

## Original Article

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**Abstract**

**Objectives.** This study aimed at characterizing 3 populations of family/friend caregivers of patients with different life-threatening organ failure regarding health-related quality of life, caregiver burden, and dyadic coping.

**Methods.** Three cross-sectional (population) studies were conducted at a tertiary hospital in Denmark (2019–2020). Patients with renal failure (RF), cystic fibrosis (CF), and intestinal failure (IF) were asked to designate the closest person with  $\geq 18$  years old involved in the care (caregiver) to participate in this study. Number of caregivers included were RF = 78, CF = 104, and IF = 73. Electronic questionnaires were filled in by caregivers to assess health-related quality of life and caregiver burden and by caregivers and respective patients to assess dyadic coping.

**Results.** The 3 caregiver groups had self-perception of poor health and energy; however, caregivers of CF patients perceived their physical role functioning better than those caregiving for RF and IF patients ( $p = 0.002$ ). The level of caregiver burden was reported as not high, but caregivers used in average 13 hours/day for caring. Moreover, cleaning tasks ( $p = 0.005$ ) and personal care ( $p = 0.009$ ) were more demanding in RF and IF patients. Caregivers also did not differ regarding dyadic coping. When comparing patients and caregivers, stress communication by oneself and the partner differed ( $p < 0.001$ ).

**Significance of results.** Caregivers spent many hours in the care role, they reported poor health, and dyadic coping may be improved. Interventions in caregivers of patients with life-threatening organ failure could help to improve care management at home, caregiver's health, and dyadic coping between caregiver and patient and consequently reduce caregiver burden.

**Background**

A caregiver is someone who provides direct care to a person who needs help taking care of his/her self (National Cancer Institute [n.d.](#)). A very common caregiver is someone who takes care of an ill family member or friend without remuneration. Despite their frequent role in many families, caregivers are not always the focus of attention and inclusion in the patient's treatment plan. Caregiving research has largely focused on patients with cancer and mental illnesses, including dementia and Alzheimer's disease, with limited research on caregiving in patients with organ failure of different origin (Chiao et al. 2015; Opsomer et al. 2022). However, caregivers of patients with life-threatening illnesses face existential, psychosocial, and physical burdens and health-related quality of life impairments (Oechsle 2019). Consistent with caregivers of patients with advanced cancer, caregivers of other life-threatening conditions report impacts such as decreased social activities, disrupted relationships, loss of employment, anxiety and depression, and even declining health (Cromhout et al. 2017; Nakaya et al. 2010; Nipp et al. 2016; Song et al. 2012). These findings have been confirmed in caregivers of patients with renal failure (RF) in hemodialysis, in patients with

cystic fibrosis (CF), and in patients with intestinal failure (IF) (Jeppesen et al. 2022a; McGuffie et al. 2008; Paschou et al. 2018; Smith 1993).

Available data suggest that caregiver burden can be higher in those taking care of patients in hemodialysis compared with caregiver of patients with renal transplantation (Avşar et al. 2015). We have recently studied and compared the current RF population with former populations treated at this hospital and found on average longer dialysis vintage and the presence of more comorbidity, which, combined with increasing age, renders a frailer population than formerly reported. Thus, surprisingly and in contrast to technological innovations, we face a different population nowadays, with a lower quality of life and increasing needs for symptom management and home care (Liem et al. 2022). However, the impact of caring for RF patients has not been well studied (Gilbertson et al. 2019).

CF is a genetic disease affecting multiple organ systems. Research and development of novel therapeutic agents including gene-targeted modulators have resulted in dramatic improvements in the quality of life and survival for people with CF (Barry et al. 2021). This has led to reinvigorated efforts and innovations in treatment approaches and care delivery, which may change disease trajectories dramatically. Despite the fact that life expectancy for people with CF has increased substantially, the disease continues to limit survival and quality of life and implicates in a substantial burden of care for people with CF and their caregivers (Bell et al. 2020).

Patients may have IF due to short bowel syndrome, infection of intestine mucosa, and alteration of gastrointestinal motility, among other causes. These patients may require long-term parenteral support and often need home care support. Parenteral nutrition and/or intravenous fluids are essential to maintain health, and although parenteral administration is lifesaving, the risk of life-threatening complications and the time and efforts involved to deliver this support are likely to impact both patients and caregivers (Jeppesen 2014; Jeppesen et al. 2022b; Pironi et al. 2016).

The evidence related to the impact of caring in caregiver of patients with RF, CF, and IF is still in construction, and there are issues to be investigated. Although there are different characteristics associated with caregiving in different life-threatening diseases, there may be some common features of the burden, which may be relieved by the same specific interventions. Therefore, the aim of this study was to characterize 3 populations of family/friend caregivers of patients with different life-threatening organ failure regarding health-related quality of life, caregiver burden, and dyadic coping.

## Methods

### Study design, settings, and participants

This study is derived from 3 cross-sectional studies conducted at in- and outpatient clinics at the Department of Nephrology, Cystic Fibrosis Centre, and Department of Intestinal Failure and Liver Diseases at Rigshospitalet Copenhagen University Hospital (Copenhagen, DK) between January 2019 and March 2021. Caregivers were recruited through the adult patients, and 3 groups were composed as follows: caregivers of RF patients, caregivers of CF patients, and caregivers of IF patients. Caregiver's inclusion criterion was at least 18 years old. The exclusion criteria were cognitive dysfunction, no fluency in Danish language, and refusal to

participate in the study. The patients' data can be found elsewhere (Liem et al. 2022) and in future publications.

### Procedures

A project nurse identified the caregivers by asking the patients to designate the closest person essential for their care (e.g., a partner, relatives, or friend), who accordingly was informed about the study, invited to participate in by email letter, and had 24 h to reflect about the invitation before signing the informed consent in case of agreement. Caregivers were asked to fill in an electronic questionnaire, which could be presented through a tablet at the study information appointment at the hospital or accessed later through a link sent by email. The questionnaire was built in REDCap (Research Electronic Data Capture) web application system. Those who consented to participate but did not respond to the electronic questionnaire received a reminder up to 2 times in an interval of 14 days by telephone.

### Variables of interest and assessment

Sociodemographic data were collected by interviewing the caregivers and included age, sex, educational level, and employment status.

Further, 3 self-report outcome measures were applied for primary variables: RAND 36-Item Health Survey version 1.0 (SF-36) (RAND n.d.; Ware and Sherbourne 1992), Zarit Burden Interview (ZBI) (Bédard et al. 2001), and Dyadic Coping Inventory (DCI) (Bodenmann 2008). Caregivers were requested to answer all measures. In addition, patients' DCI measure was assessed for comparison with caregivers. A brief description of the instruments is as follows.

SF-36 is a generic questionnaire that consists of 36 items that compose 8 health dimensions related to quality of life (Cronbach's alpha >0.70 for 7 scales). The dimensions are physical functioning, role limitation/physical, role limitation/emotional, energy/fatigue, emotional well-being, social functioning, bodily pain, and general health. Scores ranged from 0 to 100; a higher score indicated better outcomes (Gandek et al. 1998; RAND n.d.; Ware and Sherbourne 1992).

ZBI assesses burden among caregivers (overall Cronbach's alpha = 0.88). It consists of 22 items rated on a 5-point Likert scale that ranges from 0 (never) to 4 (nearly always); the sum of scores ranged between 0 and 88. A score of 17 or more was considered high burden (Bédard et al. 2001).

DCI was used to evaluate how caregivers manage stress together with the patient, concerning decision-making and giving support to each other. The instrument also assesses stress communication and the quality of self-perceived dyadic coping (Cronbach's alpha = 0.71–0.92). This study focused on how the dyad communicated their stress to each other, how they perceived the communication of stress from each other, how they coped together to handle stressful situations, and how they evaluated the way they cope together. Therefore, the DCI subscales applied were *stress communicated by oneself* (maximum score 20), *stress communication of the partner* (maximum score 20), *common dyadic coping* (maximum score 25), and *evaluation of dyadic coping* (maximum score 10). Items were rated on a 5-point Likert scale from 1 (very rarely) to 5 (very often). Higher scores denoted greater positive levels of the constructs measured by each subscale (Bodenmann 2008). Patients and caregivers answered separate forms.

### Data protection and ethic approval

This study was approved by the local Knowledge Centre on Data Protection Compliance Copenhagen (VR 2018–437, RF; VD 2019–192, CF; VR-2020-868, IF). Nonintervention studies are exempt of approval of the Ethic Committee in Denmark.

### Statistical analyses

The analyses were carried out using SAS v. 7.15 (SAS Institute Inc., Cary, NC). Data were analyzed for those who responded to the questionnaires. Incomplete subscales (<5%) were not included in the analyses. For the analysis of the dyads of DCI, only patients and respective relatives/caregivers who have both scored on at least one and the same subscale of Dyadic Coping were included. Comparisons were made among the 3 groups of relatives/caregivers by univariate analyses applying Chi-square test for the categorical variables and Kruskal–Wallis (Wilcoxon) test for the continuous/ordinal variables. Differences were observed between groups regarding sociodemographic characteristics ( $p < 0.05$ , Table 1). We deemed that the differences on SF-36, ZBI, and DCI could be associated with sociodemographic characteristics of each group; however, it reflected the actual composition of these diagnosis groups in the institution. A sensitivity analysis by linear regression was performed in 2 ways: (1) controlling for all sociodemographic characteristics (sex, age, education, occupation, and relation with patient) and (2) the significant sociodemographic characteristic to the respective group. To avoid bias due to the multiple comparisons, we have adopted level of significance as  $p < 0.01$  for the primary variables.

### Results

#### Caregivers' numbers and general characteristics

Eighty-eight caregivers of patients with RF, 104 of patients with CF and 84 of patients with IF were considered eligible. Of them, 78, 104, and 73 accepted to participate in the study and were included (Figure 1). The majority answered the electronic questionnaires by email link ( $\geq 96.2\%$ ). The groups differed regarding some sociodemographic characteristics; however, the majority in all groups were females (56.2%–79.5%), were student/work active (56.4%–88.6%), and had upper secondary/vocational or higher education ( $>80\%$ ). The majority was also spouses or cohabitant partners as follows: RF group (50%), CF group (57.7%), and IF group (74.0%) (Table 1).

#### Health-related quality of life

The lowest SF-36 scores in the 3 groups were observed for energy/fatigue and general health ( $52.8 \pm 15.8$ – $60.8 \pm 22.1$ ). The groups differed significantly regarding role functioning/physical in favor of the caregivers of the CF patients having the highest scores (RF:  $76.3 \pm 35.1$ , CF:  $90.3 \pm 26.3$ , and IF:  $74.6 \pm 39.3$ ,  $p = 0.002$ ); however, no significant difference between RF and IF groups was observed. The analyses controlling for sociodemographic characteristics did not show significant differences (Table 2).

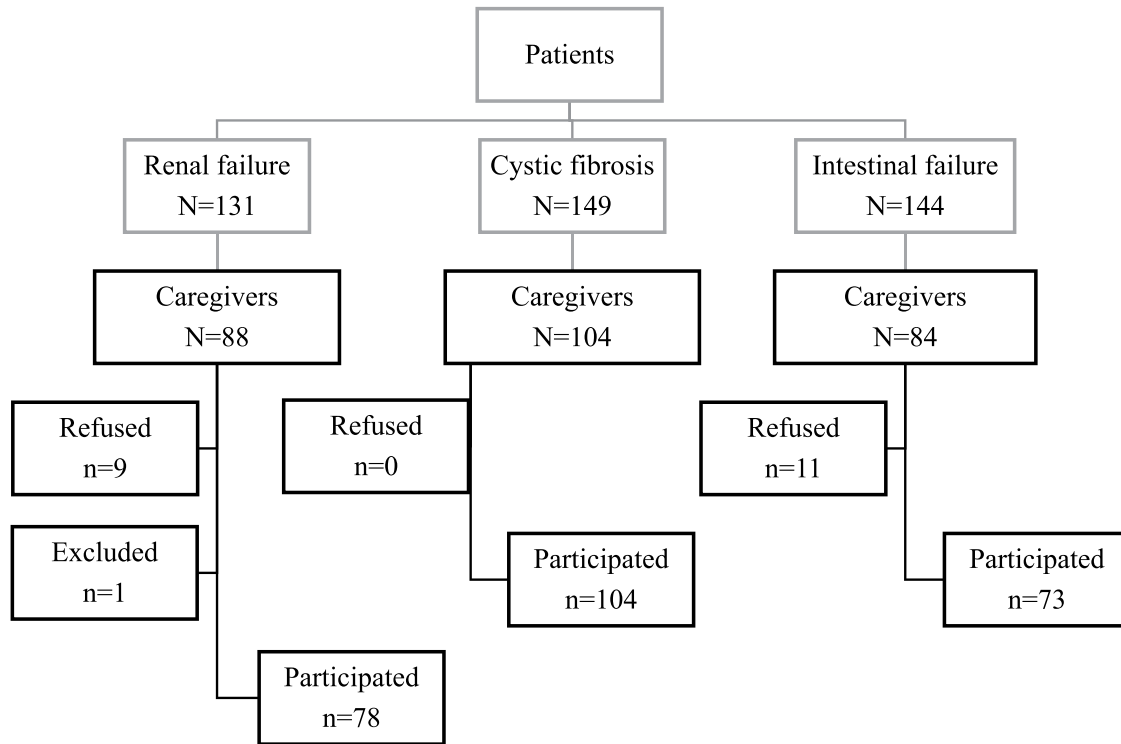
#### Caregiver burden

The 3 groups did not differ regarding mean total score at ZBI, which was  $\leq 14.3$ . However, they reported several hours of care distributed among all the different tasks, with mean variation

**Table 1.** Caregivers' characteristics

| Variables                             | Caregiver groups |                 |                    | p-Value |
|---------------------------------------|------------------|-----------------|--------------------|---------|
|                                       | Renal failure    | Cystic fibrosis | Intestinal failure |         |
| Participation, n (%)                  |                  |                 |                    | 0.001   |
| Accepted                              | 78 (89.7)        | 104 (100.0)     | 73 (86.9)          |         |
| Refused                               | 9 (10.3)         | –               | 11 (13.1)          |         |
| Assessment methods, n (%)             |                  |                 |                    | 0.489   |
| N                                     | 78 (100.0)       | 104 (100.0)     | 73 (100.0)         |         |
| Email                                 | 75 (96.2)        | 103 (99.0)      | 72 (98.6)          |         |
| Sex, n (%)                            |                  |                 |                    | 0.009   |
| N                                     | 78 (100.0)       | 104 (100.0)     | 73 (100.0)         |         |
| Female                                | 62 (79.5)        | 70 (67.3)       | 41 (56.2)          |         |
| Age (y)                               |                  |                 |                    | <0.001  |
| N                                     | 78 (100.0)       | 104 (100.0)     | 73 (100.0)         |         |
| Mean (SD)                             | 57.4<br>(14.8)   | 45.6<br>(13.3)  | 59.2<br>(14.9)     |         |
| Median (range)                        | 57.5<br>(20–80)  | 46.0<br>(20–75) | 61.0<br>(21–97)    |         |
| Schooling, n (%)                      |                  |                 |                    | 0.014   |
| N                                     | 78 (100.0)       | 104 (100.0)     | 73 (100.0)         |         |
| Primary and lower secondary education | 14 (18.0)        | 9 (8.7)         | 9 (12.3)           |         |
| Upper secondary/Vocational education  | 26 (33.3)        | 36 (34.6)       | 39 (53.4)          |         |
| Higher education                      | 38 (48.7)        | 59 (56.7)       | 25 (34.3)          |         |
| Employment, n (%)                     |                  |                 |                    | <0.001  |
| N                                     | 78 (100.0)       | 104 (100.0)     | 73 (100.0)         |         |
| Student/working                       | 44 (56.4)        | 92 (88.6)       | 41 (56.2)          |         |
| Retired                               | 33 (42.3)        | 7 (6.7)         | 30 (41.1)          |         |
| Sick leave                            | 1 (1.3)          | 5 (4.8)         | 2 (2.7)            |         |
| Patient relation, n (%)               |                  |                 |                    | 0.009   |
| N                                     | 78 (100.0)       | 104 (100.0)     | 73 (100.0)         |         |
| Spouse/cohabitant partner             | 39 (50.0)        | 60 (57.7)       | 54 (74.0)          |         |
| Siblings                              | 9 (11.5)         | 6 (5.8)         | 1 (1.4)            |         |
| Other family member                   | 24 (30.8)        | 36 (34.6)       | 16 (21.9)          |         |
| Acquaintance                          | 5 (6.4)          | –               | 2 (2.7)            |         |
| Other                                 | 1 (1.3)          | 2 (1.9)         | –                  |         |

between 0.2 and 5.0 hours, in average 13 h/day. Differences were observed regarding hours for cleaning/other tasks (RF:  $4.7 \pm 6.0$ , CF:  $2.7 \pm 4.2$ , and IF:  $5.0 \pm 5.3$ ,  $p = 0.005$ ) and for personal care (RF:  $0.5 \pm 1.8$ , CF:  $0.2 \pm 1.6$ , and IF:  $0.3 \pm 1.0$ ,  $p = 0.009$ ); highest



**Figure 1.** Participants inclusion.

**Table 2.** Caregivers' SF-36 scores

| SF- 36 domains             | Renal failure |      |      | Cystic fibrosis |      |      | Intestinal failure |      |      | Univariate      | Regression <i>p</i> -value |                    |
|----------------------------|---------------|------|------|-----------------|------|------|--------------------|------|------|-----------------|----------------------------|--------------------|
|                            | <i>n</i>      | Mean | SD   | <i>n</i>        | Mean | SD   | <i>n</i>           | Mean | SD   | <i>p</i> -value | Controlled                 | Significant effect |
| Physical functioning       | 72            | 88.5 | 17.9 | 91              | 90.7 | 16.3 | 72                 | 83.1 | 22.5 | 0.040           | 0.090                      | 0.083 (edu/occ)    |
| Role functioning/physical  | 72            | 76.3 | 35.1 | 91              | 90.3 | 26.3 | 71                 | 74.6 | 39.3 | 0.002           | 0.733                      | 0.386 (occ)        |
| Role functioning/emotional | 72            | 68.5 | 38.7 | 91              | 83.9 | 29.1 | 71                 | 76.5 | 36.3 | 0.033           | 0.163                      | 0.047 (sex/edu)    |
| Energy/fatigue             | 72            | 60.8 | 22.1 | 91              | 60.3 | 21.0 | 72                 | 56.7 | 20.0 | 0.321           | 0.724                      | 0.774 (edu/relat)  |
| Emotional well-being       | 72            | 71.0 | 18.4 | 91              | 75.4 | 15.6 | 72                 | 72.6 | 18.6 | 0.360           | 0.231                      | 0.235 (edu/relat)  |
| Social functioning         | 72            | 80.7 | 21.7 | 91              | 86.5 | 19.6 | 72                 | 82.7 | 21.9 | 0.096           | 0.236                      | 0.361 (edu/relat)  |
| Bodily pain                | 72            | 80.6 | 25.0 | 91              | 83.9 | 22.2 | 72                 | 74.3 | 25.2 | 0.023           | 0.291                      | 0.177 (occ)        |
| General health             | 72            | 54.9 | 15.1 | 92              | 58.7 | 15.7 | 72                 | 52.8 | 15.8 | 0.041           | 0.726                      | 0.369 (occ)        |

occ = occupation, edu = education, and relat = patient relation.

scores were observed in caregivers of RF and IF groups. The analysis controlling for sociodemographic characteristics did not show significant differences. It seems that the difference observed regarding cleaning and other tasks in univariate analysis ( $p = 0.005$ ) were due to differences across groups regarding occupation and patient relation (Table 3).

### Dyadic coping

The number of dyads (patient and respective caregiver) that answered the instrument were RF = 31, CF = 72, and IF = 70. The 3 groups of caregivers did not differ regarding DCI scores. The lowest mean scores were observed for stress communicated by oneself – caregiver to the patient ( $9.7 \pm 3.5$ – $11.3 \pm 3.5$ ) – and stress communication of the partner – perception of the caregiver about

the patient ( $11.0 \pm 3.1$ – $12.2 \pm 3.9$ ). The analysis controlling for sociodemographic characteristics did not show significant differences (Table 4). Scores were similar when comparing the dyads. The exceptions were the subscales stress communication by oneself and stress communication of the partner. CF and IF caregivers had approximately 2 points lower or higher in the mean scores than patients ( $p < 0.001$ ), respectively (Table 5).

### Discussion

#### Main findings and considerations

The main findings of the 3 cross-sectional studies in caregivers of patients with RF, CF, and IF demonstrated self-perception of poor health and energy; however, caregivers of CF patients perceived their physical role functioning better than those caregiving for

**Table 3.** Caregivers' Zarit burden scores

| Zarit items   | Renal failure |      |     | Cystic fibrosis |      |      | Intestinal failure |      |     | Univariate<br><i>p</i> -value | Regression <i>p</i> -value |                    |
|---|---------------|------|-----|-----------------|------|------|--------------------|------|-----|-------------------------------|----------------------------|--------------------|
|   | <i>n</i>      | Mean | SD  | <i>n</i>        | Mean | SD   | <i>n</i>           | Mean | SD  |                               | Controlled                 | Significant effect |
| Total score   | 71            | 13.9 | 8.7 | 90              | 12.1 | 9.3  | 72                 | 14.3 | 7.6 | 0.117                         | 0.116                      | 0.234 (none)       |
| Hours of care/day for                               |               |      |     |                 |      |      |                    |      |     |                               |                            |                    |
| Cooking/eating                                      | 65            | 4.0  | 5.5 | 85              | 4.2  | 13.4 | 70                 | 3.3  | 4.1 | 0.440                         | 0.415                      | 0.439 (relat)      |
| Cleaning/other tasks                                | 65            | 4.7  | 6.0 | 84              | 2.7  | 4.2  | 71                 | 5.0  | 5.3 | 0.005                         | 0.249                      | 0.136 (occ/relat)  |
| Personal care                                       | 62            | 0.5  | 1.8 | 84              | 0.2  | 1.6  | 69                 | 0.3  | 1.0 | 0.009                         | 0.416                      | 0.602 (occ)        |
| Medication/care                                     | 63            | 0.8  | 2.5 | 84              | 1.3  | 4.2  | 69                 | 1.0  | 3.7 | 0.574                         | 0.388                      | 0.695 (none)       |
| Bank/insurance/other papers                         | 65            | 0.6  | 1.0 | 85              | 0.7  | 2.4  | 69                 | 0.5  | 1.1 | 0.535                         | 0.245                      | 0.199 (edu/age)    |
| Contact hospital, physician, public health services | 63            | 0.8  | 2.3 | 84              | 1.0  | 5.6  | 70                 | 0.5  | 0.8 | 0.072                         | 0.373                      | 0.682 (none)       |
| Transport   | 60            | 1.2  | 2.3 | 84              | 0.6  | 1.7  | 69                 | 1.0  | 1.6 | 0.027                         | 0.636                      | 0.572 (sex/occ)    |
| Others  | 51            | 0.9  | 1.6 | 69              | 0.7  | 1.7  | 57                 | 1.2  | 2.5 | 0.230                         | 0.522                      | 0.663 (age)        |

occ = occupation, edu = education, and relat = patient relation.

**Table 4.** Caregivers' Dyadic Coping Inventory scores

| DCI subscales                       | Renal failure |      |     | Cystic fibrosis |      |     | Intestinal failure |      |     | Univariate<br><i>p</i> -value | Regression <i>p</i> -value |                    |
|-------------------------------------|---------------|------|-----|-----------------|------|-----|--------------------|------|-----|-------------------------------|----------------------------|--------------------|
|                                     | <i>n</i>      | Mean | SD  | <i>n</i>        | Mean | SD  | <i>n</i>           | Mean | SD  |                               | Controlled                 | Significant effect |
| Stress communicated by oneself      | 37            | 11.3 | 3.5 | 85              | 9.7  | 3.4 | 72                 | 9.7  | 3.5 | 0.037                         | 0.378                      | 0.568 (sex/relat)  |
| Stress communication of the partner | 37            | 12.2 | 3.9 | 85              | 11.0 | 3.1 | 72                 | 11.8 | 3.6 | 0.222                         | 0.370                      | 0.378 (sex/relat)  |
| Common dyadic coping                | 37            | 18.3 | 4.0 | 87              | 17.0 | 4.4 | 72                 | 16.4 | 4.5 | 0.092                         | 0.140                      | 0.150 (relat)      |
| Evaluation of dyadic coping         | 37            | 7.9  | 2.1 | 85              | 7.5  | 2.1 | 72                 | 7.4  | 2.0 | 0.350                         | 0.495                      | 0.549 (occ)        |

occ = occupation, edu = education, and relat = patient relation.

**Table 5.** Comparison between patients and caregivers regarding Dyadic Coping Inventory mean scores

| DCI subscales                       | Renal failure |     |            |     |          | Cystic fibrosis |     |            |     |          | Intestinal failure |     |            |     |          |
|-------------------------------------|---------------|-----|------------|-----|----------|-----------------|-----|------------|-----|----------|--------------------|-----|------------|-----|----------|
|                                     | Patients      |     | Caregivers |     | <i>p</i> | Patients        |     | Caregivers |     | <i>p</i> | Patients           |     | Caregivers |     | <i>p</i> |
| Stress communicated by oneself      |               |     |            |     |          |                 |     |            |     |          |                    |     |            |     |          |
| <i>n</i>                            | 31            |     | 31         |     |          | 72              |     | 72         |     |          | 70                 |     | 70         |     |          |
| Mean/SD                             | 13.0          | 4.3 | 11.0       | 3.6 | 0.056    | 11.9            | 3.4 | 9.7        | 3.5 | <0.001   | 11.3               | 3.4 | 9.9        | 3.4 | 0.015    |
| Stress communication of the partner |               |     |            |     |          |                 |     |            |     |          |                    |     |            |     |          |
| <i>n</i>                            | 31            |     | 31         |     |          | 72              |     | 72         |     |          | 70                 |     | 70         |     |          |
| Mean/SD                             | 10.5          | 3.7 | 12.0       | 4.2 | 0.108    | 11.2            | 3.6 | 11.1       | 3.2 | 0.719    | 10.1               | 3.7 | 11.9       | 3.5 | <0.001   |
| Common dyadic coping                |               |     |            |     |          |                 |     |            |     |          |                    |     |            |     |          |
| <i>n</i>                            | 31            |     | 31         |     |          | 73              |     | 73         |     |          | 69                 |     | 69         |     |          |
| Mean/SD                             | 18.5          | 3.7 | 18.9       | 3.8 | 0.469    | 17.4            | 4.3 | 16.7       | 4.7 | 0.178    | 16.8               | 4.4 | 16.4       | 4.5 | 0.362    |
| Evaluation of dyadic coping         |               |     |            |     |          |                 |     |            |     |          |                    |     |            |     |          |
| <i>n</i>                            | 31            |     | 31         |     |          | 71              |     | 71         |     |          | 70                 |     | 70         |     |          |
| Mean/SD                             | 8.6           | 1.7 | 8.2        | 2.0 | 0.474    | 7.8             | 1.9 | 7.4        | 2.2 | 0.224    | 7.8                | 2.1 | 7.4        | 2.0 | 0.201    |

RF and IF patients. The caregiver burden was generally modest in the 3 groups; however, they used many hours per day in the caring role. Particularly, cleaning tasks and personal care were more demanding in RF and IF patients. Stress communication among the patients and the caregivers, how they coped

together to handle stressful situations, and evaluation of dyadic coping were generally assessed as being of the same magnitude as formerly found in dyads of patients with advanced cancer and their caregivers (Von Heymann-Horan 2018). The differences across groups disappeared when the analyses were

controlled for the sociodemographic characteristics. This indicates that the sociodemographic distinction between caregivers may be an important factor to caregiver burden alongside with the patient diagnosis.

Comparing caregiver burden across studies is hampered by a small number of available studies in organ failure and differences in the measurement of caregiver burden due to the lack of a conceptualization or agreed definitions of caregiver burden in the literature (Chou 2000), which may contribute to differences in study findings (Xiong *et al.* 2020). However, all caregivers of patients with RF, CF, and IF in our study felt lack of energy and poor health related to the caregiver burden. Similar to other studies, caregivers of CF patients reported better emotional and physical role functioning than those caregiving for RF and IF patients. It possibly was influenced by disease-related factors associated with milder trajectories and improved prognosis. Surprisingly and in contrast to these findings, the caregiver burden was modest. In a recent systematic review of caregiving in patients with end-stage kidney disease, increased caregiver burden was among others associated with caring for patients receiving hemodialysis (Alshammari *et al.* 2021). Due to the low prevalence of IF, the burden that caregivers of patients with IF face has not been particularly well characterized. However, a cross-sectional Dutch study in IF patients and their caregivers found that high caregiver burden possibly was directly associated with the patients' quality of life (Beurskens-Meijerink *et al.* 2020). In addition, a multinational cross-sectional study with caregivers of IF patients in parenteral support showed impact of care on caregivers' productivity and leisure activities (Jeppesen *et al.* 2022a).

Patient and caregiver coping may influence each other (Hagedoorn *et al.* 2008), and the way they support each other in coping may affect their distress, supportive care needs, and quality of life (Weißflog *et al.* 2017). A meta-analysis has documented that those different interventions at the level of the patient-caregiver dyad significantly improves individual outcomes in both patients and caregivers, as well as their relationship (Badr and Krebs 2013), and the effects of dyadic interventions may be equal in size to those of individually focused interventions (Regan *et al.* 2012). Interventions at the dyad level have the advantage of being able to address dyadic processes, such as common coping efforts or stress communication, which may lower caregivers' psychological distress and increase their engagement in care and in turn lead to better support for patients, as well as prevent negative long-term effects for the caregivers themselves. Positive effects of specialized palliative care with dyadic psychological intervention on cancer patients and caregivers' symptoms of anxiety and depression have been described (Nordly *et al.* 2019; von Heymann-horan *et al.* 2018a). The key element seems to offer early specialized palliative care, including a dyadic intervention conducted by psychologists with an existential-phenomenological approach (von Heymann-horan *et al.* 2018b). Hopefully, future studies will be able to test these interventions in other patients' groups suffering from life-threatening diseases and their caregivers.

### Strengths and limitations of the study

We believe that this study contributes to increase the bulk of knowledge in an area still under construction. Three under-investigated populations of caregivers were assessed with well-validated assessment instruments to give an insight regarding their health-related quality of life, burden of care, and how they perceive, manage, and communicate stress in the dyad with the patient. However, we are

aware of the limitations of our study, especially since this is a single-center cross-sectional study with group distributions quite skewed. Thus, generalizability is restricted, causality cannot be drawn, as well as fluctuations in caregiving might not be registered as in a longitudinal study. A weakness of our study is the fact that burden in caregivers is likely to be regulated by a wide range of factors. These factors include sociodemographic characteristics of caregivers and patients including disease-related, caregiving-related, environmental/social/nature of caregiver-patient relationship, and psychological factors. However, some factors have been demonstrated to be relatively consistent across studies, while for others are inconsistent or inconclusive (Alshammari *et al.* 2021). These factors have not been well addressed in our study due to limited access of demographic data of the caregivers, which should be considered in future studies.

### Conclusion

We found that caregivers of patients with RF, CF, and IF generally spend many hours per day in the care role and reported signs and symptoms of exhaustion in terms of lack of energy and perception of poor health. The caregivers of CF patients for obvious reasons seemed to be less burdened than the 2 other groups; however, all groups demonstrated that there is room for dyadic coping improvement. Next step in our research agenda is to investigate standardized dyadic interventions in caregivers of different populations of patients with life-threatening organ failure.

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