

Sufficiency of Knowledge Processed in Patient Education in Dialysis Care

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Purpose: Patient education improves health and treatment adherence of patients with chronic kidney disease. However, evidence about the sufficiency of patients' knowledge processed in patient education is limited. The purpose of this study was to evaluate subjective and objective sufficiency of knowledge processed in patient education in dialysis care and treatment.

Patients and Methods: A cross-sectional study design was used. The sample (n=162) comprised patients in predialysis or home dialysis. All eligible patients during the data collection timeframe (2016–2017) in two university hospital districts in Finland were invited to participate. Subjective sufficiency was evaluated with a structured questionnaire having 34 items divided into six dimensions of empowering knowledge (bio-physiological, functional, social, experiential, ethical, and financial) on a Likert scale (1=not sufficient at all, 4=very sufficient). Objective sufficiency was evaluated with a structured knowledge test with 10 items (score range 0–10, correct=1, wrong/no knowledge=0) based on the multidimensional content of patient education emphasizing bio-physiological dimension.

Results: In subjective sufficiency of knowledge, the mean was 3.27 (SD 0.54). The bio-physiological dimension of empowering knowledge was the most sufficient (mean 3.52, SD 0.49) and the experiential the least (mean 2.8, SD 0.88). In objective sufficiency, the means ranged 5.15–5.97 (SD 2.37–2.68) among patients in different modalities of dialysis care and treatment. The least sufficient objective scores were bio-physiological and functional knowledge. The subjective and objective sufficiency did not correlate with each other.

Conclusion: Patients' knowledge, either subjective or objective, does not seem to be sufficient. Hence, attention should be paid to supporting patients with more personalized knowledge. Furthermore, the relationship between subjective and objective sufficiency needs future consideration, as their non-correspondence was a new discovery.

Keywords: chronic kidney disease, hemodialysis, home, patient education as topic, peritoneal dialysis, renal dialysis

Introduction

Patients with chronic kidney disease (CKD) are a growing population.¹ Living with CKD is a long-term challenge creating a need for sufficient knowledge via education for treatment adherence² and patient empowerment.^{3–5} Sufficient knowledge can be defined as adequate amount and time of essential, multidimensional knowledge enabling patient empowerment.^{6–9} However, there is limited evidence about the sufficiency of knowledge among these patients despite the strategic emphasis to support the empowerment of long-term patients.^{10,11}

Sufficient knowledge can be supported with patient education. It is necessary for patient empowerment, supports patient's self-management,^{12–14} treatment adherence,²

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decision on treatment options,¹⁵ and improves both the medical^{16,17} and psychosocial outcomes¹⁸ of patients with CKD. However, patients have reported insufficient knowledge by patient education concerning CKD^{4,5,19} and withholding of information about CKD and its care.^{4,20} Patients with CKD expect more knowledge concerning the disease and its treatment^{4,19,21} as well as useful practical advice.^{4,19–21} However, there is a research gap on the sufficiency of patients' empowering knowledge. We aimed to address this gap by evaluating knowledge from two standpoints: subjective and objective sufficiency.

Subjective and objective evaluations provide different types of knowledge as they originate from different philosophical assumptions. Subjective evaluation demonstrates the essential, unique experience of the patient,^{22,23} highlighted in international strategies (eg^{10,24}). Objective evaluation may lack the richness of experience, yet it provides standardized proof of patient's knowledge of facts specifically.^{23,25}

Subjective evaluation of patients' knowledge means studying patients' own perspective and perceptions.²⁶ Interviews^{3,5,20} and questionnaires^{13,14} have been used to discover the subjective evaluation of patients with CKD. Results suggested that patients perceived patient education as not having adequate connection with their individual lives, which may indicate insufficiency of empowering knowledge.^{5,20} No subjective method was found evaluating specifically the level of sufficiency of knowledge of patients in dialysis care and treatment.

Objective evaluation is the observation of knowledge that is independent of patients' perspective, usually using knowledge tests.²⁵ For patients with CKD, knowledge tests exist on the function of the kidneys,^{27–29} kidney disease,^{27,30} its treatment,^{27–29} kidney transplantation,^{30–32} and treatment adherence.³³ Higher knowledge levels seem to be associated with male gender^{27,29} and higher educational level.^{27,29,30} Patient education can improve knowledge level,^{33,34} but the sufficiency of knowledge varies based on forms of care and treatment.³²

The emphasis of patient empowerment in the care of patients with CKD has highlighted the importance of evaluating patient-reported outcomes.³⁵ In this study, we analyze both subjective and objective sufficiency of knowledge of patients in dialysis care, assuming their correspondence.³⁶ Sufficiency of knowledge as an outcome does not necessarily inform all important aspects of patients' lives, but it gives indications about outcomes

of empowering patient education and treatment adherence, which is recognized as important among patients with CKD.² Furthermore, assessing subjective and objective sufficiency can advance evaluation practices in clinical practice and research.

Materials and Methods

Purpose

The purpose of the study was to evaluate the subjective and objective sufficiency of knowledge processed in patient education provided by nurses in dialysis care. Subjective sufficiency was evaluated with a structured questionnaire and objective sufficiency with a knowledge test to answer the following research questions:

1. What is the level of subjective and objective sufficiency of the knowledge processed in patient education and the background factors connected to them?
2. Is there a correlation between subjective and objective sufficiency?

Sample and Data Collection

A descriptive, cross-sectional study design was used. Patients in the dialysis clinics in two (out of five) university hospital districts (representing more than third of the patients with CKD in Finland³⁷) were recruited in collaboration with nurses working in the clinics. The sample comprised patients in pre- and home dialysis with the following inclusion criteria: 1) patients had predialysis follow-ups in the clinic or carried out peritoneal dialysis (PD) or home hemodialysis (HHD), 2) spoke Finnish, 3) were a minimum of 18 years old, and 4) participated voluntarily in the study (n=162). All patients meeting the inclusion criteria in the university hospital districts were invited to participate.

Patients in pre- and home dialysis self-manage their CKD mainly in the home environment and choose the modality of dialysis in the future (predialysis) or already carry out home dialysis (PD/HHD). Thus, they have unique knowledge expectations, and knowledge may impact their future choices.¹⁵ The patient education for these patients is structured, long-term and proceeds in a systematic manner (Table 1). It is tailored to meet the state of progression of CKD and the individual needs of the patients. The patient education includes individual face-to-face sessions, written educational material and telephone counseling, is evidence-based, and covers all empowering knowledge dimensions (bio-physiological,

Table I General Outline of the Content of Patient Education in the Study Clinics

Treatment Form	Content of Patient Education
Predialysis	<p>Functions of kidneys</p> <p>CKD treatment options (PD, HD, conservative care)</p> <p>Monitoring the kidney function: symptoms, blood tests</p> <p>Diet</p> <p>Medication</p> <p>Social security</p> <p>Home remodeling and aids for home dialysis</p>
PD, HHD	<p>Living with CKD:</p> <ul style="list-style-type: none"> • Diet • Working while dialysis • Hobbies and free time • Sexuality and outer appearance <p>Practicalities in dialysis care:</p> <ul style="list-style-type: none"> • Use of dialysis machine • Fluid restrictions • Use and care of catheter and fistula • How to solve problems in dialysis treatment • Hygiene and infection control <p>Medication and vaccinations</p> <p>Self-monitoring symptoms</p> <p>When and how to contact hospital</p> <p>Kidney transplantation</p>

Abbreviations: CKD, chronic kidney disease; PD, peritoneal dialysis; HD, hemodialysis; HHD, home hemodialysis.

functional, social, experiential, ethical and financial dimensions).^{8,9}

The data was collected between September 2016 and November 2017. The participants responded to the instruments either in their dialysis clinic or at home and returned them to a return box or sent them to the researchers by mail.

Instrumentation

For subjective sufficiency evaluation, a structured questionnaire was designed in collaboration with researchers and nurses from the dialysis clinics. Theoretically, the questionnaire was based on patient education as an empowering nursing activity.^{8,9} A previously tested instrument, the Dialysis Patient Informational Needs, was used in development of the items.³⁸ It consisted of 34 structured items divided into six dimensions of empowering knowledge asking whether patients evaluated their knowledge processed in patient education as sufficient for themselves

or not (Likert scale, 1=not sufficient at all, 4=very sufficient, Table 2). “Very sufficient” (4) was interpreted as desired level in this group of patients. The questionnaire was piloted with five patients from a dialysis clinic (not included in the sample); based on that, some items were clarified. Cronbach’s alpha was 0.96 for the whole questionnaire, and 0.78–0.91 for the dimensions of empowering knowledge.

Knowledge Test

For objective sufficiency evaluation, a knowledge test was tailored for this study in collaboration between researchers and nurses in the dialysis clinics. The test was based on empowering patient education (as a theoretical basis),^{8,9} literature,^{39–42} and clinical experience. The items were related to functions of the kidneys, symptoms of CKD, healthy way of living, and dialysis care (Table 3). Biophysiological dimension was emphasized. The knowledge test comprised ten items with score range 0–10. Each item had two correct answers, one false answer and the alternative “I don’t know”. To get score one (1), both correct answers had to be selected (all other options gave score zero, maximum being 10). Clinical and instrument development experience was utilized in the development process. To strengthen the validity of the knowledge test, it was tailored for each form of care and treatment (predialysis, PD or HHD) and it had short, clear, and univocal options.

In addition, there were nine structured background factors: age, gender, perceived current health (scale from 0=very weak to 10=very good), treatment and care form (predialysis/PD/HHD), significant others’ participation in education session (yes/no), receiving written education material (yes/no), searching for information by themselves (yes/no), perceived safety of care (from 1=not safe at all to 4=very safe), and perceived confidentiality of care (from 1=not confidential at all to 4=very confidential).

Data Analysis

Statistical analysis was performed using SAS 9.3 software (SAS Institute, Inc., Cary, NC). Frequencies, percentages, means, standard deviations, and ranges were used to describe the data. In subjective sufficiency, sum variables were established in each of the empowering knowledge dimensions as a mean of all items. *t*-test was used to analyze the connection between these dimensions and background factors with two categories. The connections between dimensions of empowering knowledge and age and current

Table 2 The Subjective Sufficiency of Knowledge Processed in Patient Education in Dimensions of Empowering Knowledge

Dimensions	n	Mean (SD)	Range	Content of Questionnaire
General sufficiency	–	3.27 (0.54)	1.8–4	–
Bio-physiological	151	3.52 (0.49)	2–4	9 items: Functions of kidney, symptoms of CKD, purpose of medication, present condition and care plan, use of PD/HD at home and in hospital, kidney transplant
Functional	155	3.29 (0.59)	1.4–4	10 items: Appropriate diet, fluid restriction, medication at home, physical exercise, weight management, effect of disease on sexuality, alcohol and tobacco, potential complications with dialysis care, prevention of complications in dialysis care, instructions in case of problems with dialysis care
Social	152	3.23 (0.62)	1.4–4	6 items: Adjustment work at home and arrangements for home dialysis, combining dialysis care and daily life, how to do holiday trips, activities of patient organization, peer support, significant others' participation in care
Experiential	143	2.8 (0.88)	1–4	3 items: Emotions related to disease and its treatment, who to talk to about these emotions, effects of disease and its care on appearance
Ethical	154	3.34 (0.71)	1–4	3 items: Participation in decision-making in care, right to information, responsibilities in care
Financial	152	3.14 (0.86)	1–4	3 items: Expenses caused by disease and its care, social security benefits, working while undergoing dialysis care

Notes: Scale 1–4 (1=not sufficient at all, 4=very sufficient). Bio-physiological vs all other dimensions, adjusted $p=0.0109$ or less. Experiential vs all other dimensions, all adjusted $p<0.0001$. Ethical vs financial dimension, adjusted $p=0.0019$. Other dimensions had no significant differences (adjusted $p=0.2794$ or greater).

Abbreviations: SD, standard deviation; CKD, chronic kidney disease; PD, peritoneal dialysis; HD, hemodialysis.

health as well as the scores in objective sufficiency were analyzed using Pearson correlation coefficient. Differences between the forms of care and treatment were analyzed using ANOVA. The sum variables were compared with each other using repeated measures ANOVA. P -values ≤ 0.05 were regarded as statistically significant.

Results

Participants' Characteristics

The sample comprised 162 patients (response rate 50.3%) with a mean age of 61 (SD 14), more than half being men

(63.6%). Patients evaluated their current health from 2.7 to 10 (mean 7.2, SD 1.8). Of the participants, 45.3% were in PD, 30.2% in predialysis, and 24.5% in HHD. Most patients perceived the care to be very safe (70.7%) and very confidential (83.2%). In most of the patient education sessions, significant others were not involved (63%), written education material was provided (93.5%), and patients searched information also by themselves (79.2%, Table 4).

Subjective and Objective Sufficiency of Knowledge

The level of subjective sufficiency of knowledge processed in patient education was analyzed generally and according to the six dimensions of empowering knowledge (Table 2). The total mean of subjective sufficiency was 3.27 (SD 0.54). The most sufficient was the bio-physiological knowledge dimension (mean 3.52, SD 0.49), differing significantly from all other dimensions (adjusted $p<0.0109$). The experiential dimension was significantly the least sufficient (mean 2.8, SD 0.88, adjusted $p<0.0001$ from all other dimensions).

Four background factors had a statistically significant positive connection with more subjective sufficiency of knowledge: male gender, received written educational material, perceived safety of care, and perceived

Table 3 Description of the Items in Knowledge Tests

Predialysis	PD	HHD
Functions of kidneys Symptoms of CKD Care of CKD Diet Treatment options and their benefits/requirements Instructions in case of worsening condition	Use of PD Problems in PD Hygiene and infection control Complications (prevention, symptoms) When and how to contact hospital	Reasons for health monitoring Use of HHD Fluid restrictions Problems in PD Hygiene and infection control Complications (prevention, symptoms)

Abbreviations: PD, peritoneal dialysis; HHD, home hemodialysis; CKD, chronic kidney disease.

Table 4 Participants' Characteristics (n=162)

Background Factor	n	%	Mean (SD)	Range
Age in years			61 (14)	24–85
–40	19	12.7	–	–
41–50	13	8.7	–	–
51–60	40	26.7	–	–
61–70	33	22	–	–
71–80	35	23.3	–	–
81–	10	6.6	–	–
Gender			–	–
Women	59	36.4	–	–
Men	103	63.6	–	–
Current health (Scale 1–10)			7.2 (1.8)	2.7–10
–4	9	6	–	–
4.1–6	32	21.5	–	–
6.1–8	62	41.6	–	–
8.1–10	46	30.9	–	–
Treatment form			–	–
Predialysis	48	30.2	–	–
PD	72	45.3	–	–
HHD	39	24.5	–	–
Significant others' participation in education session			–	–
Yes	60	37	–	–
No	102	63	–	–
Receiving written education material			–	–
Yes	143	93.5	–	–
No	10	6.5	–	–
Searched information by oneself			–	–
Yes	126	79.2	–	–
No	33	20.8	–	–
Safety of care (Scale 1–4)			3.6 (0.49)	–
Not safe at all	0	0	–	–
Just a little safe	2	1.3	–	–
Somewhat safe	44	28	–	–

(Continued)

Table 4 (Continued).

Background Factor	n	%	Mean (SD)	Range
Very safe	111	70.7	–	–
Confidentiality of care (Scale 1–4)			3.8 (0.49)	–
Not confidential at all	1	0.7	–	–
Just a little confidential	3	2	–	–
Somewhat confidential	21	14.1	–	–
Very confidential	124	83.2	–	–

Abbreviations: SD, standard deviation; PD, peritoneal dialysis; HHD, home hemodialysis.

confidentiality of care (Table 5). Furthermore, some connections with separate dimensions of empowering knowledge and background factors were identified. Men subjectively evaluated their knowledge more sufficient than women in the functional, experiential and ethical dimensions. Received written educational material was positively connected with the functional and social dimension, and higher current health level with the biophysiological dimension. Form of treatment had a connection with the financial dimension, patients in predialysis having the lowest level of subjective sufficiency in this dimension. There was a strong positive connection between sufficiency and very safe or very confidential care.

Objective sufficiency of knowledge was evaluated by 156 patients (47 predialysis, 69 PD and 40 HHD) responding to the knowledge test (maximum score of 10). Patients on predialysis had a mean of 5.64 (SD 2.68), patients on PD 5.97 (SD 2.43), and patients on HHD 5.15 (SD 2.37), with no statistically significant difference between patients in different forms of care and treatment. No connection was found between background factors and level of objective sufficiency of knowledge.

Correlation Between Subjective and Objective Sufficiency of Knowledge

The subjective and objective sufficiency of knowledge did not correlate statistically significantly in any dimension of empowering knowledge (Table 6). The strongest correlation was in experiential dimension among patients on HHD. Among patients on predialysis, a negative correlation, albeit not statistically significant, was discovered in every dimension of empowering knowledge.

Table 5 Connection Between the Subjective Sufficiency of Knowledge Processed in Patient Education and Patients' Background Factors

Dimensions		General Sufficiency Mean (SD)	Bio- physiological Mean (SD)	Functional Mean (SD)	Social Mean (SD)	Experiential Mean (SD)	Ethical Mean (SD)	Financial Mean (SD)
Background Factors	n							
Safety of care ^a								
Not at all–somewhat	45	2.96 (0.55)	3.29 (0.55)	2.96 (0.61)	2.93 (0.62)	2.50 (0.85)	3.00 (0.77)	2.72 (0.88)
Very safe	106	3.40 (0.49)	3.61 (0.42)	3.42 (0.53)	3.35 (0.58)	2.92 (0.87)	3.48 (0.63)	3.31 (0.79)
p-value		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Confidentiality of care ^a								
Not at all–somewhat	25	2.84 (0.62)	3.14 (0.59)	2.80 (0.68)	2.72 (0.74)	2.54 (0.88)	2.88 (0.77)	2.69 (0.98)
very confidential	118	3.36 (0.48)	3.60 (0.42)	3.37 (0.53)	3.34 (0.52)	2.83 (0.88)	3.42 (0.65)	3.25 (0.79)
p-value		<0.0001	<0.0001	<0.0001	0.0006	0.1528	0.0004	0.0030
Treatment form ^b								
Predialysis	42	3.12 (0.65)	3.36 (0.57)	3.17 (0.68)	3.09 (0.78)	2.73 (0.95)	3.28 (0.80)	2.63 (0.95)
PD	71	3.32 (0.52)	3.56 (0.46)	3.33 (0.59)	3.21 (0.59)	2.87 (0.85)	3.36 (0.72)	3.38 (0.74)
HHD	39	3.31 (0.43)	3.56 (0.41)	3.30 (0.48)	3.38 (0.42)	2.73 (0.87)	3.32 (0.58)	3.24 (0.72)
p-value		0.1464	0.0805	0.4003	0.1089	0.6392	0.8596	<0.0001
Gender ^a								
Men	96	3.36 (0.48)	3.57 (0.42)	3.38 (0.51)	3.30 (0.56)	2.92 (0.82)	3.48 (0.62)	3.22 (0.82)
Women	59	3.13 (0.62)	3.42 (0.57)	3.13 (0.67)	3.12 (0.68)	2.61 (0.94)	3.10 (0.78)	3.00 (0.91)
p-value		0.0179	0.0896	0.0136	0.0878	0.0400	0.0010	0.1262
Received written educational material ^a								
Yes	138	3.30 (0.55)	3.54 (0.47)	3.31 (0.58)	3.25 (0.63)	2.82 (0.90)	3.35 (0.71)	3.14 (0.86)
No	9	2.90 (0.56)	3.22 (0.62)	2.89 (0.73)	2.81 (0.47)	2.56 (0.55)	3.19 (0.77)	2.76 (0.87)
p-value		0.0370	0.0535	0.0300	0.0364	0.3841	0.4928	0.1981
Significant others' participation in education ^a								
Yes	58	3.32 (0.51)	3.57 (0.44)	3.33 (0.54)	3.29 (0.58)	2.89 (0.90)	3.39 (0.73)	3.20 (0.79)
No	97	3.24 (0.56)	3.49 (0.51)	3.26 (0.62)	3.20 (0.64)	2.75 (0.87)	3.31 (0.69)	3.10 (0.89)
p-value		0.3791	0.3286	0.4567	0.3975	0.3594	0.4820	0.4921
Searched information by oneself ^a								
Yes	123	3.27 (0.56)	3.50 (0.50)	3.26 (0.61)	3.24 (0.62)	2.82 (0.88)	3.34 (0.70)	3.17 (0.84)
No	29	3.25 (0.49)	3.57 (0.43)	3.35 (0.50)	3.16 (0.63)	2.67 (0.88)	3.32 (0.77)	2.94 (0.93)
p-value		0.8428	0.5021	0.4665	0.5726	0.4142	0.8759	0.2041
Current health ^c		r=0.11567	r=0.19463	r=0.09028	r=0.11905	r=-0.00245	r=0.0.9858	r=0.12544
p-value		0.1531	0.0170	0.2655	0.1454	0.9769	0.2254	0.1248
Age ^c		r=-0.02844	r=-0.08050	r=-0.01858	r=-0.04497	r=-0.04886	r=0.05342	r=0.01258
p-value		0.7254	0.3258	0.8186	0.5822	0.5623	0.5105	0.8778

Notes: ^at-test; ^bANOVA; ^cPearson correlation coefficient.

Abbreviations: SD, standard deviation; PD, peritoneal dialysis; HHD, home hemodialysis; r, Pearson correlation coefficient.

Table 6 Correlation Between Subjective and Objective Sufficiency of Knowledge Processed in Patient Education

Dimensions		General Sufficiency	Bio-physiological	Functional	Social	Experiential	Ethical	Financial
Treatment Form	n							
Predialysis	47	$r=-0.25876$	$r=-0.28437$	$r=-0.15494$	$r=-0.25470$	$r=-0.23905$	$r=-0.13505$	$r=-0.23260$
p-value		0.1023	0.0753	0.3334	0.1176	0.1542	0.3999	0.1486
PD	69	$r=0.02862$	$r=0.02043$	$r=0.07757$	$r=-0.05332$	$r=0.00719$	$r=0.04774$	$r=0.00765$
p-value		0.8168	0.8706	0.5327	0.6683	0.9561	0.7013	0.9514
HHD	40	$r=0.10302$	$r=-0.05932$	$r=0.01770$	$r=0.10639$	$r=0.30155$	$r=0.16768$	$r=-0.04282$
p-value		0.5270	0.7198	0.9137	0.5135	0.0621	0.3010	0.7930

Abbreviations: r, Pearson correlation coefficient; PD, peritoneal dialysis; HHD, home hemodialysis.

Discussion

The purpose of this study was to evaluate subjective and objective sufficiency of knowledge processed in nurse-provided patient education in dialysis care and treatment. The topic has specific importance due to the high number of these patients and the long-term nature of the disease.¹ In this study, patients expressed their knowledge as sufficient: The mean of subjective sufficiency was above 3 (on a Likert scale, 1=not sufficient at all, 4=very sufficient). However, the desired level would be “very sufficient” (4) for these patients. Thus, the results indicate that knowledge is not sufficient. Furthermore, subjective and objective sufficiency did not correlate. This new finding in the field of empowering dialysis care highlights the importance of relevant evaluation methods for patient education and central role of patients in these evaluations.

Based on the results, patients did not subjectively evaluate their knowledge as sufficient in any of the dimensions of empowering knowledge. This finding has implications for the empowerment of patients, as knowledge processed in patient education supports empowerment.^{7,8} Subjective, individual perceptions are also important elements in the evaluation of the quality of patient education.^{24,43} As the number of people with chronic diseases and multimorbidity is growing, empowering support is crucial.⁴⁴ Among patients with CKD, however, current evidence about the sufficiency of knowledge processed in patient education as evaluated by patients is limited. Some earlier studies suggest these patients to have insufficient professional

informational support,^{4,5,19} in line with the findings of this study. However, it would be important to know about the knowledge expectations and level of health literacy of our patients (or those in earlier studies).⁴⁵ Earlier studies suggest that patients with CKD expect knowledge about bio-physiological issues, such as the disease and its treatment,^{4,5,19} which were evaluated as the most sufficient in this study.

In subjective sufficiency, the least sufficient dimension of empowering knowledge was the experiential dimension (for example, emotions and experiences related to CKD). Earlier studies show inconsistent results concerning the importance of the experiential dimension.^{5,19} For example, among Asian patients with CKD, the emotional aspect was perceived as less important than the bio-physiological dimension,¹⁹ whereas Zala et al found Swiss patients to value the emotional support received from nurses.⁵ Our results support the latter finding, as patients expected knowledge in the experiential dimension through patient education.

The problem, however, is the lack of correspondence between subjective and objective sufficiency: Patients' success in the knowledge test was rather poor, as also indicated in earlier studies,^{27,32} and there was no statistically significant correlation between subjective and objective sufficiency. This was contrary to our basic theoretical assumption: We assumed correspondence between subjective and objective sufficiency, and those evaluating their own knowledge as sufficient also scoring high in the

knowledge test.^{36,46} There can, of course, be several reasons for the results. For example, subjective sufficiency of knowledge may depend on individual needs³² not known in this sample. Furthermore, the progress of disease and the choice of care and treatment can influence the subjective and objective sufficiency of knowledge.⁴⁷ Moreover, the questionnaire and knowledge test were used for the first time in this study, limiting the conclusions that can be made from the results. In the future, there is a need for further studies to analyze more deeply and multidimensionally the existing knowledge of patients and their history of experiences together with both the subjective and objective sufficiency of knowledge.

The subjective sufficiency of knowledge seemed to be linked to several background factors. In particular, patients perceiving care as safe or confidential evaluated their knowledge as more sufficient (see also Virtanen et al⁴⁸), emphasizing the importance of these experiences and emotions in patient education. In addition, women should be acknowledged due to their evaluations of insufficiency in several dimensions. Patients' educational level may also be linked to knowledge,^{27,29,30} yet it was not investigated in this study due to focusing on factors related to health and patient education. Written educational material can contribute to the sufficiency of knowledge processed in patient education, although earlier studies suggest that patients with CKD do not necessarily perceive written material as useful.²⁰ Among patients in predialysis, a negative correlation between subjective and objective sufficiency of knowledge was identifiable, indicating a specific need to analyze further the patient education in this group.

Patients often look for information from other sources than professional education.^{19,20} This is important, but it also can lead to insufficient or wrong information without the patient realizing it. It also can contribute to the evaluation of sufficiency of knowledge. Professionals have a duty to support patients to evaluate the quality and evidence base of information. This is particularly important among long-term patients, such as those with CKD and in dialysis care. These patients need multidimensional knowledge to be empowered in everyday life. It is not possible to determine the most efficient educational method among these patients.² However, based on this study, we have shown the need to include different methods in the evaluation of patient education.

Implications of this study are related to health care practice and future research. In health care practice, it seems necessary for patients to have additional support for their knowledge. Experience of sufficiency of patients' own knowledge could empower them in their care and treatment at home environment. Literature in empowering patient education suggests that empowering knowledge can be supported with multidimensional, patient-centered approach.^{6,8} As for future research, the correlation between subjective and objective sufficiency of knowledge needs further studies with larger samples and in other fields of chronic health problems to test our findings.

Limitations

The limitations in this study relate to the patient education, data collection and sample. Firstly, we only know the general outline of the content and execution of the patient education: It is modified based on patients' individual needs and progression of the health problem, which can affect sufficiency of knowledge.

As for data collection, the questionnaire and knowledge test were tailored and used for the first time in this study due to lack of existing instruments for patients in dialysis care. In the development process, an earlier validated instrument was used, the instruments were piloted with corresponding patients in dialysis care, and the questionnaire demonstrated high internal consistency. The instruments, however, still need further testing with different groups of patients with CKD. Furthermore, based on Cronbach's alpha, shortening the questionnaire should be considered. Moreover, study participants were able to respond at home, enabling them to use educational material or significant others' assistance in the knowledge test, but the low scores indicate that this may not be the case. However, patients might actively use multiple information sources in their daily lives, in which case the responses accurately represent the real-life situation.

Another limitation is the sample. The sample was collected in two university hospital districts representing a large part of the population with CKD in Finland (37%)³⁷ and corresponds well with the characteristics of population with CKD in Europe.⁴⁹ The groups within the sample were rather small, however. As the response rate was slightly over 50% and it is not possible to know the

reasons for not responding, caution should be used in the generalization of the results.

Conclusion

Patients in dialysis care seemed to have both subjectively and objectively insufficient knowledge. This highlights the role of empowering patient education in their care and treatment. However, subjective sufficiency did not correspond with objective sufficiency of knowledge. This discrepancy between the evaluations warrants further research in the future. Especially, there is a need to continue to investigate the meaning of existing knowledge, preferences and experiences of patients, not only in CKD, but also in other long-term health problems. In the evaluation of patient education, multidimensional patient-oriented methods should be used.

Abbreviations

CKD, chronic kidney disease; HHD, home hemodialysis; PD, peritoneal dialysis; SD, standard deviation.

Data Sharing Statement

The data sets generated during and/or analyzed during the current study are not available because consent for sharing the data was not obtained from the patients.

Ethics Approval and Informed Consent

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of University of Turku (19/2016, 4th April 2016). Permissions were given by authorities of the hospital districts. Permissions to use and modify the original instruments were given by copyright holders. All patients were informed about the purpose of the study, confidentiality, anonymity, voluntary participation, and possibility to withdraw from the study at any time. Written informed consent was given by all participants.

Acknowledgments

We warmly thank the patients for their time and interest to participate in the study in the middle of their care and treatment. This is the only way to develop patient-oriented education.

Funding

This work was supported by Turku University Hospital, Turku, Finland with governmental funding for research in health sciences (Project 13762).

Disclosure

Miss Saija Inkeroinen reports grants from Turku University Hospital, during the conduct of the study. The authors report no other conflicts of interest in this work.

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