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Health-related quality of life and depression in dialysis patients:
Associations with current smoking

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Abstract
Objective. The study explored health-related quality of life (HRQoL) and depression in a culturally homogeneous dialysis patient population. Furthermore, the associations between HRQoL and depression with current smoking were elaborated.
Material and methods. In a cross-sectional study of 301 dialysis patients from 10 dialysis centres in Norway, HRQoL was evaluated with the Kidney Disease and Quality of Life Short Form, version 1.3. Physical component summary scores (PCS) and mental component summary scores (MCS) were computed. Depression was assessed using the Beck Depression Inventory (BDI), and Cognitive Depression Index (CDI) was calculated. Depression was defined as a BDI score greater than 14.
Results. HRQoL was poorer in dialysis patients compared with population norms. Depression was prevalent (33.2%), and differed significantly between smokers and non-smokers (52.8 vs 26.4%, p < 0.001). MCS was significantly reduced in smokers compared with non-smokers (44.1 ± 12.2 vs 48.7 ± 10.3, p < 0.001), but there was no difference in PCS (35.7 ± 10.2 vs 37.1 ± 10.4, not significant). Current smoking was independently associated with higher BDI score (p = 0.039), as well as with higher CDI score (p = 0.005) and worse score on MCS (p = 0.002), after adjustments for multiple covariates.
Conclusions. HRQoL is lower in Norwegian dialysis patients than in the general population, and depression is prevalent. The study suggests that poor perceived mental aspects of HRQoL and depression are associated with current smoking in dialysis patients, but a causal relationship remains to be shown.

Key Words: Chronic dialysis, current smoking, depression, quality of life.

Introduction

Health-related quality of life (HRQoL) is substantially suppressed in patients with chronic kidney disease (CKD) in dialysis treatment compared with the general population [1–3]. Furthermore, depression has been found to be highly prevalent in dialysis patients, and to have a profound negative impact on HRQoL [4, 5]. Both HRQoL and depression are related to survival in dialysis patients [6–11]. Thus, knowledge of potential modifiable factors that are associated with both HRQoL and depression in dialysis patients seems essential.

The reciprocal relationship between smoking and depression in the general population is well established, although a causal relationship remains to be shown [12–14]. There are limited data on the effect of smoking on HRQoL in the general population [15–17], and even fewer for individuals with chronic disease. Smoking, a potential modifiable risk factor, is discouraged in all patients with CKD because of the increased risk of atherosclerotic events and other ill effects induced by tobacco use. A recent study of 909 incident dialysis patients showed that current smoking was associated with poor sleep quality [18]. Leggat et al. showed that current smoking was
associated with different measures of non-compliance with the medical treatment regime in a study of 6251 haemodialysis patients [19], and this observation has been confirmed in both haemodialysis and peritoneal dialysis patients [20, 21].

To the authors’ knowledge, there is a scarcity of studies elaborating the associations between smoking and HRQoL, and between smoking and depression, in dialysis patients. However, in a study of 119 haemodialysis patients and 51 peritoneal dialysis patients, Kutner et al. [20] found no difference in reported depression between smokers and non-smokers, when applying two screening questions from the Primary Care Evaluation of Mental Disorders Brief Patient Health Questionnaire. Based on present knowledge, it was hypothesized that smoking is associated with reduced HRQoL and increased level of depression in dialysis patients.

The incidence rate of patients with end-stage renal disease (ESRD) in Norway was 112.7 per million population in 2007 according to the Norwegian Renal Registry, which is comparable to other European countries, but lower than what has been reported in the USA [22]. The number of patients recruited yearly into chronic dialysis is steadily increasing. However, there is a paucity of data regarding both HRQoL and depression in the Norwegian dialysis population. Given the importance of HRQoL and depression regarding clinical outcomes in dialysis patients, the current study aimed to explore both HRQoL and prevalence of depression in Norwegian chronic dialysis patients, and to look at possible associations between HRQoL, depression and current smoking.

Material and methods

Study setting and design

Patients from 10 different hospitals (five university hospitals and five regional hospitals) from all parts of Norway participated in the cross-sectional study. The study centres provide renal healthcare for more than two million Norwegian inhabitants, close to half of the total Norwegian population. Two of the centres supply healthcare mainly for an urban population, whereas the other hospitals receive patients from both rural and urban areas. All adult patients (over 18 years) receiving either chronic haemodialysis (HD) or peritoneal dialysis (PD) were screened and were included if they had received dialysis for more than 2 months and were in a clinically stable condition. The study required adequate Norwegian language skills. Oral and written information was given, and signed, informed consent was required for enrolment. Cognitive dysfunction, based on clinical judgement, or major psychiatric disorder, such as psychosis or drug abuse, were exclusion criteria. Hospitalization during the investigation period excluded patients from the study; however, they could be enrolled 4 weeks or more after discharge from hospital if they were clinically stable.

Dialysis patients considered eligible for this cross-sectional study were recruited consecutively from August 2005 to February 2007 (Figure 1). Self-administered questionnaires were answered during the dialysis treatment. The study nurses attended special teaching sessions to enhance their consistency in the use of the study instruments. The Regional Committee for Research Ethics in Norway approved the study protocol. Concession was obtained from the National Data Inspectorate.

Clinical and sociodemographic data

Demographic data including age, gender, marital status, education and work status were collected from reviews of hospital charts and/or direct questioning. Cause of renal failure, dialysis modality, dialysis vintage, comorbidities, and clinical and laboratory data were collected from the hospital charts. Comorbidity was measured using the modified Charlson Comorbidity Index (CCI) [23]. The CCI has been validated for dialysis patients and found to be a strong predictor of clinical outcomes [23]. The CCI is a composite score of 17 comorbid conditions and age. Comorbid conditions are given scores ranging from 1 to 6, and a score of 1 was added for each decade over 40 years of age. In this study, CCI was also calculated without including age to evaluate the effect of age as a separate factor in multivariate analysis. Information about current smoking status (yes/no) was collected by direct verbal questioning the patients (“do you smoke?”) at the time of study inclusion, and by cross-checking with available information in the hospital’s charts. In addition, data on previous smoking habits and number of daily smoked cigarettes were gathered in self-administered questionnaire at the time of the study. Previous smokers and never smokers were categorized as non-smokers.

Measures of health-related quality of life and depression

The Kidney Disease and Quality of Life Short Form, version 1.3 (KDQOL-SF) [24], was applied to assess HRQoL. The Medical Outcome Study 36-item Short Form Health Survey (SF-36) [25] was administered
as the first part of the KDQOL-SF, to measure generic dimensions of HRQoL. It consists of 36 items, 35 of which form eight multi-item scales: physical function, role limitation because of physical problems, bodily pain, general health perception, vitality, social functioning, role limitation because of emotional problems and mental health. Two component summary scores are derived from the eight subscales: the physical component summary scale (PCS) and the mental component summary scale (MCS). A Norwegian version of the SF-36 has been validated [26], and population norms have been established [27]. The KDQOL questionnaire was developed by the Rand group in 1990 [24], to address kidney disease-specific HRQoL. Forty-three items are classified into 11 specific kidney-related scales: symptoms, effect of kidney disease, burden of kidney disease, work status, cognitive function, quality of social interactions, sexual function, sleep, social support, dialysis staff encouragement and patient satisfaction. The KDQOL-SF has been applied in several international studies on dialysis patients, and in a Scandinavian population [28]. The questionnaire was translated into Norwegian and back-translated to American English, as instructed by the Rand group. All the SF-36 subscales and the 11 specific kidney-related scales were scored independently and given a score from 0 to 100; a higher score indicates a more positive state. The MCS and PCS scores were standardized to a general population mean of 50 and a standard deviation of 10 (i.e. T-score metric) by using the scoring algorithm proposed by Ware [29]. Thus, a score above or below 50 indicates a state above or below average functioning.

The Beck Depression Inventory (BDI) self-administered questionnaire was applied to measure the level of depressive symptoms. BDI has been used in both the general and CKD populations [30, 31]. It consists of 21 items that examine the somatic and cognitive effects of depression. Each item is scored from 0 to 3, where a higher score indicates a higher level of depressive symptoms. A BDI score greater than 14 was used as the cut-off value for clinical significant depression in the current study, based on

Figure 1. Flowchart of the recruitment process.
previous reports [32, 33]. A Cognitive Depression Index (CDI) consisting of 15 BDI items was generated to evaluate depressive symptoms without including the somatic aspects of depression [34].

Statistical analyses

Data are presented as mean ± standard deviation, or median (25th percentile Q1, 75th percentile Q3) if data were skewed. Percentages were used for categorical variables. Student’s t test, or Mann–Whitney test if appropriate, was used to compare the two groups. Chi-squared tests were used to compare categorical variables. Patients were grouped according to age quartiles (18–49, 50–61, 62–72 and 73–89 years) and their scores on the SF-36 compared with those of appropriate age- and gender-matched population norms. To examine whether current smoking was independently associated with HRQoL or depression, log-transformed BDI, log transformed CDI, MCS and PCS scores were set as dependent variables in separate multiple linear regression analysis. Bivariate Spearman’s correlations and chi-squared tests were performed to identify potential confounders. Sociodemographic and clinical variables were selected from bivariate analysis if they were correlated (p <0.2) with both current smoking and the dependent variable, or if they were considered clinically important. If Spearman’s correlation coefficient between two potential confounders was outside the interval –0.70 to 0.70, one of them was excluded. Continuous skewed variables were log-transformed before being included in the regression models. All selected covariates were entered into multiple linear regression analysis simultaneously. Backwards variable selection was then applied to identify the most important covariates. Variance inflating factors were computed for all covariates participating in multivariate analysis and the maximum value was 1.92. Unstandardized beta values were given with 95% confidence intervals (CIs). For all analyses, a significance level of 5% was used. The data were analysed using SPSS for Windows version 16 (SPSS, Chicago, IL, USA), except for the analysis comparing SF-36 scores between dialysis patients and population norms, for which Number Cruncher Statistical System for Windows, 2007 version (NCSS, Kaysville, UT, USA) was used.

Results

A total of 301 (72.4%) of 416 eligible dialysis patients entered the study (Figure 1). Patients willing to participate in the study were younger (59.6 ± 16.2 vs 67.9 ± 15.8 years, p <0.001), and a higher proportion used PD (20% vs 10%, p = 0.03) than non-participants, but no difference in gender or dialysis vintage was observed.

Sociodemographic and clinical variables for the smoking and non-smoking study patients are summarized in Table I. Of all study patients, 25.6% were current smokers (n = 77), 29.6% were former smokers (n = 89) and 44.9% had never smoked (n = 135). Time since smoking cessation ranged from 0.5 to 50.0 years. The mean number of daily smoked cigarettes reported by the current smokers was 13.1 ± 8.0 (range 0.5–40.0). Two of the current smokers reported being only weekend smokers and smoked on average 0.5 cigarettes per day. Only five patients of the current smokers smoked five or fewer cigarettes per day. Significantly higher proportions of current smokers were in the two lowest age quartiles (35% each) than in the two highest age quartiles (22% and 10%, χ² = 14.663, p = 0.002), but no gender differences were observed. As shown in Table I, patients who smoked were younger and leaner, but had higher comorbidity scores than non-smokers. Haemoglobin, C-reactive protein, albumin, cholesterol and systolic blood pressure scores did not differ between the two groups.

Comorbid conditions were frequent in the study population: 31.4% had signs or symptoms of coronary heart disease, 26.1% had diabetes mellitus and 16.7% had pulmonary disease. SF-36 scores of dialysis patients are shown in Table II. As HRQoL scores were similar for HD and PD patients (data not shown), data were pooled. Overall, both male and female dialysis patients scored significantly lower compared with population norms on all SF-36 subscales (Table II), but the differences were attenuated with increasing age (Figure 2). Differences in SF-36 scores between genders appeared in the two highest age quartiles, where females scored better than males on some scales. In female patients above 72 years all SF-36 subscale scores were similar to norms except for general health.

The mean BDI score for all patients was 11.4 ± 7.9, and the median score was 10.0 (Q1 6.0, Q3 15.5). The prevalence of depression, based on the BDI scores, was 33.2% in the entire study population. Patients below the median age of 62 years scored higher on the BDI than those above [11.5 (Q1 6.0, Q3 18.0) vs 9.0 (Q1 6.0, Q3 14.0), p = 0.024], and the prevalence of depression was also higher in the youngest group (41.1 vs 25.2%, p = 0.005).

The scores for HRQoL and BDI were similar for previous smokers and never smokers (data not shown); therefore, the data were pooled for all current non-smokers. As seen in Table III, there were...
Table I. Sociodemographic and clinical variables for dialysis patients categorized as smokers and non-smokers.

| Variable                              | Non-smokers (n = 224) | Smokers (n = 77) | p    |
|---------------------------------------|-----------------------|------------------|------|
| Age (years)                           | 61.5 ± 16.4           | 54.7 ± 14.5      | 0.001|
| Male gender (%)                       | 65.9                  | 66.2             | 0.960|
| Marital status                        |                       |                  |      |
| Single (%)                            | 12.6                  | 20.8             | 0.081|
| Married or cohabitant (%)             | 68.9                  | 49.4             | 0.002|
| Divorced or separated (%)             | 5.4                   | 23.4             | <0.001|
| Widowed or widower (%)                | 13.1                  | 6.5              | 0.118|
| Education                             |                       |                  |      |
| 0–7 years (%)                         | 23.8                  | 27.1             | 0.573|
| 7–12 years (%)                        | 50.9                  | 51.4             | 0.94 |
| >12 years (%)                         | 25.2                  | 21.4             | 0.52 |
| Work status                           |                       |                  |      |
| Able to work (%)                      | 13.3                  | 11.0             | 0.600|
| Disabled (%)                          | 42.4                  | 71.2             | <0.001|
| Retired (%)                           | 44.3                  | 17.8             | <0.001|
| Primary renal disease                 |                       |                  |      |
| Vascular/hypertensive kidney disease (%) | 26.0          | 28.6             | 0.664|
| Glomerulonephritis (%)                | 23.7                  | 11.7             | 0.024|
| Diabetic nephropathy (%)              | 12.3                  | 18.2             | 0.201|
| Others (%)                            | 37.9                  | 41.6             | 0.571|
| Clinical characteristics              |                       |                  |      |
| Peritoneal dialysis (%)               | 20.6                  | 15.6             | 0.334|
| Dialysis vintage (months)             | 16.8 ± 15.9           | 16.3 ± 15.4      | 0.795|
| Previous transplant failure (%)       | 16.7                  | 16.9             | 0.965|
| Haemoglobin (g/dl)                    | 12.2 ± 1.5            | 12.1 ± 1.4       | 0.614|
| Albumin (g/l)                         | 38.1 ± 4.8            | 38.6 ± 5.4       | 0.465|
| CRP (mmol/l)                          | 14.2 ± 33.3           | 12.6 ± 24.1      | 0.741|
| Total cholesterol (mmol/l)            | 4.2 ± 1.3             | 4.3 ± 1.2        | 0.559|
| SBP (mmHg)                            | 140.9 ± 21.2          | 142.7 ± 22.3     | 0.544|
| DBP (mmHg)                            | 76.4 ± 12.6           | 80.4 ± 12.8      | 0.029|
| BMI (kg/m²)                           | 25.3 ± 4.4            | 23.8 ± 5.8       | 0.021|
| Comorbidity                           |                       |                  |      |
| Diabetes (%)                          | 24.4                  | 29.9             | 0.348|
| CCI                                   | 6.4 ± 2.4             | 6.3 ± 2.7        | 0.880|
| CCI without age                       | 3.7 ± 1.6             | 4.3 ± 2.1        | 0.006|

CRP = C-reactive protein; SBP = systolic blood pressure; DBP = diastolic blood pressure; BMI = body mass index; CCI = modified Charlson Comorbidity Index.

significant differences in HRQoL scores between non-smokers and smokers. The scores were reduced for bodily pain, general health, vitality and social function in smokers (Table III). Mental health, and mental component summary scores were also lower in smokers. Furthermore, smokers reported worse scores in the kidney-related scales than non-smokers on symptoms, effect of kidney disease, quality of social interaction, sleep and social support. BDI and CDI scores also differed significantly between the two groups; almost twice as many smokers as non-smokers had clinically significant depression (Table III).

In multiple linear regression analysis, with the log-transformed BDI score as the dependent variable, current smoking, younger age, poorer scores on effect of kidney disease, social support and symptoms were independently associated with higher BDI score (Table IV).

When entering the log-transformed CDI score as the dependent variable in a similar way, current smoking (unstandardized $\beta = 0.146$, 95% CI 0.046 to 2.46, $p = 0.005$), younger age ($p = 0.028$), lower education ($p = 0.004$), being divorced/separated ($p = 0.006$), higher comorbidity ($p = 0.001$), and poorer scores on effect of kidney disease ($p < 0.001$), social support ($p < 0.001$), sleep ($p = 0.002$) and symptoms ($p = 0.007$) were all independently associated with higher CDI scores; the regression model yielded an unadjusted $R^2 = 0.495$. MCS was independently associated with smoking (unstandardized $\beta = -4.622$, 95% CI $-7.544$ to $-1.699$, $p = 0.002$, adjusted $R^2 = 0.030$), but not with other sociodemographic or clinical variables. PCS was not associated with smoking.

**Discussion**

The data on HRQoL, measured by the SF-36 in the Norwegian dialysis population, are consistent with the findings from other European countries, Canada and the USA, showing significantly lower HRQoL than the general population [8, 35–37]. In contrast to some studies [38, 39], but in accordance with others [40, 41], this study observed that increasing age attenuated the self-assessed HRQoL differences between the dialysis patients and the general population. In particular, female dialysis patients in the highest age quartile reported similar scores as age- and gender-matched norms on all SF-36 subscales except for general health perception. Several dimensions of HRQoL seemed better preserved in the older patients. The observation that elderly people can adapt better emotionally to ESRD than younger patients is consistent with the findings reported by DeOreo [8], but contrasts with those of other studies [3, 42, 43].

Depression was highly prevalent in the present dialysis patients, supporting the observations of previous studies [44–46]. The data showed a BDI total score distribution curve similar to that reported by Kimmel et al. [10].
More than half of the smokers reported clinically significant depression, compared with one-quarter of the non-smokers. Smoking was associated with depression in univariate analysis, and also with both BDI and CDI scores in multivariate analysis. The association was stronger with the CDI, an instrument which excludes the somatic aspects of depression. The reciprocal relationship between smoking and depression is well established through numerous epidemiological studies [12–14, 47], but has not previously been described in dialysis patients. Because depression is more common in smokers, it has been suggested that a common genetic background may predispose for both problems [48]. Smoking, being a marker of lower priority of health, has been found to predict non-compliance with prescribed treatment in chronic dialysis patients [19]. If considering smoking as a sign of non-compliance or as a maladaptive coping strategy to experienced loss and burden, well-targeted interventions (depression screening and treatment and/or smoking cessation programmes) seem clinically meaningful.

Data from the Dialysis Outcomes and Practice Pattern Study (DOPPS) have shown that depression affects morbidity and mortality [49, 50]. These and other observations [51] have raised the need for more knowledge about the treatment approaches for depression in this patient group. Whether HRQoL would be improved and depressive symptoms alleviated by smoking cessation in dialysis patients is not known. Smoking cessation did not improve HRQoL in women in the Nurses’ Health Study, but smokers did have an inferior HRQoL compared with non-smokers [52]. Smokers who are depressed seem less likely to quit smoking [53–55]. Be that as it may, smoking cessation should be encouraged in dialysis patients as a preventive effort for cardiovascular disease. It is discouraging that one-quarter of the dialysis patients were smokers, and nearly one-third of the younger dialysis patients were smokers, a higher proportion than in comparable age groups in the general population, according to Statistics

|            | Female patients | Female Norwegian references | p     | Male patients | Male Norwegian references | p     |
|------------|-----------------|-----------------------------|-------|---------------|---------------------------|-------|
|            | (n = 102)       | (n = 1184)                  | p     | (n = 199)     | (n = 1127)                | p     |
| Physical function | 49.9 ± 28.5     | 84.8 ± 20.8                 | <0.001 | 56.7 ± 27.4   | 89.8 ± 15.5               | <0.001 |
| Role limitation because of physical problems | 26.5 ± 38.1     | 75.4 ± 37.7                 | <0.001 | 24.0 ± 35.0   | 80.5 ± 33.6               | <0.001 |
| Bodily pain | 52.7 ± 31.2     | 73.0 ± 26.6                 | <0.001 | 60.1 ± 26.3   | 77.2 ± 25.0               | <0.001 |
| General health | 41.7 ± 24.0     | 76.3 ± 22.5                 | <0.001 | 44.0 ± 21.2   | 77.4 ± 21.3               | <0.001 |
| Vitality   | 42.9 ± 24.3     | 56.9 ± 21.2                 | <0.001 | 44.4 ± 20.4   | 63.2 ± 19.9               | <0.001 |
| Social function | 65.6 ± 28.3     | 83.7 ± 23.1                 | <0.001 | 66.2 ± 28.3   | 87.6 ± 20.9               | <0.001 |
| Role limitation because of emotional problems | 57.1 ± 44.1     | 79.1 ± 34.6                 | <0.001 | 52.6 ± 43.0   | 84.5 ± 29.7               | <0.001 |
| Mental health | 72.6 ± 19.7     | 77.6 ± 17.0                 | 0.005 | 75.5 ± 17.7   | 80.0 ± 15.8               | <0.001 |

Figure 2. Mean differences in Short Form-36 (SF-36) subscale scores between dialysis patients and age-matched Norwegian references for males (filled bars) and females (open bars) in the lowest and highest age quartiles. PF = physical function; RP = role limitation because of physical problems; BP = bodily pain; GH = general health; VT = vitality; SF = social function; RE = role limitation because of emotional problems; MH = mental health.
Table III. Health-related quality of life assessed by Kidney Disease Quality of life Short Form and depression assessed by Beck Depression Inventory (BDI) and Cognitive Depression Index (CDI), in smoking and non-smoking dialysis patients.

| SF-36 scales                          | Non-smokers (n = 224) | Smokers (n = 77) | p     |
|---------------------------------------|-----------------------|-----------------|-------|
| Physical functioning                  | 55.5 ± 27.7           | 51.9 ± 28.2     | 0.339 |
| Role limitation because of physical problems | 24.3 ± 35.6           | 26.9 ± 37.3     | 0.586 |
| Bodily pain                           | 60.2 ± 26.9           | 50.6 ± 30.9     | 0.010 |
| General health                        | 46.2 ± 22.0           | 34.5 ± 20.5     | <0.001|
| Vitality                              | 45.8 ± 21.5           | 38.3 ± 22.1     | 0.010 |
| Social function                       | 68.1 ± 26.9           | 59.9 ± 31.4     | 0.029 |
| Role limitation because of emotional problems | 56.4 ± 42.9 | 47.9 ± 44.1 | 0.146 |
| Mental health                         | 77.0 ± 16.7           | 67.6 ± 21.1     | <0.001|
| SF-36 dimensions                      |                       |                 |       |
| PCS                                   | 37.1 ± 10.4           | 35.7 ± 10.2     | 0.331 |
| MCS                                   | 48.7 ± 10.3           | 44.1 ± 12.2     | 0.002 |
| Specific kidney-related scale         |                       |                 |       |
| Symptoms                              | 74.5 ± 14.6           | 66.9 ± 17.7     | <0.001|
| Effects of kidney disease             | 68.4 ± 18.6           | 59.0 ± 22.5     | 0.001 |
| Burden of kidney disease              | 36.8 ± 25.2           | 34.1 ± 26.6     | 0.418 |
| Work status                           | 15.7 ± 29.8           | 13.2 ± 27.5     | 0.509 |
| Cognitive function                    | 85.5 ± 17.5           | 82.8 ± 17.3     | 0.242 |
| Quality of social interaction         | 83.6 ± 17.4           | 75.6 ± 18.4     | 0.001 |
| Sexual function                       | 62.1 ± 33.6           | 57.3 ± 35.4     | 0.436 |
| Sleep                                 | 64.4 ± 20.3           | 57.0 ± 21.1     | 0.007 |
| Social support                        | 80.8 ± 25.8           | 73.5 ± 26.7     | 0.035 |
| Dialysis staff encouragement          | 84.5 ± 17.9           | 83.4 ± 18.5     | 0.684 |
| Patient satisfaction                  | 81.1 ± 20.0           | 80.2 ± 19.1     | 0.742 |
| Depression                            |                       |                 |       |
| Total BDI score                       | 10.1 ± 6.9            | 15.2 ± 9.4      | <0.001|
| CDI score                             | 5.0 ± 5.0             | 8.9 ± 6.8       | <0.001|
| Depression (BDI) (%)                  | 26.4 ± 52.8           |                 | <0.001|

SF-36= Short Form 36; PCS = Physical component summary score; MCS = Mental component summary score.

Norway [56]. Smoking has declined steadily during the past decade in the Norwegian population according to yearly surveys. Whether this is reflected in the dialysis population is not known.

The differences in HRQoL subscales scores measured with the SF-36 between smokers and non-smokers were modest. There was no difference in the PCS scores, while MCS scores were clearly lower in smokers, and this pattern persisted after adjustments in multivariate analysis. This is in contrast to the finding that smoking in HIV-infected patients was associated with poorer physical, mental and social well-being [57]. The pronounced deterioration in PCS score regularly seen in dialysis patients could possibly have masked an effect of smoking on physical well-being. The reduction in PCS scores has been shown to be much more pronounced in patients with ESRD than in patients with other chronic illnesses [42]. Yet another explanation for the lack of reduction in reported PCS score among smokers could be that non-compliant dialysis patients tend to judge themselves as physically healthier but less mentally healthy than compliant patients [8, 19, 20]. The latter could partly explain the observation that social function and quality of social interaction are reduced in smokers compared with non-smokers. As previously shown by Unruh et al., current smoking was associated with poor sleep quality [18]. In keeping with that, the present data show that current smokers report worse sleep than non-smokers on the kidney-related scales.

There are limitations in this study that should be taken into consideration when interpreting the data. The cross-sectional design does not allow a causal link to be demonstrated between smoking and depression; it only serves to highlight the association. The information regarding smoking was collected in different ways, and complete data regarding current smoking status were obtained for all patients. The inclusion criteria for study participation may have led to a selection bias toward healthier dialysis patients as recent hospitalization or intercurrent disease led to exclusion. However, a strength of this study is that the patients comprised almost one-third of the total dialysis population in Norway. Age, gender, cause of renal failure, prevalence of diabetes and coronary artery disease were comparable to those reported for the total Norwegian dialysis population. All of the study patients were Caucasians except for seven patients, of whom six were of Indian or Pakistani origin and one was from Africa.

In conclusion, the study shows that reduced self-experienced HRQoL and a high level of depressive symptoms are present in Norwegian dialysis patients. The observations that poor perceived mental health and higher level of depression are associated with current smoking suggest that aspects of health behaviour may be possible targets for interventions aimed at improving well-being and outcome in this patient population. Although smoking cessation should be encouraged to assist cardiovascular disease prevention in dialysis patients, this may be difficult to achieve as depressive symptoms are highly prevalent. This complex therapeutic challenge should be addressed further in prospective clinical trials.
Table IV. Multiple regression analysis with log-transformed BDI score as dependent variable to show the associations with current smoking, sociodemographic, clinical and HRQoL variables.

| Variable                                      | β (95% CI) | p       |
|-----------------------------------------------|------------|---------|
| Current smoking (yes/no)                     | 0.156 (0.008, 0.305) | 0.039   |
| Age                                          | 0.007 (0.002, 0.011)  | 0.003   |
| Log-transformed CCI without age              | -0.133 (-0.289, 0.022) | 0.093   |
| Social support                                | -0.005 (-0.007, -0.002) | <0.001  |
| Effect of kidney disease                      | -0.015 (-0.019, -0.011) | <0.001  |
| Symptoms                                     | -0.012 (-0.017, -0.007) | <0.001  |

The regression model yielded an adjusted R² = 0.505. Unstandardized beta coefficients are given. The following variables were excluded by backward selection: gender, education > 12 years (yes/no), divorced/separated (yes/no), unable to work (yes/no), dialysis vintage, haemoglobin, albumin, body mass index, physical component summary score and quality of social interaction. BDI = Beck Depression Inventory; HRQoL = health-related quality of life; CI = confidence interval; CCI = modified Charlson Comorbidity Index.

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