3.7)	**<0.001**	
$P*$	**0.045**	**<0.001**			
Interpersonal					
Control	11.48 (12.26)	11.36 (11.96)	−0.12 (1.36)	0.841	0.509
Intervention	15.08 (10.23)	15.52 (8.24)	0.44 (3.98)	0.463	
$P*$	0.265	0.159			
Well-being					
Control	−1.52 (13.81)	−1.84 (13.93)	−0.32 (1.97)	0.402	**0.030**
Intervention	3.64 (14.15)	4.52 (14.33)	0.88 (1.81)	**0.024**	
$P*$	0.198	0.118			
Transcendent					
Control	12.32 (12.57)	12.24 (11.65)	−0.08 (3.57)	0.929	**0.033**
Intervention	12.28 (12.31)	15 (8.61)	2.72 (5.26)	**0.004**	
$P*$	0.991	0.345			
MVQoLI-15 total score					
Control	18.22 (3.48)	18.34 (3.54)	0.12 (0.48)	0.478	**<0.001**
Intervention	19.86 (3.59)	21 (2.89)	1.14 (1.04)	**<0.001**	
$P*$	0.108	**0.005**			

Bold values indicate the statistically significant

SD standard deviation

*Difference between groups

**Difference between measurements

‡Repeated ANOVA measurements. Differences in the change from one measurement to the other among the groups (using logarithmic transformations)

Discussion

This study investigated the effect of a nurse-led educational intervention on changes in the level of knowledge, QoL and adherence to the treatment regimen among HD patients. The challenge for HD nurses is significant, as the lack of knowledge and the low adherence may negatively affect the patient's QoL and increase the cost of hospitalization and mortality.

This study showed that the educational intervention may improve knowledge, adherence, and the health-related QoL by way of improving information and limiting misconceptions about the disease. Several studies [33, 34], both in the hospital and in the community health care settings, emphasize that patients suffering from chronic diseases may benefit in a number of dimensions (physical, mental, self-care, clinical decision-making) from educational programs. These studies emphasize the importance of the patient-centred

approach. According to this approach, the patient is treated as a partner, is well informed about his/her health and is involved in clinical decision-making.

Prior to the intervention, both groups had similar levels of knowledge. After the intervention, while there was a significant increase for both groups, the increase in the intervention group was significantly higher, resulting in a significantly higher score compared to the control group. Several studies [17, 35] have shown the positive impact of an educational session in knowledge levels. Ebrahimi et al. [18] also reported a significant increase in the level of their patients' knowledge in relation to the diet restrictions after educational intervention. Similar results were found by other researchers [8] in a population of Iranian HD patients.

Both before and after the intervention, the total GR-SMAQ-HD and the "Medication Adherence" scores were higher in the intervention group than the control group. However, the "Medication Adherence" score was not

significantly altered in any group after the intervention. In contrast, other studies [21, 36] showed a significant increase in the level of adherence to medication (phosphate binders) after the educational intervention.

There was a significant improvement in the total GR-SMAQ-HD and "Diet/Fluid Restrictions" scores in the intervention group. Consequently, the degree of change in total GR-SMAQ-HD and "Diet/Fluid Restrictions" scores was found to differ significantly between the two groups. Barnett et al. [37], in their research study in Malaysia, found that the weight of overweight HD patients reduced by 0.43 kg post educational intervention. The level of adherence to fluid restrictions increased from 47% before intervention to 71.5% after intervention. Also, there was a remarkable difference in the mean blood pressure before and after the educational intervention.

Prior to intervention, the total score of QoL did not differ significantly between groups. After the intervention, however, the individuals belonging to the intervention group had a significantly higher total score, i.e. better QoL than those in the control group. Therefore, the degree of improvement in QoL differed significantly among the groups.

There were no differences in the "Symptoms", "Interpersonal", "Well-being" and "Transcendent" dimensions between the groups neither before nor after the intervention. After the intervention, there was a significant improvement recorded in the scores of the dimensions of "Symptoms", "Well-being" and "Transcendent" in the intervention group, while the control group remained at similar levels. In addition, the degree of change in "Well-being", "Transcendent" and "Functionality" was found to differ significantly between the two groups but not in "Symptoms". Research studies carried out in this field have revealed the positive influence of counselling on self-care and the increase of disease-related knowledge to prevent secondary negative effects [38]. Moshtagh et al. [39] claimed that dietary counselling may improve mental health as well as the physical and social dimensions of QoL by reducing levels of anxiety and depression. Weiss et al. [3] highlight that counselling may improve copings strategies and, therefore, the health-related QoL.

Correlations between the scales before intervention (*N* = 50)

In neither of the two groups, there was a significant correlation between the scale of knowledge and the dimensions of the adherence scale nor between the scale of knowledge and the dimensions of QoL. This finding can be attributed to the small sample size (*N* = 50). There was, however, a significant positive correlation of the "Symptoms" dimension with the total adherence score and "Attendance at HD Session" and "Diet/Fluid Restrictions" scores. Therefore, the higher the score of total adherence and the above dimensions, the

Table 5 Correlation between patients' knowledge with adherence and QoL

	KDQ score	
	Pre (*N* = 50)	Post (*N* = 25)
Total GR-SMAQ-HD score		
r	0.28	0.12
P	0.057	0.563
Medication		
r	0.25	0.34
P	0.087	0.092
Attendance at HD session		
r	0.20	0.21
P	0.179	0.181
Diet/fluid restrictions		
r	0.06	0.00
P	0.703	0.982
MVQoLI-15 total score		
r	− 0.12	0.08
P	0.405	0.696
Symptoms		
r	− 0.03	− 0.11
P	0.834	0.599
Functionality		
r	− 0.08	0.09
P	0.603	0.669
Interpersonal		
r	− 0.15	0.21
P	0.310	0.325
Well-being		
r	− 0.03	0.05
P	0.828	0.827
Transcendent		
r	− 0.09	0.06
P	0.518	0.779

better the score of the "Symptoms" dimension. Two studies exploring the role of adherence in QoL and its psychosocial variables such as depression, anxiety and stress have shown that low adherence may reduce the physical dimension of QoL and well-being vitality [40].

Correlations between the changes in the study scales in the intervention group (*N* = 25)

In this study, there was no significant correlation between changes in the knowledge scale and changes in the dimensions of the adherence scale. Similar results were shown by others [41], as a pilot study involving Indian HD patients did not find a correlation between the level of knowledge and adherence behaviour in relation to dietary regimen and fluids restrictions. In the study by Nerbass et al. [42],

Table 6 Correlations between patients' adherence and QoL before and after the intervention

	Pre (N = 50)				Post (N = 25)			
	GR-SMAQ-HD total score	Medication	Attendance at HD session	Diet/fluid restrictions	GR-SMAQ-HD total score	Medication	Attendance at HD session	Diet/fluid restrictions
MVQoLI-15 total score								
r	0.14	0.08	0.09	0.23	0.49	0.00	0.00	0.49
P	0.326	0.592	0.558	0.110	**0.015**	1.000	1.00	**0.013**
Symptoms								
r	0.46	0.27	0.32	0.41	0.38	0.06	0.112	0.35
P	**0.001**	0.062	**0.023**	**0.003**	0.068	0.786	0.44	0.089
Functionality								
r	−0.08	−0.13	−0.06	0.08	−0.07	0.04	0.132	−0.11
P	0.569	0.362	0.707	0.564	0.752	0.839	0.376	0.597
Interpersonal								
r	0.11	0.04	0.12	0.14	0.41	0.38	0.00	0.25
P	0.439	0.781	0.408	0.323	0.049	0.062	0.981	0.231
Well-being								
r	0.04	0.13	0.00	0.06	−0.01	−0.10	0.04	0.03
P	0.777	0.373	0.974	0.678	0.957	0.629	0.85	0.874
Transcendent								
r	−0.08	−0.08	0.03	−0.02	0.17	−0.12	0.15	0.21
P	0.593	0.598	0.845	0.905	0.425	0.561	0.31	0.304

Bold values indicate the statistically significant

although patients showed a good level of knowledge about phosphate binders, the majority of them could not adhere to the treatment. Some studies have shown that the increase of knowledge alone may not increase adherence [17, 43]. This finding is not specific for HD patients as other researchers [44] found that knowledge on complications of hypertension is, also, not correlated to adherence among patients with hypertension.

In contrast with the findings of other studies [45, 46], where there is a positive correlation between HD patient's knowledge and QoL, this study did not find any significant correlation between changes in these variables. However, there was a significant positive correlation between changes in the total QoL score and the changes in the total adherence and adherence to "Diet/Fluids Restrictions" scores. Therefore, the greater the improvement in total adherence and "Diet/Fluid Restrictions", the greater the improvement in the QoL as a whole is. Higher levels of QoL are probably associated with higher adherence levels [47]. Peritoneal dialysis patients with higher levels of self-reported adherence experienced higher levels of QoL, while patients who adhered to antihypertensive agents demonstrated a better physical QoL.

The major strength of this study is that it is the first study among international literature exploring these variables (knowledge, adherence and QoL) prior to and after educational nurse-led intervention among HD patients.

The limitation is that the results cannot be generalized as the sample did not come from different regions of Greece, although patients of Western Attica come from all socio-economic classes. Moreover, the impact of factors such as noise, interruption by others, or participants' fatigue may influence the answers of individuals. There was also a limitation of the time available to cover all thematic units, as the participants had only one educational session, which included a variety of thematic sections on CKD. For this reason, and in order to enhance the educational outcome, the booklets were given to each participant separately after the intervention.

Conclusion

The results indicate that a nurse-led educational intervention can increase knowledge, adherence, and dimensions of QoL among HD patients. The increase in knowledge level does not lead to increase in adherence. However, the increase in adherence may improve some dimensions of QoL.

The patient-centred approach involves strengthening the role of the patient in clinical decision-making through information and the detection of the patient's educational needs, which are key elements. Also, the creation of an

interdisciplinary team consisting of nephrology nurses, nephrologists, psychologists, social workers and dieticians will lead to better outcomes. In addition, education should begin at the stage prior to HD to help patients identify existing coping strategies. To achieve this, the creation of educational centres within the hospitals or HD units is essential.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Ethical approval was granted by the Authority for Personal Data Protection (Number: //240-3/11-02-2016) and the Scientific Council of "Iatriko Therapeutirio Iliou, Dialysis Centre in Athens MEDIFIL A.E.", (http://medifil.gr/index-en.html) on 25 November 2015. All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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