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Social relationships and their impact on health-related outcomes in peritoneal versus haemodialysis patients: a prospective cohort study

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ABSTRACT

Background. Social relationships are important determinants of health-related outcomes for patients with chronic conditions. However, the effects of social networks and social support on health outcomes of dialysis patients in different treatment modalities have been under studied.

Methods. We surveyed peritoneal dialysis (PD) and haemodialysis (HD) patients in the Choice of Renal Replacement Therapy project about their social relationships and health-care outcomes at baseline and 1-year follow-up. Two propensity score-matched groups ($n = 353$; HD = 200, PD = 153) with similar age, comorbidity level, education and employment status were compared. We used an ego-centred Network Generator to assess quantitative and qualitative aspects of social networks and the Berlin Social Support Scales to evaluate dimensions of social support, and analysed the effects of the social variables on anxiety, depression, autonomy preferences, and physical and psychological quality of life.

Results. Over time, the non-family networks (e.g. friends) of both groups decreased ($P = 0.04$) and the absolute number of types of relationships increased ($P = 0.01$). The family-network size, quality of relationships and social support remained stable. Larger social networks were associated with higher participation-seeking preferences ($B = 1.39$, $P = 0.002$) and lower anxiety

($B = -0.11$, $P = 0.03$). Closer and more satisfying relationships were associated with better psychological well-being ($B = 3.41$, $P = 0.003$). PD patients had larger networks, more types of relationships and received more social support than HD patients ($P \leq 0.05$).

Conclusions. These differences may reflect the degree of autonomy and self-care associated with the different treatment modalities. In practice, our findings suggest that the early identification and inclusion of persons providing social support for patients may have a positive effect on different aspects of their care and quality of life.

Keywords: haemodialysis, longitudinal, peritoneal dialysis, social network, social support

INTRODUCTION

Social network as a resource in chronic conditions

Patients diagnosed with end-stage renal disease (ESRD) are confronted with the burden of a chronic disease and limitations on their daily routines, and they often experience a variety of negative emotions (e.g. despair), threats to personal and professional relationships and loss of self-esteem. The initiation of dialysis

treatment is often perceived as a paradigmatic burden for patients and their social circle, partly because the equipment required for dialysis treatment is difficult to integrate into their social activities [1].

An individual's social network, social integration and social support are important determinants of health-related outcomes [2]. Perceived social support reduces the psychological and physiological effects of stress [3] and social relationships increase a sense of well-being, which is related to social integration. Individuals who are more socially integrated have a lower risk of premature death from heart diseases, are less depressed and have better immune responses [4].

Given the positive influence of social support on the quality of life of patients with chronic conditions, it is remarkable that relatively little is known about the social networks or social support of dialysis patients in the long term, and their effects on health-related outcomes. Research has also failed to examine social structures with respect to different treatment modalities. This issue is crucial for haemodialysis (HD) and peritoneal dialysis (PD) patients because the self-care required differs substantially depending on the nature of their treatment. A study by Dimond [5] indicated that patients' adaptation to HD is a function of distinct dimensions of social support, with family cohesion being a key source of support and social functioning. Burton *et al.* [6] showed that supportive social environments can buffer against the stress associated with PD and that social support contributes to emotional well-being. Jager *et al.* [7] found that having a spouse was a significant factor in being assigned to PD because a supportive partner increases the success of PD. We assume that PD patients have larger social networks due to their greater autonomy, compared with HD patients, and that they have higher quality networks.

Research questions

Changes in social relationships and social support after the initiation of dialysis have not been investigated in depth, and their influence on different aspects of health-related quality of life with respect to different treatment modalities is not clear. Therefore, we proposed the following research questions, within the framework of the Choice of Renal Replacement Therapy (CORETH) project:

1. What are the characteristics of the social networks of HD versus PD patients, with respect to their quantity, quality, structure and social support?
2. How do the social networks and the social support of HD and PD patients change over time?
3. To what extent are the characteristics of the social networks and social support of patients at baseline associated with health-related outcomes at follow-up, including anxiety, depression, participation- and information seeking-preferences, and physical and psychological quality of life?

MATERIALS AND METHODS

Study design and sampling

The study was part of the CORETH project, funded by the German Federal Ministry of Education and Research (German

Clinical Trials Register: DRKS00006350 [8]). Detailed information about the study was published previously [8–10]. In brief, patients were recruited from May 2014 to May 2015 from 55 dialysis units throughout Germany and screened by local nephrologists. The inclusion criteria were: 6–24 months after the initiation of dialysis at study entry, absence of acute psychiatric symptoms, ability to read and understand the questionnaire, ability to provide written consent and ≥ 18 years old. A 1-year follow-up was conducted.

Figure 1 illustrates the sampling procedure. At baseline, 758 patients consented and provided data, 195 of whom were lost to follow-up (HD = 107, PD = 88). To ensure the comparability of patients who would have been eligible for both treatments (HD and PD), we matched the treatment groups using a linear propensity score [11] at baseline. PD patients were compared with HD patients who were similar in age, comorbidity (Charlson comorbidity index [12]), occupational status (employed versus not employed/retired) and education level (low, without graduation; medium, middle school; high, high school diploma): $N = 353$: HD = 200, PD = 153. Descriptions of the propensity score matching (PSM) procedure have been published [8–10].

Instruments and outcome measures

Social network generator. Lamprecht *et al.* [13] proposed an ego-centred network generator (NWG) to study the qualitative, quantitative and structural characteristics of positive social relationships, which was used in the present study to construct each patient's social network, by having patients list up to 10 of the most important persons in their daily life, their relationship to them (e.g. mother or work colleague) and their gender. Patients indicated how close they felt to these persons, how often they contacted them and how satisfied they were with their relationships with them on a 0–5 scale, with higher values indicating more positive evaluations. The patient's total social network was the sum of listed persons, which was classified into (i) a family network, including all relatives; (ii) a non-family network, including all non-relatives; (iii) a female network, including all females; and (iv) a male network, including all males. The NWG has been validated for a range of medical indications and shows good test criteria [13].

Berlin Social Support Scales. The Berlin Social Support Scales (BSSS [14]) is a 34-item measure of social support that assesses five dimensions of social support, in general, and under psychologically demanding circumstances, for example, coping with severe disease. Each item is rated on 1–4 scale. Examples of the items in the five subscales are shown in Table 1.

Health-related outcomes. The Hospital Anxiety and Depression Scale—German Version [15] consists of 14 items, 7 for each subscale (anxiety and depression). The German version of the Autonomy-Preference Index [16], which consists of 11 items, measures patients' preferences for autonomy in health-care decision-making. It includes a participation-seeking subscale (4 items, e.g. 'Important medical decisions should be made by your doctor, not by you') and an information-seeking subscale (7-items, e.g. 'Information about your illness is as important to you as treatment'). The 12-item Short-Form

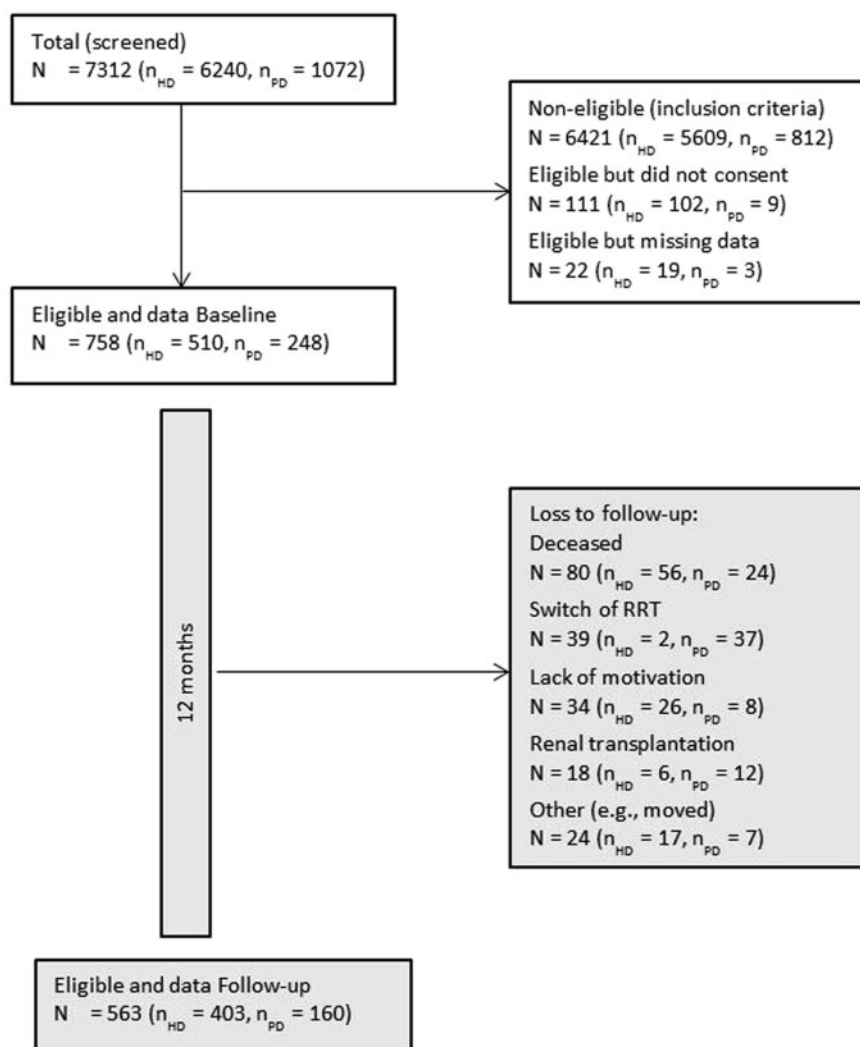


FIGURE 1: CORETH sampling flow chart. RRT, renal replacement therapy.

Table 1. The five dimensions of social support measured by the scales

BSSS	Number of items	Example item	Cronbach's α [14]
Perceived social support	8	If everything is just too much, there are others to help me through.	0.83
Actual received social support	11	This person was there when I was in need of help.	0.83
Need for support	4	When I'm feeling depressed, I need someone to lift my mood.	0.63
Mobilization of support	5	When I'm in need of help I ask for it.	0.81
Protective buffering	6	I didn't show how depressed I was.	0.82

Health Survey [17] assesses health-related quality of life on two subscales: physical and psychological quality of life.

Statistical analyses

We analysed the NWG data to answer Research Question 1, regarding the structure, quantity and quality of the social networks of HD and PD patients at baseline. Means and standard deviations (SDs) were calculated for the data on network persons (quantity, age, different kinds of relationships, frequency of contact, emotional closeness and satisfaction with the relationship). The distribution of types of relationships was

illustrated by a spider-web chart [13], which enabled visual comparisons between the treatment groups. A network quality index was constructed to differentiate between qualitative aspects of the networks by calculating the means of satisfaction, emotional closeness and frequency of contact. The means and SDs were calculated for the BSSS subscales. The *t*-test was used to compare HD and PD patients on continuous variables.

Changes over time were estimated for the social networks and social support (Research Question 2) with a general linear model of the observed effects of time (baseline versus follow-up), treatment (HD versus PD) and their interaction.

Table 2. Characteristics of the total sample and the subsamples (PD and HD)

Characteristic	Unmatched sample					Matched sample				
	Total (n = 563)	PD (n = 160)	HD (n = 403)	z-Differences	P-value	Total (n = 353)	PD (n = 153)	HD (n = 200)	z-Differences	P-value
Mean age, years (SD)	63.1 (14.9)	58.7 (15.2)	64.9 (14.4)	0.42	<0.001	59.4 (15.8)	59.0 (15.4)	59.8 (16.0)	0.05	0.63
Sex, female (%)	33.4	30.6	34.5	1.96	0.38	32.3	30.7	33.5	1.12	0.58
Education level (%)										
Low	24.0	21.9	24.9	1.67	<0.001	21.5	22.9	20.5	1.10	0.06
Medium	57.7	47.5	61.7	6.82		54.7	47.7	60.0	4.64	
High	18.3	30.6	13.4	-8.28		23.8	29.4	19.5	-4.37	
Employment status, employed (%)	17.1	26.9	13.2	-8.63	<0.001	24.4	23.5	25.0	0.66	0.75
Living in a partnership (%)	72.0	81.3	68.3	-6.87	0.002	73.1	82.4	66.0	-6.95	<0.001
Have children (%)	78.3	77.5	78.6	0.63	0.77	74.8	76.5	73.5	1.30	0.52
Mean CCI (SD)	5.6 (2.4)	4.8 (2.2)	5.9 (2.3)	0.46	<0.001	5.00 (2.3)	4.9 (2.2)	5.1 (2.3)	0.09	0.42

The *t*-test was used to analyse continuous variables and the chi-square test was used to analyse categorical variables. Z-differences, as per Kuss [18], were used to measure the balance of covariates in the matched propensity score analyses. Education level: low, without graduation; medium, middle school; high, high school diploma. CCI, Charlson comorbidity index [12]. Bold entries mark results with a P-value <0.05.

The effects of baseline social network and social support characteristics on health-related outcomes at follow-up (Research Question 3) were analysed by linear regression with the following predictors: social network size, network quality, the BSS subscales and dialysis treatment (HD versus PD) as a binary variable. We also controlled for patients' partnership and parental status (yes versus no) and adjusted for health-related outcome scores at baseline. Model accuracy was assessed by the total variance explained (R^2).

The significance level was set at $\alpha = 0.05$, two-tailed. All analyses were conducted with SPSS 22.0 and R 2.15.0 for Windows.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Halle-Wittenberg and the ethics committees at each study site. Data security and quality, consistent with good clinical practice regulations, were guaranteed by the Coordination Centre for Clinical Studies Halle.

RESULTS

Sample characteristics

The sample with complete data at follow-up contained 563 patients (HD = 403, PD = 160), and the sample analysing PSM cases contained 353 patients (HD = 200, PD = 153). Table 2 presents the sample characteristics. There were no differences in age, comorbidity, education or employment status between the HD and PD patients after PSM. PD patients were more likely to be living in a partnership than the HD patients were (no matching criterion). Sample characteristics of the sample lost to follow-up are presented in [Supplementary data, Table S1](#).

Baseline social network and social support of HD versus PD patients (Research Question 1)

The characteristics of the social networks and social support of HD and PD patients are presented in Table 3. For the

matched sample, on average, PD patients reported 4.4 (SD = 2.9) important persons in their daily life, and thus, had a larger network than the HD patients: mean = 3.8 (SD = 2.4). This was attributable to larger family-member and female networks among PD patients, who also reported more different types of relationships than HD patients did. The same pattern emerged for the unmatched sample, including also a larger non-family and male network for PD compared with HD patients.

Figure 2 illustrates the spider-web chart of the different types of relationships of HD and PD patients for the matched sample. The most frequent relevant relationship was a life-partner or spouse. The second most frequent important persons were children, followed by friends, other relatives, parents and siblings. Few participants said relationships with work colleagues were important, but only 24% of patients said they were employed (matched sample, see Table 2). In general, the various types of relationships were distributed equally across treatment groups, except that PD patients named their partner more often (and also reported living in a partnership more often). The same pattern applied to the unmatched sample. The qualitative aspects of the NWG (emotional closeness, frequency of contact and satisfaction) were rated rather high by both HD and PD patients, and there were no significant group differences for the matched sample. However, the network members of PD patients were younger and lived farther away.

For the matched sample, PD patients reported receiving more social support than the HD patients reported on the BSSS. The remaining dimensions of the BSSS did not differ significantly between the two groups. Within the unmatched sample, HD patients indicated a higher tendency towards protective buffering compared with the PD subgroup. The baseline results of the social network, social support and patient-centred outcomes of the sample lost to follow-up compared with the sample with follow-up data are presented in [Supplementary data, Table S2](#). In general, the lost to follow-up sample was similar to the sample with follow-up data. For the lost to follow-up sample, PD patients showed a smaller social network compared with the sample with complete data, but a higher frequency of contact.

Table 3. Characteristics of the social network and social support of HD and PD patients at baseline

Outcomes at baseline	Unmatched sample			Matched sample			P-value
	Total	PD	HD	Total	PD	HD	
	(n = 563)	(n = 160)	(n = 403)	(n = 353)	(n = 153)	(n = 200)	
NWG							
Network size, mean (SD)	3.74 (2.51)	4.48 (2.90)	3.44 (2.28)	3.99 (2.66)	4.39 (2.89)	3.76 (2.43)	0.02
Network size, family, mean (SD)	2.85 (1.86)	3.19 (1.97)	2.72 (1.79)	2.93 (1.91)	3.18 (1.99)	2.80 (1.80)	0.05
Network size, non-family, mean (SD)	0.88 (1.56)	1.28 (2.01)	0.71 (1.31)	1.05 (1.70)	1.22 (1.98)	0.96 (1.47)	0.17
Network size, male, mean (SD)	1.63 (1.53)	1.94 (1.74)	1.50 (1.42)	1.72 (1.60)	1.90 (1.76)	1.60 (1.47)	0.08
Network size, female, mean (SD)	2.13 (1.56)	2.53 (1.74)	1.97 (1.46)	2.27 (1.63)	2.50 (1.71)	2.16 (1.54)	0.05
Kinds of relationships, mean (SD)	2.41 (1.14)	2.73 (1.26)	2.28 (1.06)	2.52 (1.18)	2.69 (1.25)	2.44 (1.11)	0.05
Emotional closeness, mean (SD) ^a	4.10 (0.61)	4.15 (0.60)	4.08 (0.62)	4.11 (0.62)	4.16 (0.59)	4.08 (0.62)	0.52
Frequency of contact, mean (SD) ^a	4.19 (0.72)	4.16 (0.73)	4.20 (0.71)	4.18 (0.71)	4.17 (0.74)	4.18 (0.68)	0.91
Satisfaction with relationships, mean (SD) ^a	4.20 (0.59)	4.29 (0.59)	4.17 (0.58)	4.21 (0.64)	4.29 (0.58)	4.18 (0.61)	0.15
Network age, mean (SD)	49.36 (19.71)	46.95 (19.11)	50.60 (19.90)	48.14 (19.57)	47.06 (19.09)	49.11 (19.95)	0.05
Living in distance to patient, mean (SD)	132.91 (760.23)	223.89 (1174.20)	85.63 (394.95)	161.37 (885.51)	234.31 (1210.31)	95.46 (401.26)	0.01
BSSS^b							
Perceived available social support, mean (SD)	3.80 (0.39)	3.81 (0.43)	3.80 (0.38)	3.78 (0.44)	3.80 (0.43)	3.76 (0.44)	0.34
Actually received social support, mean (SD)	3.71 (0.42)	3.73 (0.39)	3.70 (0.43)	3.67 (0.48)	3.72 (0.39)	3.63 (0.54)	0.05
Need for support, mean (SD)	2.90 (0.89)	2.86 (0.88)	2.91 (0.89)	2.82 (0.90)	2.88 (0.88)	2.78 (0.92)	0.28
Mobilization of support, mean (SD)	3.10 (0.71)	3.11 (0.72)	3.10 (0.70)	3.05 (0.74)	3.13 (0.73)	3.00 (0.74)	0.11
Protective buffering, mean (SD)	2.42 (0.79)	2.28 (0.81)	2.48 (0.77)	2.36 (0.78)	2.34 (0.83)	2.38 (0.75)	0.48

The *t*-test was used to analyse continuous variables. Range of indicated persons: 0–10.

Bold entries mark results with a P-value < 0.05.

^aHigher values indicate higher outcomes (scale range = 0–5).

^bHigher values indicate higher outcomes (scale range = 1–4).

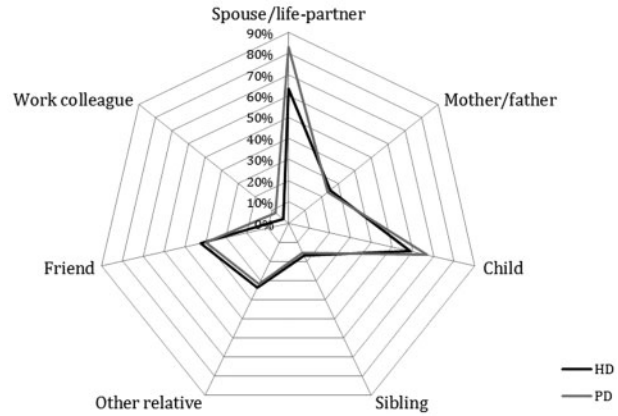


FIGURE 2: Frequency distribution of the types of relationships within the social network of HD and PD patients at baseline (matched sample).

HD patients of the lost to follow-up sample were older, had fewer different kinds of relationships and reported less satisfaction with their social relationships. They also stated a poorer physical quality of life and a higher participation-preference than the HD patients with follow-up data.

Changes in the social networks and social support of PD versus HD patients (Research Question 2)

Table 4 presents the results of the longitudinal analyses of changes in social-network characteristics, social support and health-related outcomes. Within the matched sample, the non-family networks of both groups decreased significantly over 1 year, whereas the absolute number of types of relationships increased. Yet, the size of the family, male and female networks remained stable over time for both groups, as did the quality of the relationships. These analyses confirm the differences between HD and PD patients observed at baseline (Table 3). The direction and extent of changes were similar in both groups (no interaction effects). In addition, within the unmatched sample, the non-family and male networks were larger and decreased more strongly for the PD than the HD patients (significant interaction effects).

Within the matched sample, the BSSS dimensions of social support did not change significantly over time. However, PD patients mobilized more social support over time than HD patients did. There were no significant changes over time in health-related outcomes, or participation-seeking or information-seeking preferences. PD patients generally had higher information-seeking preferences; no group differences were found for participation-seeking preferences. Depression levels were higher at follow-up in both groups. The physical and psychological quality of life of both groups of patients decreased over time, with no significant differences between the two groups. The unmatched sample revealed a similar pattern including an increasing tendency towards protective buffering over time with HD patients demonstrating more protective buffering than PD patients. Additionally, PD patients demonstrated a higher participation-seeking preference.

Table 4. The course of the social network, social support and patient-centred outcomes over time

	Unmatched sample				Matched sample				P-value					
	PD (n = 160)		HD (n = 403)		PD (n = 153)		HD (n = 200)		Time		Time		Interaction	
	Baseline Mean (SD)	Follow-up Mean (SD)	Baseline Mean (SD)	Follow-up Mean (SD)	Baseline Mean (SD)	Follow-up Mean (SD)	Baseline Mean (SD)	Follow-up Mean (SD)	Time	Treatment	Time	Treatment	Time	Treatment
NGW														
Network size	4.48 (2.90)	4.29 (2.34)	3.44 (2.28)	3.54 (1.97)	4.39 (2.89)	4.25 (2.29)	3.76 (2.43)	3.82 (2.20)	0.69	<0.001	0.17	0.73	0.02	0.40
Network, family	3.19 (1.97)	3.31 (1.64)	2.72 (1.79)	2.84 (1.62)	3.18 (1.99)	3.31 (1.66)	2.80 (1.80)	2.92 (1.66)	0.12	0.001	0.93	0.17	0.02	0.93
Network, non-family	1.28 (2.01)	1.00 (1.51)	0.71 (1.31)	0.70 (1.26)	1.22 (1.98)	0.94 (1.47)	0.96 (1.47)	0.91 (1.52)	0.01	<0.001	0.03	0.04	0.34	0.15
Network, male	1.94 (1.74)	1.69 (1.34)	1.50 (1.42)	1.53 (1.26)	1.90 (1.76)	1.65 (1.31)	1.60 (1.39)	1.64 (1.39)	0.10	0.01	0.03	0.19	0.26	0.08
Network, female	2.53 (1.74)	2.61 (1.59)	1.97 (1.46)	2.02 (1.38)	2.50 (1.71)	2.60 (1.59)	2.16 (1.54)	2.19 (1.53)	0.29	<0.001	0.89	0.38	0.02	0.59
Kinds of relationships	2.73 (1.26)	2.90 (1.20)	2.28 (1.06)	2.43 (0.97)	2.69 (1.25)	2.87 (1.18)	2.44 (1.11)	2.57 (1.04)	0.001	<0.001	0.84	0.01	0.01	0.64
Network quality index	4.20 (0.51)	4.22 (0.53)	4.15 (0.52)	4.21 (0.49)	4.21 (0.51)	4.22 (0.53)	4.15 (0.53)	4.21 (0.51)	0.10	0.46	0.37	0.19	0.43	0.47
BSSS														
Perceived available social support	3.81 (0.43)	3.79 (0.40)	3.80 (0.38)	3.78 (0.41)	3.80 (0.43)	3.78 (0.41)	3.76 (0.44)	3.75 (0.44)	0.15	0.75	0.85	0.45	0.40	0.76
Actually received social support	3.73 (0.39)	3.68 (0.43)	3.70 (0.43)	3.70 (0.42)	3.72 (0.39)	3.68 (0.43)	3.63 (0.54)	3.62 (0.50)	0.20	0.90	0.22	0.26	0.10	0.41
Need for support	2.86 (0.88)	2.83 (0.67)	2.91 (0.89)	2.80 (0.68)	2.88 (0.88)	2.84 (0.67)	2.78 (0.92)	2.72 (0.70)	0.06	0.87	0.31	0.32	0.79	0.14
Mobilization of support	3.11 (0.72)	3.11 (0.77)	3.10 (0.70)	3.08 (0.72)	3.13 (0.73)	3.13 (0.78)	3.00 (0.74)	2.98 (0.71)	0.89	0.72	0.82	0.76	0.04	0.69
Protective buffering	2.28 (0.81)	2.37 (0.82)	2.48 (0.77)	2.54 (0.78)	2.34 (0.83)	2.41 (0.84)	3.38 (0.75)	2.43 (0.78)	0.051	0.01	0.84	0.15	0.72	0.67
Patient-centred outcomes preference ^a	32.85 (24.96)	33.63 (27.35)	25.94 (22.27)	27.82 (23.83)	32.15 (24.62)	33.58 (27.31)	28.64 (23.33)	31.53 (25.24)	0.18	0.02	0.58	0.07	0.25	0.53
Information-seeking preference ^a	93.79 (8.91)	93.66 (12.62)	91.88 (13.20)	91.41 (13.52)	93.73 (9.03)	93.67 (9.99)	90.76 (14.26)	90.99 (13.44)	0.65	0.03	0.80	0.91	0.01	0.83
Depression ^b	4.14 (3.68)	4.82 (4.25)	4.79 (3.59)	4.98 (3.59)	4.22 (3.74)	4.92 (4.29)	4.38 (3.69)	4.60 (3.57)	0.001	0.20	0.06	0.01	0.99	0.11
Anxiety ^b	3.46 (3.00)	3.61 (3.45)	3.80 (3.31)	4.00 (3.28)	3.49 (3.04)	3.68 (3.49)	3.56 (3.36)	3.82 (3.26)	0.15	0.20	0.83	0.09	0.74	0.77
Physical quality of life ^c	38.66 (9.83)	35.59 (11.53)	37.30 (10.88)	35.08 (11.46)	38.32 (9.82)	35.41 (11.62)	39.85 (10.81)	37.91 (11.51)	<0.001	0.33	0.30	<0.001	0.06	0.32
Psychological quality of life ^c	52.14 (9.40)	46.06 (10.57)	51.79 (9.77)	45.50 (11.06)	52.09 (9.42)	45.76 (10.64)	52.10 (10.04)	46.05 (11.58)	<0.001	0.59	0.82	<0.001	0.81	0.88

NGW, Range of indicated persons: 0–10; network quality index: higher values indicate higher outcomes (scale range = 0–5). BSSS, Higher values indicate higher outcomes (scale range = 1–4).

Bold entries mark results with a P-value <0.05.

^aAutonomy-Preference Index German modified version (scale range = 0–100): higher scores indicate higher outcomes.

^bHospital Anxiety and Depression Scale—German Version (min = 0, max = 21): higher scores indicate higher levels of depression.

^cTwelve-item Short-Form Health Survey (scale range = 0–100): higher values indicate a better quality of life.

Effects of social network and social support on health-related outcomes (Research Question 3)

Table 5 shows the regression coefficients of the social variables at baseline on health-related outcomes at follow-up. Larger social networks predicted significantly higher participation-seeking-preferences ($B = 1.4$), whereas smaller social networks predicted significantly lower anxiety ($B = -0.1$). Higher relationship quality predicted significantly better psychological quality of life ($B = 3.4$). In contrast, higher perceived social support predicted significantly higher anxiety ($B = 0.9$). Finally, higher protective buffering predicted lower psychological quality of life ($B = -1.6$). No effects of treatment modality were found. The models explained 20–54% of the overall variance.

DISCUSSION

Our study presents a comprehensive overview and longitudinal analysis of structural, quantitative and qualitative measures of social relationships and social support among HD versus PD patients, and how they affect health-related outcomes. The results indicate that the non-family network of dialysis patients became smaller over time. Friends and work colleagues appeared to drop out as important persons in a patient's daily life, although the number of social relationships within the family network remained stable. This indicates that family members are more likely to remain close to dialysis patients during a time when adaptation to fundamental changes in their daily routine takes place. Presumably, some family members became 'substitutes' for other persons who had been important in the patient's daily life. For example, family members who had not been close to patients at the start of treatment might have become more important during treatment, while other relatives and other people became less important. Overall, the family network of dialysis patients, provided a stable resource for improving patients' quality of life, which aligns with several studies that found family relationships provide substantial social support throughout the lifespan [19–21]. This finding is especially relevant for older dialysis patients, whose interactions with family members and close friends can enhance their psychological well-being [6].

Our longitudinal analyses suggest that larger social networks were associated with less anxiety and a higher preference for actively participating in medical decision-making. This effect might even transfer to activities promoting medical adherence. For instance, family support tends to reduce anxiety and depressive symptoms in HD patients [6] and contributes to improved compliance with dietary and fluid restrictions [22].

In contrast, we found high perceived social support (which differs from received social support) was associated with greater anxiety. One explanation may be that stressful situations induce anxiety despite the perception of a high level of social support. This result might also reflect the wording of items, e.g. 'If everything is just too much, there are others to help me through.' We also found that patients tended to shield others from their own suffering (protective buffering), which could have worsened their psychological quality of life. A plausible explanation, provided by the authors of the BSSS [14], is that protective buffering can lead one to avoid social support, and consequently, to lose the benefits of

social support on psychological well-being. We also found patients' perceptions about different dimensions of social support were not affected, despite changes in their social network over time.

PD patients had an advantage over HD patients with respect to social integration. PD patients had younger and more cohesive networks, even though their network members lived farther away. Moreover, PD patients had larger family and female networks, which is advantageous because family members provide critical social support and women are especially important for providing and mobilizing emotional support [23]. This might account for the higher levels of received social support among PD patients at baseline and their stronger mobilization of social support over time. These findings may reflect the greater autonomy of PD patients, which is essential for handling their treatment modality and the recent finding that PD patients have better psychological and physical outcomes [8–10, 24]. Thus, the superior social support provided by the family network of PD patients might also have contributed to their opting for PD treatment. A recent longitudinal analysis of a dialysis cohort [25] found higher baseline social support among PD than HD patients, but group differences in social support did not affect health-related outcomes. This implies that social support is important for the quality of life of both HD and PD patients, but social support might be a crucial factor determining the choice of renal replacement therapy [25]. A similar pattern was revealed in our sample: PD patients received more social support than HD patients did at baseline; however, the effects of social support and social relations on patient outcomes did not differ between the two groups over time.

Knowledge about the structure, quantity and quality of the social relationships of dialysis patients may be useful for the entire treatment process, because it can identify key persons who can support patients undergoing PD (i.e. home dialysis), and ensure patients' adherence. In practice, these different aspects of the social relationships of dialysis patients should be considered early, especially during modality choice, as the involvement of persons close to patients can improve modality selection and optimize treatment satisfaction [10]. Social networks may subsequently be important for dealing with treatment, improving adherence and coping with the disease, thereby leading to a better quality of life.

This study has some limitations. First, the NWG merely classifies friends or work colleagues as non-family relations. However, other non-family relationships, like frequent contact with dialysis staff, may also be important although they are not recognized within this approach. However, relationships with dialysis professionals might have ambiguous effects as such contact is somewhat 'unavoidable'. Even when staff provide patient support, their support may not reduce the overall burden of disease. For example, a recent study of the effects of social support by family members and dialysis staff on adherence and quality of life [26] revealed that 'staff encouragement and support were not associated with patient adherence and may not be able to overcome the possible stronger influence of other psychosocial factors and family support' (p. 8). Hence, family relationships probably play the most important role and can override the influence of social support from dialysis professionals.

Second, this study only examined positive relationships. Yet, other research has found that social relationships can negatively

Table 5. Linear regression coefficients on outcomes at follow-up (matched and unmatched sample)

Predictor	Regression coefficients on outcomes at follow-up [B (95% CI), P-value]					
	Participation-seeking-preference	Information-seeking-preference	Anxiety	Depression	Physical quality of life	Psychological quality of life
Intercept	45.00 (18.89; 71.12), <0.001 [44.45 (24.45; 64.44), <0.001]	44.13 (28.56; 59.70), <0.001 [44.03 (30.71; 57.35), <0.001]	-0.66 (-3.70; 2.38), 0.67 [-0.46 (-2.92; 1.99), 0.71]	1.71 (-2.01; 5.43), 0.37 [1.36 (-1.62; 4.33), 0.37]	3.28 (-8.32; 14.89), 0.58 [3.32 (-6.14; 12.78), 0.49]	9.77 (-3.02; 22.57), 0.13 [11.61 (1.00; 22.23), 0.03]
Social network size	1.39 (0.53; 2.24), 0.002 [1.25 (0.55; 1.94), <0.001]	0.11 (-0.36; 0.58), 0.64 [0.09 (-0.34; 0.51), 0.68]	-0.11 (-0.21; -0.01), 0.03 [-0.04 (-0.12; 0.05), 0.41]	-0.10 (-0.22; 0.01), 0.08 [-0.04 (-0.14; 0.05), 0.37]	0.24 (-0.13; 0.61), 0.20 [0.12 (-0.19; 0.42), 0.45]	0.35 (-0.07; 0.77), 0.10 [0.17 (-0.18; 0.51), 0.34]
Network quality index	1.93 (-2.68; 6.53), 0.41 [0.69 (-2.81; 4.20), 0.70]	1.88 (-0.67; 4.44), 0.15 [1.87 (-0.28; 4.02), 0.09]	-0.003 (-0.54; 0.55), 0.99 [0.12 (-0.32; 0.56), 0.60]	-0.46 (-1.09; 0.17), 0.15 [-0.19 (-0.68; 0.31), 0.46]	0.65 (-1.34; 2.64), 0.52 [-0.11 (-1.68; 1.47), 0.89]	3.41 (1.15; 5.67), 0.003 [2.86 (1.07; 4.65), 0.002]
Perceived available social support	-4.80 (-11.99; 2.40), 0.19 [-3.93 (-9.33; 1.48), 0.15]	0.25 (-3.73; 4.23), 0.90 [0.67 (-2.65; 3.98), 0.69]	0.93 (0.08; 1.78), 0.03 [0.38 (-0.30; 1.06), 0.28]	0.16 (-0.86; 1.18), 0.75 [0.08 (-0.71; 0.87), 0.84]	0.47 (-2.72; 3.66), 0.77 [1.97 (-0.50; 4.47), 0.12]	-1.17 (-4.85; 2.50), 0.53 [-1.11 (-3.99; 1.77), 0.45]
Actually received social support	-5.75 (-12.12; 0.62), 0.08 [-3.67 (-8.73; 1.38), 0.15]	-0.73 (-4.23; 2.77), 0.68 [0.34 (-2.77; 3.44), 0.83]	-0.25 (-0.99; 0.49), 0.50 [0.02 (-0.62; 0.65), 0.96]	0.22 (-0.64; 1.08), 0.62 [0.31 (-0.43; 1.04), 0.42]	-1.07 (-3.90; 1.76), 0.46 [-1.42 (-3.82; 0.98), 0.25]	-0.002 (-3.20; 3.19), 0.89 [-0.01 (-2.73; 2.72), 0.997]
Need for support	-0.32 (-3.19; 2.54), 0.82 [0.50 (-1.76; 2.77), 0.66]	0.63 (-0.94; 2.21), 0.43 [0.44 (-0.94; 1.82), 0.53]	-0.12 (-0.45; 0.22), 0.51 [0.01 (-0.28; 0.30), 0.93]	-0.38 (-0.77; 0.01), 0.053 [-0.29 (-0.61; 0.02), 0.07]	0.50 (-0.73; 1.72), 0.42 [0.27 (-0.74; 1.28), 0.60]	-0.03 (-1.38; 1.91), 0.96 [-0.02 (-1.18; 1.15), 0.98]
Mobilization of support	-0.79 (-4.54; 2.97), 0.68 [-1.63 (-4.54; 1.29), 0.27]	-0.04 (-2.14; 2.07), 0.97 [0.11 (-1.71; 1.92), 0.91]	0.05 (-0.40; 0.49), 0.84 [-0.13 (-0.49; 0.24), 0.50]	0.28 (-0.23; 0.80), 0.28 [-0.10 (-0.40; 0.31), 0.64]	0.76 (-0.85; 2.37), 0.36 [0.46 (-0.82; 1.74), 0.48]	0.01 (-1.88; 1.91), 0.99 [0.51 (-0.97; 1.99), 0.50]
Protective buffering	-0.69 (-3.50; 2.11), 0.63 [-1.18 (-3.33; 0.96), 0.28]	0.52 (0.02; 2.06), 0.51 [0.06 (-0.24; 1.36), 0.93]	-0.13 (-0.45; 0.20), 0.45 [0.08 (-0.19; 0.35), 0.55]	0.20 (-0.18; 0.58), 0.30 [0.25 (-0.04; 0.54), 0.09]	0.68 (-0.53; 1.88), 0.27 [0.63 (-0.31; 1.56), 0.19]	-1.56 (-2.92; -0.21), 0.02 [-1.41 (-2.47; -0.36), 0.01]
Treatment (HD versus PD)	-1.51 (-5.82; 2.80), 0.49 [-0.73 (-4.45; 2.98), 0.70]	1.72 (0.67; 4.11), 0.16 [1.78 (-0.49; 4.05), 0.12]	-0.02 (-0.52; 0.49), 0.95 [-0.19 (-0.65; 0.27), 0.42]	0.55 (-0.03; 1.14), 0.06 [0.41 (-0.10; 0.91), 0.11]	-1.44 (-3.31; 0.43), 0.13 [-0.36 (-1.99; 1.26), 0.66]	-0.48 (-2.60; 1.64), 0.66 [0.08 (-1.76; 1.92), 0.94]
R ²	0.44 (0.39)	0.20 (0.15)	0.53 (0.48)	0.54 (0.53)	0.48 (0.49)	0.30 (0.27)

Results for the unmatched sample in parentheses. B, parameters; CI, confidence interval. Interpretation of negative parameters: 'if (parameter) increases by 1 unit, outcome decreases by (B) units.' Adjusted for partnership status (yes versus no), having children (yes versus no) and outcomes at baseline.

Bold entries mark results with a P-value < 0.05.

affect health-related outcomes [27] if patient expectations or needs are not fulfilled when patients are suffering substantially [28]. For instance, older HD patients with severe comorbidities might expect more support from their family, which may cause psychosocial distress in addition to their suffering from the disease. There also may be a potential of misclassification due to the subjective self-reports of the patients.

Third, it should be noted that the results derived from PSM may be mainly applicable to advantaged, younger and healthier HD patients. Empirically, the HD patients were older and had more comorbidities than the PD patients, but these differences were adjusted for the propensity score-matched samples to simulate that both groups could have opted for both dialysis modalities. The PSM procedure aims to retrospectively simulate the case that HD and PD patients would have been candidates for both treatment options but cannot completely substitute for a randomized controlled trial. Finally, there may be a certain selection bias due to study site selection (inclusion criterion: 6–24 months on dialysis) and exclusion of a larger number of patients at follow-up, which might have partially contributed to the results found in the sample of analysis.

In summary, our findings indicate that the social relationships of dialysis patients underlie changes that may affect different aspects of their daily life and well-being. For example, PD patients appeared to have better social networks and more social support than their HD counterparts. Future studies should examine the potential burden of social relationships and their effects on patients' well-being. In practice, our findings suggest that early identification of sources of patient social support and the inclusion of persons providing assistance, such as partners and children, may affect different aspects of care and quality of life.

SUPPLEMENTARY DATA

Supplementary data are available at [ndt](http://ndt.oxfordjournals.org/) online.

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AUTHORS' CONTRIBUTIONS

D.N., J.L. and M.R. interpreted the data and wrote the manuscript. M.G. and W.M. designed the study and revised the article critically.

CONFLICT OF INTEREST STATEMENT

None declared.

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The first 365 days on haemodialysis: variation in the haemodialysis access journey and its associated burden

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ABSTRACT

Background. The modality by which haemodialysis (HD) is delivered [arteriovenous fistula (AVF), arteriovenous graft (AVG) or central venous catheter (CVC)] varies widely and is influenced by clinical evidence, patient factors and the prevailing service configuration. The aim of this study was to determine the outcome and impact of access strategy on patient outcome by mapping out the HD journey in a cohort of incident patients.

Methods. A 2-year cohort of consecutive incident HD patients from the point of referral for first dialysis access to completion of the first 365 days of HD was prospectively reviewed. Data were sought on access type; radiological, surgical and other access-related activity; bacteraemic events; admission rates and cumulative financial cost.

Results. A total of 144 patients started RRT for the first time with HD over the 2-year period. All were followed up to 1 year after starting HD, generating a total of 47 753 observed HD days.

Activity prior to starting HD for the full cohort was found to average 0.92 arteriovenous (AV) access creation procedures, 0.40 CVC insertions, 0.14 interventional radiology procedures and 0.41 ultrasound examinations per patient. The small number of patients who started on an AVG had a tendency towards

higher pre-HD surgical and imaging activity than those who started on an AVF or CVC.

Activity after starting HD varied greatly with the access type used at the start of HD, with AVF patients experiencing less hospitalization, procedure and imaging activity and financial costs compared with those who start HD with a CVC. Patients who started on an AVG had a tendency towards lower surgical activity rates and financial costs than those who started on a CVC.

Conclusions. Providing, maintaining and dealing with the complications of HD vascular access places a significant burden of activity that is shared across nephrology, surgery and imaging services. A well-functioning AVF is associated with the lowest burden, whereas a failed AVF or CVC access is associated with the highest burden. Patient journeys are shaped by the vascular access that they use and we suggest that the contemporary pursuit of HD access should focus on delivering personalized access solutions.

Keywords: arteriovenous fistula, arteriovenous graft, central venous catheter, haemodialysis, vascular access

INTRODUCTION

Regular hospital haemodialysis (HD) has proven to be especially costly and much of this is attributed to the provision,