Self-assessed physical and mental function of haemodialysis patients

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Abstract

Background. Physical (PCS) and mental (MCS) component summary scales of the Short Form 36 (SF-36) health survey are validated measures of quality of life (QOL) and functional status. We sought to evaluate the PCS and MCS in haemodialysis patients as compared to the general population and other chronic diseases.

Methods. A cohort of 134 haemodialysis patients (mean age 60.9 ± 14.3 years, males 63.4%, Caucasians 66.4%) was followed from January 1996 to December 1998 (mean follow up 14.5 ± 5.7 months). SF-36 questionnaires were administered every 3 months and PCS and MCS were calculated. Results were compared to the general population and other chronic diseases. Correlators of PCS and MCS, change in QOL over time, and the correlators of this change were determined.

Results. Mean PCS was 36.9 ± 8.8 and mean MCS was 47 ± 10.7. Compared to the general US population, these represent a decline of 8.7 ± 0.8 for PCS (P < 0.0001) and 2.7 ± 0.8 for MCS (P < 0.001). PCS and MCS in end-stage renal disease (ESRD) were lower than in most other chronic diseases studied. Univariate correlators of PCS in haemodialysis patients included age, male sex, haematocrit, serum albumin, and severity of comorbid cardiac and pulmonary illnesses. Multivariate analysis demonstrated independent correlators of PCS to be male sex, serum albumin and severity of comorbid cardiac and pulmonary diseases. Univariate as well as multivariate correlators of MCS included: serum albumin, KT/Varea, and status living alone. A trend analysis revealed that both PCS and MCS tended to decline in the initial months of dialysis but stabilized over time. Status living alone was a significant predictor of improvement in MCS by univariate as well as multivariate analysis.

Conclusions. Self assessed physical and mental health of haemodialysis patients is markedly diminished compared to the general population and other chronic diseases.

Keywords: quality of life; SF-36; end-stage renal disease; haemodialysis; depression; co-morbidity

Introduction

Recently there has been growing recognition of health-related quality of life (QOL) as an important indicator of the quality of care for patients with various illnesses. For patients with end-stage renal disease (ESRD), chronic maintenance haemodialysis successfully prolongs life span. A broader goal, however, is to optimize the patient’s self perceived sense of well being and quality of life. Studies comparing QOL between dialysis patients and the general population generally note the negative impact of renal disease and its treatment on patients’ lives [1–6], although this is not confirmed by all studies [7,8].

The SF-36 health survey questionnaire is a self administered standardized assessment of QOL and functional status. It was developed and extensively evaluated as part of the Medical Outcomes Study [9], and contains essential psychometric criteria that have been shown to be both reliable and valid in a variety of chronic disease states [10,11]. It has recently been used in the dialysis population to evaluate self-perceived health status [1,3,5,6,12]. We chose to use this tool because of an ample literature supporting its validity, and its ease of administration and interpretation. The responses to items on the SF-36 questionnaire are summed into eight scales of health: physical function (PF), social function (SF), limitation in role due to physical health (RP), limitation in role due to mental health (RE), mental health (MH), vitality (VT), bodily pain (BP), general health (GH). In clinical practice we have found it difficult to use eight separate measures to meaningfully guide the detection and treatment of health status problems. We were intrigued by the development and validation by John E. Ware of summary scores based on the SF-36 to aggregate the eight scale scores into a physical component summary score.
score (PCS) and a mental component summary score (MCS) [10]. The purpose of this study was to compare the PCS and MCS in haemodialysis patients to the general population and other chronic diseases, to determine correlates and to evaluate the change in scores over time.

**Subjects and methods**

**Patient population**

The study was performed at Winthrop-University Hospital, Mineola, NY, outpatient dialysis centre. At the time of study, the centre treated approximately 191 haemodialysis patients, with most on a thrice-weekly dialysis regimen. The SF-36 questionnaire was administered to all patients every 3 months starting in January 1996. For the purpose of this study we have extracted data on all patients dialysed in the period between January 1996 and February 1998, who neither died nor were transplanted. The recruitment rate was 100% at the start of the study. All patients were dialysed with conventional, single use, high-efficiency polysulfone dialysers using bicarbonate dialysate. The study protocol and informed consent were approved by the institutional review board of Winthrop-University Hospital.

**Quality of life assessment and study design**

Renal social workers were instructed and trained on the use and purpose of the SF-36. They distributed the SF-36 questionnaire every 3 months to all haemodialysis patients. Patients were given a brief explanation of the questionnaire and were asked to complete it during regularly scheduled dialysis treatments. Assistance was given for patients who were illiterate or had a language problem. For those with diminished vision, a large font version of the SF-36 was given. The surveys were scored by hand, and the data were entered on a Microsoft Excel spreadsheet which was updated monthly.

The SF-36 is a 36-question instrument consisting of eight scales to measure physical and mental dimensions of health status. The eight scales are: PF, RP, BP, GH, VT, SF, RE, MH. The scales are scored on a 0–100 possible range. The above scales can be summarized into two component summary scores which aggregate the physical and mental components of the eight scale profile of SF-36 into PCS and MCS scores. The PCS reflects physical morbidity and adaptability to disease, whereas the MCS reflects psychological or mental morbidity and adaptation. The component summary scores are positively scored and normalized to a general population mean of 50 and a standard deviation of 10.

We calculated the PCS and MCS scores for each patient with the help of SAS code for scoring algorithms provided by the Medical Outcome Trust [10].

**Comorbidity information and demographics**

Demographic data (age, sex, ethnicity), duration of haemodialysis, prescribed dialysis time, underlying aetiology of ESRD, and marital status were recorded for each patient by a blinded investigator. Level of education was graded as: 1, illiterate; 2, can only read and write; 3, completed primary studies; 4, high school; and 5, university studies or higher.

Presence of comorbid illness (cardiac, pulmonary and peripheral vascular disease) was also graded and recorded by disease type as: grade 0, no past or present illness; grade 1, no current symptoms but positive disease prior to 6 months; grade 2, presence of mild symptoms within the past 6 months; and grade 3, moderate to severe symptoms within the past 6 months. Total number of hospitalizations and hospital days during the study period were recorded.

**Dialysis indicators**

The mean (during the study period) serum albumin, haematocrit, KT/Vurea, normalized protein catabolic rate (nPCR) and urea reduction ratio (URR) were followed for all patients.

**Statistical methods**

Univariate analysis of mean PCS and MCS was performed with Spearman correlation coefficients. Multivariate analysis used stepwise regression to obtain the most efficient equation. Comparisons between this study cohort and the general population, and in relation to other chronic diseases, were performed using algorithms of the Medical Outcomes Trust [10]. Rate of change in PCS and MCS over time was computed in two ways: first by obtaining the slope with time using all observations for each patient; second by subtracting the baseline from the final value, and dividing by the time between those readings. The results from both analyses were the same, and, for simplicity, the later analysis is reported here. All results are reported as mean ± standard deviation. Statistical significance was considered to be a P value of <0.05.

**Results**

One hundred and ninety-one haemodialysis patients were entered into the initial dataset. Of these, 45 patients who had incomplete or single SF-36 scores were excluded. The reasons for incomplete record were: inability to speak English in 12 patients; unwillingness to answer the questionnaire in 20 patients; and/or unsuitability due to cognitive impairment in 17 patients. Patients who were excluded did not differ significantly from those included in the study except for a higher number of diabetes (23 out of 45) in the excluded patients. Of the remaining 146 patients with at least two complete scored questionnaires, three were transplanted and nine patients died during the study period, and were excluded from the analysis. This was done to include only those patients who were stable and completed the 2-year study period. Thus, we report on 134 patients with at least two scored questionnaires (range 2–8 per patient). The mean time interval between first and last SF-36 scores was 14.5 ± 5.7 (range 3–24) months. Descriptive statistics including demographics and clinical information are presented in Table 1. The mean PCS was 36.9 ± 8.8 (range 18.1–56.7, median 36.3) and MCS was 48.7 ± 9.3 (range 20.3–67.5, median 50.7).
Impact of ESRD on physical and mental health as compared to the general population

There was a significant reduction in both PCS and MCS of ESRD patients as compared to that expected of healthy subjects (Table 2). For PCS, the age and sex adjusted score was 8.7 ± 0.8 points lower than that of the general US population (P < 0.00001) and for MCS the score was 2.7 ± 0.8 points lower (P < 0.001). Study patients of all ages rated their PCS to be significantly worse than their healthy counterparts, except for those >75 years of age. In general, there was a trend towards reduced PCS scores with age. Male patients were found to have PCS scores 4.6 points above their female counterparts (P < 0.05), while MCS scores were not significantly different between the sexes.

Impact of ESRD on physical and mental health as compared to other chronic diseases

PCS scores were significantly lower in haemodialysis patients as compared to patients with chronic angina, diabetes mellitus, chronic lung disease, arthritis, hypertension, cancer and depression (Figure 1). The MCS score was also significantly lower in haemodialysis patients than in several chronic diseases including diabetes, chronic angina, limitation in the use of a limb, and hypertension. In contrast, the MCS scores for patients with chronic depression were significantly lower than that found in haemodialysis patients (Figure 2).

Correlators of the physical and mental component summary scores

On univariate analysis, variables which significantly predicted a better PCS score were male sex (r = 0.25, P = 0.004), higher haematocrit (r = 0.19, P = 0.03), and a higher level of serum albumin (r = 0.3, P = 0.0005). In contrast, older age (r = −0.17, P = 0.05), diabetes as the cause of ESRD (r = 0.18, P = 0.036), severe cardiac (r = −0.21, P = 0.013) and pulmonary disease (r = −0.29, P = 0.0007) were inversely correlated with PCS. Higher number of hospitalizations and hospital days trended towards predicting lower PCS scores, but did not achieve statistical significance. Dialysis adequacy measured by K/\(V_{\text{urea}}\) (r = 0.16, P = 0.06) and a higher serum albumin (r = 0.15, P = 0.08) trended towards predicting a better MCS score but without reaching statistical significance. Individuals living alone had a higher MCS (r = 0.18, P = 0.042) than those living with others.

Serum level of albumin was the strongest correlate of PCS on multivariate analysis (Table 3) with 8.8% of the variation in PCS explained by the serum albumin.
Fig. 1. Effect of chronic diseases on PCS.

Fig. 2. Effect of chronic diseases on MCS.
We found that every 1 mg/dl increase in serum albumin is reflected by a 1.2 point increase in PCS.

Hospitalizations
Over the 2-year study period, 89 out of 134 patients (66.4%) were hospitalized. The average length of hospital stay was 12.2 ± 21.1 days. Patients who were hospitalized had a significantly lower mean baseline PCS and MCS than patients who were never admitted (35.8 ± 8.6 vs 39.2 ± 8.8 PCS respectively, \( P < 0.05 \); and MCS 47.3 ± 9.4 vs 51.3 ± 8.7, \( P < 0.05 \)). The odds ratio for hospitalization was 1.92 (95% confidence interval 0.91–4.01, \( P = 0.08, \chi^2 \)) when the PCS score was lower than the median value of 36.3.

### Table 3. Correlators of PCS and MCS (multivariate analysis)

<table>
<thead>
<tr>
<th>Variable</th>
<th>PCS Slope (95% CL)</th>
<th>( P )</th>
<th>MCS Slope (95% CL)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex</td>
<td>3.2 (0.3,6.1)</td>
<td>0.022</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Living alone</td>
<td>NS</td>
<td>NS</td>
<td>5.3 (1.1,9.5)</td>
<td>0.042</td>
</tr>
<tr>
<td>Cause of ESRD (not diabetes)</td>
<td>2.2 (0.4,4.0)</td>
<td>0.043</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Severity of cardiac disease</td>
<td>-1.4 (–2.6,–0.2)</td>
<td>0.026</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Severity of pulmonary disease</td>
<td>-4.9 (–8.7,–1.1)</td>
<td>0.003</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>KT/Vurea</td>
<td>NS</td>
<td>NS</td>
<td>5.6 (0.4,10.8)</td>
<td>0.037</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>5.3 (1.1,9.5)</td>
<td>0.0005</td>
<td>5.3 (0.7,9.9)</td>
<td>0.033</td>
</tr>
</tbody>
</table>

Total \( r \) squared 0.24 (PKCS); 0.10 (MCS); CL, confidence limit.

**Rate of change of PCS and MCS over time**

The mean rate of change of PCS (0.08 ± 0.89/month, range −2.13 to 3.92, median 0.08) and MCS (0.1 ± 0.94/month, range −2.49 to 3.11, median 0.09) scores over time were not significantly different from zero (Figure 3). Rate of change scores in individual patients were categorized as improved, unchanged, or worsened by determining whether the patient’s rate of change was within or outside of the 95% confidence bands for group rate of change scores. Approximately one-half of patients stayed the same physically (50.7%) or mentally (53.7%) over the study period. A slightly greater percentage declined (26.1%) in physical health status than improved (23.1%) while the reverse was true for mental health (27.6% improved and 18.7%...
declined). None of these categorical changes were statistically significant.

**Correlators of change of PCS and MCS over time**

By univariate analysis, number of months on dialysis had an inverse relationship with the change in PCS ($r = -0.21$, $P = 0.01$) as well as change in MCS ($r = -0.19$, $P = 0.03$) scores. When the PCS and MCS scores were plotted against time on dialysis, both showed a regression to the mean (Figure 3). By multivariate analysis, months on dialysis proved to be the only independent predictor of change in both PCS and MCS over time (Table 4). A living status of living alone was an independent predictor of improvement in MCS with time (Table 4).

**Discussion**

The metrics used in the study, the PCS and MCS scores of the Short Form-36 profile, proved easy to work with and analyse. In clinical practice, we have found the summary scores to be of greater use compared to the eight individual SF-36 scales. The PCS and MCS scores allow the physician to rapidly assess whether the health needs of importance to the patient are being met. If either score is low, the individual SF-36 scales can be used to focus further investigation. For the purpose of research, utilizing the summary scores in contrast to using the eight individual SF-36 measures, makes it possible to reduce the number of statistical comparisons and thereby the role of chance in testing hypotheses [10]. Validation studies make it clear that little information is lost when aggregating the eight component scores into the PCS and MCS [10,11]. We sought, therefore, to establish the range of values of the PCS and MCS in haemodialysis patients, to evaluate how these scores change over time, and to determine the importance of various factors that may impact on patients’ perceived health status.

The haemodialysis patients studied had a significant reduction in self-assessed physical and mental health compared to the general population. Interestingly, the reduction in scores compared to normals was greater for physical rather than mental health. This finding is in agreement with other reports of studies of functional health status of haemodialysis patients [6,12]. A greater effect on self assessed physical compared to mental health has also been found in other chronic diseases [13]. It may be that with chronic disease, the impact on aspects of self-assessed mental health may become blunted with time, as a useful psychological adaptation.

The disease states previously reported to cause the greatest reduction in measured PCS (6–8 points range) have been congestive heart failure (CHF) and limitation in the use of an arm or leg [10]. The effect of CRF and haemodialysis on perceived physical health were found in our study to exceed the effect of both of these chronic diseases (Figure 1). We found several factors that explained this reduction in PCS scores in haemodialysis patients, including female sex, diabetes as the cause of ESRD, severe comorbidity due to pulmonary or cardiac disease, and the strongest predictor was low levels of serum albumin. The importance of female sex will be discussed in a later section. The association of diabetic kidney disease and severe cardiac with pulmonary disease, points to the important detrimental effect of comorbid factors superimposed on chronic renal failure in reducing the patients’ perceived physical health [14]. The serum albumin remains a powerful, yet enigmatic predictor of poor outcomes in ESRD [15]. In recent years, a body of evidence has accumulated suggesting that a low serum albumin concentration reflects the presence of inflammation and malnutrition [16]. The association we have found between serum albumin and patients’ perception of their physical health is consistent with the general perception that low serum albumin levels may reflect poor overall physical health.

As was true for PCS scores, we found MCS scores in haemodialysis patients to be decreased compared to the general population and certain chronic diseases such as angina pectoris and diabetes mellitus. The need for haemodialysis treatment imposes a significant psychosocial burden on patients. Aside from the time commitment, the increased dependence on family members, and the anxiety that the treatment causes, many patients feel tired or depressed after treatments. We found that a lower KT/V and serum albumin concentration independently predicted a reduction in MCS. The complexity of interpreting the albumin effect has already been discussed. The effect of lower levels of KT/V is interesting, and suggests the value of including MCS as an outcome variable in studies of dialysis adequacy.

An MCS score of $\leq 42$ has a sensitivity and specificity of 73.7% and 80.6% respectively to diagnose clinical depression [10]. We found that one out of four haemodialysis patients met this criterion, a prevalence...
of depression similar to that found in other reports in haemodialysis patients [4,6]. Depression impacts on loss of well being to the same degree as chronic medical illness [13] and may also contribute to mortality in haemodialysis patients [17]. The MCS may provide an easy screen to identify haemodialysis patients at risk for clinical depression who require further evaluation.

We found lower PCS scores in female compared to male patients on haemodialysis. It is of interest that this pattern has also been found in studies of the general US population, where the mean PCS score is 2.0 points higher in men than women. This difference by sex does not emerge until after age 24 [10,18]. Other investigators have noted that female sex is associated with a reduced quality of life in ESRD [19,20]. In fact, these investigators found the impact of female sex on physical function to be roughly equivalent to the effect of having diabetes mellitus. The reason for this gender difference remains speculative. Possible explanations could include biological factors or cultural conditioning, biases in the provision of care according to sex [21], or the effect of differences in clinician’s attitude toward female patients [22]. This is an area that is poorly understood and one that needs additional study.

The effect of age on PCS and MCS in the general population indicates that PCS begins to decline significantly in the 5th decade, whereas MCS stays stable throughout all age groups [10]. Our study of haemodialysis patients confirms a similar pattern. There was a roughly linear decline in PCS with age, but MCS scales remained relatively stable in older subjects. In a previous study, DeOreo found that MCS increased significantly in older dialysis patients [6]. It may be that with older age, patients are better able to adapt emotionally for their chronic disease, based on their wealth of life experience. It should be noted, however, that other investigators have found that self-assessed mental function of dialysis patients may actually decrease with age [19,23,24].

The availability of social support can affect both survival and health-related QOL of dialysis patients. Perceived social support has been independently and positively associated with a better perception of illness, life satisfaction, and feeling about life in general [25,26,27]. Surprisingly, we found that living alone independently predicted a better MCS score in the present investigation. None of the other social factors studied, including level of education and marital status, correlated with physical or mental health. Better self-assessed mental status of a patient on maintenance dialysis living alone may partially be due to difficulties in coping with family responsibilities and increased dependence [28]. Patients’ autonomy and control associated with aspects of self-care process might be an additional factor [29].

We could not find any correlation between measures of dialysis adequacy (KT/V urea, URR, and nPCR) or prescribed dialysis time and PCS, MCS, however, had a mild positive correlation with KT/V urea on multivariate analysis. Similarly Kurtin et al. [1] and Morton et al. [30], using the RAND 36 item health survey, failed to show any relationship between dialysis adequacy and any of the domains of HRQOL. In another study which used the SF-36 to measure HRQOL, no significant association was observed between dialysis KT/V urea and scale scores [5]. Another important variable, haematocrit, has recently been demonstrated to positively influence QOL in dialysis patients [5,12,19]. Our study confirmed a positive impact of haematocrit on PCS. This effect, however, was not evident on multivariate analysis.

A practical use of functional health status measures is to estimate changes over time and evaluate the impact of various treatment interventions. As an example, significant improvement in various physical and emotional scales have been reported as a result of treatment with rHuEPO [12,31]. Overall, we found no significant mean change in self-assessed physical or mental health of our patients during the 2-year study period (Figure 3). Both PCS and MCS tended to decline in the initial months of dialysis but stabilized over time. Norms for 1-year change scores for various chronic conditions also follow a similar pattern [10]. Despite not finding a change in mean scores, we did find that 23.1% (PCS) and 27.6% (MCS) of patients had improvement in scores over time. Months on dialysis and status living alone were the two most important variables that independently predicted an improvement. Of note, none of the other important clinical variables like KT/V, URR, nPCR, haematocrit, serum albumin, level of education, severity of comorbidity or number of hospitalizations predicted a change in self-assessed physical or mental health.

In summary, we have found the component summary scales of SF-36 health survey to be user friendly and easy to interpret. The results indicate the important negative impact that chronic renal failure and haemodialysis treatments have on self-assessed mental and physical health. We suggest that research in ESRD should focus more on patient-assessed health outcomes such as those provided by the SF-36 questionnaire.

References


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