
Health-Related Quality of Life Predictors of Survival and Hospital Utilization

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The health-related quality of life (HRQOL) of 103 end-stage renal disease (ESRD) patients on hemodialysis was studied for prediction of 1-year survival and hospital days in the context of other predictors. Higher HRQOL physical functioning, higher provider-reported functional performance, fewer private religious activities, living with family, black race, and having a diagnosis of hypertension predicted survival. Lower HRQOL energy, higher pain, and not living with family predicted more hospital days. Patients living with family reported more social support and better HRQOL general health, emotional well-being, social health, and quality of social interactions than other patients.

INTRODUCTION

In recent years there has been increasing interest in the HRQOL of patients with ESRD (Rettig et al., 1997; Rettig and Sadler, 1997). HRQOL has been shown to be important not only as an outcome of medical care for these patients, but also to be a predictor of survival and hospital utilization. Now one of the research issues is the relative predictive strength of HRQOL factors vis-a-vis other psychosocial factors and known demographic and pathophysiologic factors.

Most research on predictors of survival has focused on demographic and pathophysiologic factors, indicating that positive predictors of survival include younger age,

female sex, black race, absence of diabetes mellitus and cardiovascular disease, higher serum albumin, and adequate dose of dialysis (Plough et al., 1985; Lowrie and Lew, 1990; McClellan, Flanders, and Gutman, 1992; Churchill et al., 1992; Brogan, Kutner, and Flagg, 1992; Owen et al., 1993; Hakim et al., 1994; Held et al., 1996; Excerpts from the United States Renal Data System, 1998). Other studies have implicated most of these same factors as negative predictors of greater hospital utilization (Churchill et al., 1992; Brogan, Kutner, and Flagg, 1992; Hakim et al., 1994; Ifudu et al., 1996; Morduchowicz and Boner, 1996; Thamer et al., 1996; Rocco et al., 1996; Becker et al., 1997; Lowrie et al., 1998).

Early studies on the effect of psychosocial factors used the Karnofsky Performance Index of provider-assessed functional status (Karnofsky and Burchenal, 1949) as an outcome measure and found that absence of diabetes (Gutman, Stead, and Robinson, 1981) and renal transplantation (Evans et al., 1985) were predictors of higher performance scores. More recent studies have used the Karnofsky index to predict outcomes. For example, higher Karnofsky scores have been shown to predict survival (Husebye, et al., 1987; McClellan et al., 1991), and lower scores to predict increased risk of hospitalization (Ifudu et al., 1996).

In contrast to the provider-reported Karnofsky, HRQOL psychosocial measures reflect perspectives of patients, and provide not only general information about health and function, but also specific data

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on physical, emotional, and social well-being (Rettig et al., 1997). It has become clear that quality of life is complex and requires multiple types of instruments for adequate measurement (Kimmel et al., 1995; Edgell et al., 1996). Research on patient-report HRQOL scales has indicated the following predictors of survival: higher general well-being (McClellan et al., 1991; Kimmel et al., 1995; Edgell et al., 1996; Devins et al., 1990), lower depression (Peterson et al., 1991; Kimmel, Weihs, and Peterson, 1993), and higher physical function (DeOreo, 1997). Also, favorable social environment in terms of patient-reported higher social support predicts survival (McClellan, Stanwyck, and Anson, 1993; Christensen et al., 1994; Holder, 1997; Kimmel et al., 1998). Lower HRQOL physical function and emotional well-being have been found to predict greater hospital utilization (DeOreo, 1997).

As health care providers and dialysis network organizations increase their use of outcomes information to improve medical care for ESRD patients, they need comparative data to show the relative strength of HRQOL factors compared with other psychosocial factors and with the more well-known demographic and pathophysiologic outcome predictors. The present exploratory study compared HRQOL factors with multiple other factors as predictors of 1-year survival and hospital utilization. Survey data were obtained both from the nephrologist provider and from the patients, using multiple survey instruments.

METHODS

Study Design and Study Population

This was a 1-year longitudinal observational study of ambulatory ESRD patients who required hemodialysis three times a week to sustain life. Survey data were col-

lected at baseline, 6 months, and 1 year. Outcome data on survival and hospital utilization were collected during the 1 year following baseline. All patients in three dialysis centers (Freedom Lake Dialysis Center and the West Pettigrew Dialysis Center in Durham, NC, and the Neuse River Dialysis Center in Oxford, NC) were asked to enroll in the study unless they were mentally incompetent, in the hospital, too sick to be interviewed, or already enrolled in another similar study.

Patient-reported survey data were collected by interview while the patients were being dialyzed. After informed consent was obtained, five questionnaires were administered by a trained research assistant who read each of the 143 questions verbatim to each of the patients and recorded their responses. There was sufficient background music and/or noise to protect confidentiality. The questionnaires were: a sociodemographic form, the Kidney Disease and Quality of Life Short Form (KDQOL-SF) (Hays et al., 1994; Hays et al., 1996), the Duke Health Profile (DUKE) (Parkerson, Broadhead, and Tse, 1990; Parkerson, 1999), the Duke Social Support and Stress Scale (DUSOCS) (Parkerson, 1999; Parkerson, Broadhead, and Tse, 1991), and the Duke Religion Index (DUREL) (Koenig, Parkerson, and Meador, 1997). It is important to note that the KDQOL-SF includes the RAND 36-item Health Survey (SF-36) (Hays, Sherbourne, and Mazel, 1993), and that the physical and mental health summary scores of the Short-Form Health Survey (SF-12) (Ware, Kosinski, and Keller, 1995) can be calculated. The sociodemographic form was administered first to all patients, but the sequence of the other four instruments differed among patients by random assignment.

Physician-reported survey data were recorded within 48 hours of collection of patient-reported survey data by one of the attending nephrologists (co-investigator

RG), using the Karnofsky Index to assess the functional status and the Duke Severity of Illness Checklist (DUSOI) (Parkerson, 1999; Parkerson, Broadhead, and Tse, 1993) to assess the severity of illness of each patient. Diagnoses were recorded by the nephrologist at the time of severity of illness assessment. Survival, hospital days, laboratory, and other pertinent data were obtained from the medical records by the research assistant.

Survey Instruments

The 17-item sociodemographic questionnaire asked for personal identification; marital, educational, and work status; number of persons in the household; and living arrangement, i.e., whether living with own family, with others, alone, or in a rest home or nursing home. Items such as name, age, and address, were included not so much for data gathering but rather for estimating the patient's mental orientation. Socioeconomic status was based on education and occupation using the Green Scale (Green, 1970), with possible scores ranging from a low of 28 to a high of 84.

The KDQOL-SF, DUKE, DUSOCS, and DUREL were administered to the patients to measure their perceptions of HRQOL, social environment, and religiosity, and the Karnofsky and DUSOI were completed by the nephrologist to measure physician perception of patient functional performance and disease severity.

The 80-item KDQOL-SF has 12 kidney disease-specific scales and 9 generic scales, i.e., not disease-specific. None of the scales has overlap from sharing the same items. The disease-specific scales are as follows: symptom/problem list (12 items), effects of kidney disease (8 items), burden of kidney disease (4 items), work status (2 items), cognitive function (3 items), quality of social interaction

(3 items), sexual function (2 items), sleep (4 items), social support (2 items), dialysis staff encouragement (2 items), patient satisfaction (1 item), and overall health (1 item). The generic scales are identical to those of the RAND 36-item Health Survey (SF-36) and are as follows: physical functioning (10 items), role-physical (4 items), pain (2 items), general health (5 items), emotional well-being (5 items), role-emotional (3 items), social function (2 items), energy/fatigue (4 items), and change in health (1 item). Scoring range is 0-100, from lowest to highest HRQOL.

The 17-item DUKE has 11 scales, all of which are generic. Five of the scales do not have overlapping items and are as follows: physical health (5 items), mental health (5 items), social health (5 items), perceived health (1 item), and disability (1 item). Six of the scales do have overlapping items and are as follows: general health (15 items), self-esteem (5 items), anxiety (6 items), depression (5 items), anxiety-depression (7 items), and pain (1 item). All of the scales are scored 0-100. Highest scores indicate highest HRQOL for physical, mental, social, general, and perceived health and for self-esteem. Highest scores indicate lowest HRQOL for the other scales.

The 24-item DUSOCS has 6 scales, 4 without overlapping items, and 2 with overlapping items. The first 4 scales are family support (7 items), family stress (7 items), non-family support (5 items), and non-family stress (5 items), and the other scales are total social support (12 items) and total social stress (12 items). Scoring is 0-100, from lowest to highest support or stress.

The 5-item DUREL has 4 scales. The 3 with non-overlapping items are organizational religiosity, i.e., group religious activities (1 item); non-organizational religiosity, i.e., private religious activities (1 item); and subjective or intrinsic religiosity, i.e., per-

sonal religious beliefs (3 items). The scale with overlapping items is overall religiosity (all 5 items). Scoring is 0-100, from lowest to highest religiosity.

The Karnofsky Index has 1 scale with 1 item that has 11 response options, using 10-point increments from 0 for “dead,” to 100 for “normal, no complaints.” The DUSOI has 3 scales: diagnosis severity, comorbid severity, and overall severity. Each diagnosis is rated by the physician along four parameters of severity, i.e., symptom status, complication status, prognosis without treatment during the next 6 months, and treatability (i.e., the expected response to treatment if indicated). The diagnosis severity scores are combined to form the comorbid and overall severity scores. Scoring is 0-100, from lowest to highest severity.

Statistical Methods

Univariate analyses included the chi-square statistic for associations between categorical variables and Student’s *t*-test for differences in mean scores between two groups. Multivariate analyses included logistic regression for prediction of patient survival and linear regression for prediction of hospital days’ utilization. In the regression analyses, because of the relatively small number of patients, only one psychosocial independent variable was added to each set of demographic and pathophysiologic variables that were chosen as control variables, for a maximum of five variables in any one regression for the survival analyses and seven for the hospital days analyses. For all analyses, statistical significance was defined as $\alpha = 0.05$.

The process of selection of independent variables for the regression analyses was as follows:

- Include the demographic factors age, sex, and race in all models, because, even if these variables did not always predict the outcomes in our study patients, they have been shown to be predictors in other studies.
- Select pathophysiologic variables that were found in our study to be statistically significant predictors after controlling for the effects of the three demographic variables. We tested the following, most of which have been shown to be predictive in other ESRD studies: primary causes of renal failure (diabetes, hypertension, and glomerulonephritis); current major diagnoses (diabetes, hypertension, heart disease, coronary arteriosclerotic disease, and depression); key laboratory values (albumin, hematocrit, and Kt/V); and the number of months since beginning dialysis therapy.
- Use the 3 demographic variables plus the selected pathophysiologic variables as the control variables in all subsequent analyses, to which each of the following 55 survey variables were added one at a time in separate analyses: physician survey variables: Karnofsky Index (1 score), and DUSOI (3 scores), and patient survey variables: KDQOL (21 scores), DUKE (11 scores), SF-12 (2 scores), DUSOCS (6 scores), DUREL (5 scores), and the 6 variables: married versus not, living with own family versus not, living alone versus not, number of people in household, high school graduate versus not, and Green socioeconomic score.

RESULTS

Study Patients

Of the 156 hemodialysis patients considered for enrollment in the study, 107 (66.6 percent) signed consent forms, and 103

(66.0 percent) were enrolled after final screening. Of the 103 study patients at baseline, 53.4 percent were female, 68.9 percent were black, 50.5 percent were currently married, 72.8 percent lived with their own families, and 43.7 percent had at least a high school education. Their mean age was 62.6 years (standard deviation [SD]=14.7, range=28.8-93.0), and their mean Green socioeconomic score was 53.9 (SD=10.0, range=32.9-76.7). They had required dialysis for a mean of 36.2 months (SD=35.4, range=0.6-209.8). Their mean serum albumin was 3.9 mg/dl (SD=0.4, range=2.7-5.1); mean hematocrit was 32.7 percent (SD=3.9, range=20.5-48.7); and mean Kt/V was 1.5 (SD=0.2, range=0.8-2.0).

Their most prevalent health problems in addition to ESRD were hypertension 47.6 percent, diabetes mellitus 45.6 percent, depressive disorder 32.0 percent, and coronary atherosclerosis 24.3 percent. When all heart problems including coronary atherosclerosis were grouped together, they made up 38.8 percent of all problems. There was marked overlap of diagnoses among patients. Of the 49 patients with hypertension, 32 also had at least 1 of the other 3 most prevalent health problems. Likewise, 33 of the 47 with diabetes, 24 of the 33 with depression, 21 of the 25 with coronary disease, and 27 of the 40 with heart disease had at least 1 of the other diagnoses. The most frequent causes of renal failure were diabetes 47.6 percent, hypertension 26.2 percent, and glomerulonephritis 8.7 percent.

Prediction of 1-Year Survival

Of the 103 patients at baseline, 18 died by the end of 1 year (survival rate = 82.5 percent). The terminal event was cardiac-related in 50.0 percent, due to infection in 16.7 percent, other causes in 16.7 percent, and unknown in 16.6 percent.

The statistically significant predictors of 1-year survival are shown in Table 1. The strongest predictor was black race, which was the only statistically significant demographic variable. The only pathophysiologic variable to reach significance was hypertension, the presence of which unexpectedly predicted survival. The remaining statistically significant predictors, after controlling for demographic factors and hypertension, were the following psychosocial factors: higher HRQOL physical functioning, higher performance, fewer private religious activities, and living with own family. The odds ratio in the table indicates that n units of change in predictor variable units would increase the chance of survival by odds ratio number (OR^n) times. For example for the variable race in Table 1, where there is only one unit of change between black and white, a black patient was 12.6 times more likely to survive than a white patient ($OR^n = 12.6421 = 12.6$). For the variable HRQOL physical functioning, where there are a possible 100 units of change in the score, a patient with a score 10 points higher than another patient was 1.63 times (63 percent) more likely to survive ($OR^n = 1.05010 = 1.63$).

In all of the analyses, black race was by far the strongest predictor of 1-year survival. The survival rate for the 71 black patients was 93.0 percent, compared with the survival rate of 59.4 percent for the 32 white patients (chi-square=17.3, $p=0.001$). Univariate analyses by race showed that higher physical functioning, higher performance, and fewer private religious activities were statistically significant predictors of survival for black patients but not for white patients. For example, the mean baseline HRQOL physical functioning score was 49.5 (SD=28.3) for black survivors and 17.0 (SD=19.2) for black non-survivors ($t=2.51$, $p=0.01$), compared with 37.3 (SD=24.4) for white survivors and 32.7

Table 1

Predictors of 1-Year Survival for End-Stage Renal Disease Patients on Hemodialysis¹

Variable	Predictor Variables		Logistic Regression Estimates				Full Model of Variables			
	Type	Units	DF	Chi-Square	P-value	Odds Ratio ²	Additional Variables in Model ³	DF	Chi-Square	P-value
	Specific Variable									
Black Race	Demographic	0-1	1	13.8	0.0002	12.642	Age, Sex	3	18.6	0.0003
Hypertension	Pathophysiological (Diagnostic)	0-1	1	6.5	0.01	8.954	Age, Sex, Race	4	25.3	0.0001
Higher Physical Functioning ⁴	Psychosocial (HRQOL Physical)	0-100	1	7.0	0.008	1.050	Age, Sex, Race, Hypertension	5	30.7	0.0001
Higher Performance ⁵	Psychosocial (Provider-Report)	0-100	1	6.3	0.01	1.061	Age, Sex, Race, Hypertension	5	30.0	0.0001
Fewer Private Religious Activities ⁶	Psychosocial (Religiosity)	0-100	1	5.7	0.02	1.030	Age, Sex, Race, Hypertension	5	30.8	0.0001
Living with Own Family	Psychosocial (Social Environment)	0-1	1	4.8	0.03	5.196	Age, Sex, Race, Hypertension	5	29.1	0.0001

¹ N=103.

² The odds ratio (OR) indicates that *n* units of change in predictor variable units would increase the chance of survival by ORⁿ times.

³ In each of the separate logistic regressions with 1-year survival as the dependent variable, the full model of independent variables included the specific variable in the first column plus the control variables listed in this column.

⁴ Kidney Disease Quality of Life Short Form (KDQOL-SF). Scale=0-100.

⁵ Karnofsky Performance Index. Scale=0-100.

⁶ Duke Religion Index (DUREL). Scale=0-100

NOTES: DF is degrees of freedom. HRQOL is health-related quality of life.

SOURCE: Parkerson, G. R. Jr. and Gutman, R.A., Duke University Medical Center, Durham, North Carolina, 1998.

(SD=26.7) for white non-survivors ($t=0.50$, $p=0.63$). On the other hand, the presence of hypertension and living with own family were statistically significant predictors for white persons but not for black persons. For example, while hypertension appeared to be protective in both races, the prevalence in black persons was 59.1 percent for survivors versus 20.0 percent for non-survivors (chi-square=2.9, $p=0.08$), compared with prevalence in white persons of 42.1 percent for survivors and 7.7 percent for non-survivors (chi-square=4.5, $p=0.03$).

Prediction of 1-Year Hospital Utilization

Hospital utilization was measured as the number of hospital days within the 1-year period following baseline. The actual number of days was used in the analyses for the 77 patients who survived 1 year and remained on hemodialysis in a study site. For the other patients (i.e., the 18 who died and the 8 who either transferred to other facilities, were transplanted, or changed to home dialysis) the number of hospital days was estimated from the number of hospital days per day of observation from baseline date to date of stopping hemodialysis at the study sites. The mean number of hospital days during the 1-year period for the 103 patients was 7.9 days (SD=22.0, range=0-201) that resulted from a mean of 1.5 hospitalizations (SD=2.2, range=0-15). Of the total hospital days, a mean of 0.64 days (SD=1.7, range=0-13) were primarily for vascular access problems, and a mean of 7.3 days (SD=22.1, range=0-201) were primarily for medical problems other than vascular access.

As shown in Table 2, all three of the statistically significant predictors of 1-year hospital days for the 103 patients were psychosocial factors, i.e., not living with own family, lower energy/fatigue, and more

pain. Although the family social environment variable was the strongest predictor, the two other predictors were HRQOL factors. For example in Table 2, the energy/fatigue model (i.e., the one in which lower HRQOL energy/fatigue baseline scores were statistically significant predictors and the control variables age, sex, race, and serum albumin were not significant) explained 9.5 percent of the variance (R-square=0.095) in hospital days during the following year. None of the demographic or pathophysiologic variables were statistically significant predictors of hospital days.

Racial and Family Comparisons

Because race was the strongest predictor of survival, and living with one's own family was the only factor that was both a predictor of survival and hospitalization utilization, univariate analyses were done to examine race and living with family more closely. Baseline characteristics of the 103 patients were compared by race. The 71 black patients were younger than the 32 white patients (mean age=59.5, SD=15.0, years; versus 69.4, SD=11.4, respectively; $t=3.33$, $p=0.001$). The Green SES scores were lower for black persons than for white persons (52.6, SD=10.6; versus 56.9, SD=7.8, respectively; $t=2.10$, $p=0.04$). Fewer black persons were married than white persons (43.7 percent versus 65.6 percent, respectively; chi-square=4.3, $p=0.04$), but there was no statistically significant difference in sex, high school graduation status, or whether or not they lived with their families. However, for black persons there were more people other than the patient in each household (mean=1.8, SD=1.6 for black persons versus 1.0, SD=0.7 for white persons; $t=3.52$, $p=0.0007$). There was no statistically significant difference in baseline serum albumin,

Table 2
Predictors of 1-Year Hospital Days for End-Stage Renal Disease Patients on Hemodialysis¹

Variable	Predictor Variables		Linear Regression Estimates			
	Type	Specific Variable	Additional Variables in Model ²	F-value	P-value	R-square
Not Living with Own Family	Psychosocial (Social Environment)	t-value 2.67 P-value 0.009	Age, Sex, Race, Albumin	2.61	0.03	0.119
Lower Energy/Fatigue ³	Psychosocial (HRQOL Physical)	t-value 2.09 P-value 0.04	Age, Sex, Race, Albumin	2.02	0.08	0.095
More Pain ³	Psychosocial (HRQOL Physical)	t-value 2.06 P-value 0.04	Age, Sex, Race, Albumin	1.99	0.09	0.094

¹ N=103.

² In each of the separate linear regressions with 1-year hospital days as the dependent variable, the full model of independent variables included the specific variable in the first column plus the control variables listed below in this column.

³ Kidney Disease Quality of Life Short Form (KDQOL-SF). Scale=0-100.

NOTE: HRQOL is health-related quality of life.

SOURCE: Parkerson, G.R. Jr., and Gutman, R.A., Duke University Medical Center, Durham, North Carolina, 1998.

hematocrit, or Kt/V. More black patients had hypertension than white patients (56.3 percent versus 28.1 percent, chi-square=7.0, $p=0.008$), but fewer black persons had heart disease (26.8 percent versus 50.0 percent, respectively, chi-square=5.3, $p=0.02$). Hypertension was the cause of renal failure more often in black persons, and glomerulonephritis, in white persons. The primary cause of death was cardiac-related in both races, but less frequently in black patients than in white patients.

Racial comparisons of baseline scores of the psychosocial scales that had predicted 1-year survival indicated higher HRQOL physical functioning scores in black patients (mean=47.2, SD=28.9 for black patients versus 35.4, SD=25.0 for white patients, $t=2.00$, $p=0.05$). There was no statistically significant difference in baseline performance scores or private religious activity scores. On other scales whose scores were not statistically significant predictors of survival, it is of interest that black persons scored higher than white persons on the other three types of religiosity, i.e., group religious activities, personal religious beliefs, and overall religiosity. Also, black persons exhibited higher HRQOL perceived and physical health, lower overall and comorbidity severity of illness, and lower HRQOL disability than white persons. Although there was no racial difference in any of the social support scores, black persons had higher family, non-family, and total stress scores than white persons.

Additional analyses were done to compare the baseline characteristics of the 75 patients who lived with their own families and those of the 28 who had other living arrangements (19 living alone, 5 with others than family, 3 in nursing homes, and 1 in a rest home). More patients who lived with their families were males than females

(53.3 percent versus 46.7 percent, chi-square=5.0, $p=0.03$), and more were married than not married (65.3 percent versus 34.7 percent, chi-square=24.3, $p=0.001$). There was no statistically significant difference by age, education, or socioeconomic status. Although there was no difference in serum albumin or hematocrit levels, the mean Kt/V was higher for those who lived with their families (1.56 versus 1.45, $t=2.30$, $p=0.03$). Fewer patients living with their families had renal failure caused by diabetes (41.3 percent versus 64.3 percent, chi-square=4.3, $p=0.04$). However, there was no statistically significant difference in the prevalence of diabetes, hypertension, heart disease, or depression.

Comparison of baseline psychosocial factors showed that patients who lived with their families had statistically significantly fewer symptoms/problems, lower non-family stress, and higher general health, emotional well-being, self-esteem, social health, quality of social interaction, and family, non-family, and total social support than patients who did not live with their families. For example, the mean HRQOL general health score for patients living with family was 67.5, SD=14.5 versus 59.4, SD=17.4 for others ($t=2.39$, $p=0.02$). Those living with family also reported higher patient satisfaction and encouragement from the dialysis staff.

Analyses of Hospital Days for 1-Year Survivors

Separate analyses of hospital utilization were done for the 77 patients who survived and remained on hemodialysis for a full year. As shown in Table 3, the statistically significant predictors included one pathophysiologic factor: heart disease, and eight psychosocial factors: lower social support, higher family stress, and six HRQOL factors. The HRQOL factors covered a wide

Table 3
Predictors of 1-Year Hospital Days for End-Stage Renal Disease Patients on Hemodialysis Who Survived 1 Year¹

Variables	Predictor Variables		Linear Regression Estimates				
	Type	Specific Variable	Additional Variables in Model ²	F-value	p-value	R-square	
		t-value	p-value				
Heart Disease	Pathophysiologic (Diagnostic)	2.53	0.01	Age, Sex, Race	2.68	0.04	0.130
Lower Overall Health ³	Psychosocial (HRQOL General)	2.64	0.01	Age, Sex, Race, Albumin, Kt/V, Heart Disease	3.20	0.005	0.248
Higher Family Stress ⁴	Psychosocial (Social Environment)	2.64	0.01	Age, Sex, Race, Albumin, Kt/V, Heart Disease	3.20	0.005	0.248
Lower Social Health ⁵	Psychosocial (HRQOL Social)	2.58	0.01	Age, Sex, Race, Albumin, Kt/V, Heart Disease	3.15	0.006	0.245
Lower Social Support ³	Psychosocial (Social Environment)	2.55	0.01	Age, Sex, Race, Albumin, Kt/V, Heart Disease	3.30	0.005	0.256
Lower Emotional Well-Being ³	Psychosocial (HRQOL Emotional)	2.25	0.03	Age, Sex, Race, Albumin, Kt/V, Heart Disease	3.05	0.008	0.241
Lower Quality of Social Interaction ³	Psychosocial (HRQOL Social)	2.04	0.05	Age, Sex, Race, Albumin, Kt/V, Heart Disease	2.89	0.01	0.232
Lower General Health ⁵	Psychosocial (HRQOL General)	2.04	0.05	Age, Sex, Race, Albumin, Kt/V, Heart Disease	2.81	0.01	0.230
More Symptoms/Problems ³	Psychosocial (HRQOL Physical)	2.02	0.05	Age, Sex, Race, Albumin, Kt/V, Heart Disease	2.87	0.01	0.231

¹ N=77. Of the 103 patients at baseline, these 77 survived and remained on hemodialysis at one of the study sites for a full year after baseline data intake.

² In each of the separate linear regressions with 1-year hospital days as the dependent variable, the full model of independent variables included the specific variable in the first column plus the control variables listed in this column.

³ Kidney Disease Quality of Life Short Form (KDQOL-SF). Scale=0-100.

⁴ Duke Social Support and Stress Scale (DUSOCS). Scale=0-100.

⁵ Duke Health Profile (DUKE). Scale=0-100.

NOTE: HRQOL is health-related quality of life.

SOURCE: Parkerson, G.R. Jr., and Gutman, R.A., Duke University Medical Center, Durham, North Carolina, 1998.

spectrum of health: physical (more symptoms/problems), emotional (lower emotional well-being), social (lower social health and lower quality of social interaction), and general (lower overall health and lower general health). None of the demographic variables reached levels of statistical significance.

Other regression analyses that used vascular access and non-vascular access hospital days separately as the dependent variable showed that most of the statistically significant psychosocial predictors of all hospital days described previously predicted non-vascular access hospital days, but not vascular access days. Heart disease, primarily coronary arteriosclerosis, predicted both types of hospitalization. The pathophysiologic factor lower serum albumin was identified as one predictor that was statistically significant for vascular access hospital days ($t=2.2, p=0.03$), but not for non-vascular access days.

DISCUSSION

This study demonstrated that certain HRQOL factors were relatively strong independent predictors of survival and hospital utilization, after adjusting for the effects of known demographic and pathophysiologic predictors. Although the strongest predictor of survival was the black race, additional statistically significant predictors were the HRQOL factor higher physical functioning, and the other psychosocial factors: higher provider-reported performance, fewer personal religious activities, and living with own family. Black patients had higher scores than white patients for HRQOL perceived and physical health, and for personal religious beliefs and group religious activities. More hospital days were predicted if the patient did not live with family and had lower HRQOL energy scores and higher HRQOL

pain scores. Patients who lived with their families reported greater social support and better HRQOL general health, emotional well-being, social health, and quality of social interactions than those who did not live with their families. The only pathophysiologic predictor of survival was hypertension, which unexpectedly protected against death. The only pathophysiologic predictor of hospital days was heart disease.

As reported in other studies, higher baseline physician-report performance scores (Husebye et al., 1987; McClellan et al., 1991) and higher patient-report HRQOL physical functioning scores (DeOreo, 1997) predicted greater survival. Not reported previously, lower private religious activity scores predicted survival. It is understandable that non-survivors would participate in more private religious activities within a year before their death because of the tendency of people to turn more to religion as their lives become more threatened. Previous studies have shown that religion is important to ESRD patients (Matthews, 1998), but much more research is needed in this area.

Also, further research is needed to explain the apparent protective effects against death of both the black race and the presence of hypertension. The effect of race has been reported previously (Brogan, Kutner, and Flagg, 1992; Kimmel et al., 1998; Price and Owen, 1997). Our findings that some HRQOL scores were higher in black persons may be a partial explanation, but it should be noted that the black persons were on average 10 years younger than the white persons and had a lower prevalence of heart disease, which was both a predictor of death and the most frequent terminal event in our patients. Some of the protective effect of hypertension may be race-related since black patients in this study had a higher prevalence of

hypertension than white patients. Others have suggested that the association of lower blood pressure with mortality may be secondary to cardiac failure (Foley et al., 1996). Rocco et al. (1996) discussed the hypertension paradox after their data showed that the presence of hypertension also protected against hospitalization.

Living with family as both a positive predictor of survival and a negative predictor of hospital days fits with previous reports of the importance of family support (Christensen et al., 1994; Holder, 1997), but further research is needed to explain more precisely what the benefits are, and how household family support differs from family support when the patient is housed elsewhere. Also, the effects of family stress need to be explained, for example, why the black patients had both more family stress and better survival.

In the hospitalization utilization analyses for the entire study group, two of the three predictors of hospital days were HRQOL factors, and in the analyses for survivors six of the nine predictors were HRQOL factors. These utilization analyses emphasize the known importance of psychosocial factors (McClellan, Stanwyck, and Anson, 1993; Christensen et al., 1994; Holder, 1997; Kimmel et al., 1998), as measured in a variety of ways by three different HRQOL instruments. The only pathophysiologic predictor of all types of hospital days was heart disease (predominantly coronary arteriosclerosis), while lower serum albumin was predictive only of hospital days for vascular access problems. The study identifies a need for research that will indicate how many hospital days can be eliminated by improving outpatient medical care of heart problems and by improving patient social environment. It seems possible that improved social conditions could make both outpatient cardiac and renal disease

treatment safer and more effective, while at the same time improving quality of life and reducing the expense of hospital care.

The overlapping effects of the many predictors of survival and hospitalization can be highlighted but not defined adequately in a small exploratory study like this one, in which the results must be considered as preliminary to future studies with multiple sites and more numerous patients. The strength of this study lies in its multifactorial comprehensiveness, while its principal weakness is danger of Type II error resulting from the small sample size of 103 patients. Overlooking statistically significant predictors as a result of Type II error may have been less problematic here, where the main purpose was to compare the relative strength of known predictors, rather than to detect new predictors. Another problem, the analysis of multiple variables in a limited number of subjects, was addressed by first testing each of the variables one at a time and then choosing a limited number to test together in any one multivariate analysis.

While this study is small and the results cannot be generalized, it indicates that certain HRQOL and other psychosocial factors are relatively strong predictors of survival and hospital utilization of ESRD patients when compared with, and after controlling for, known demographic and pathophysiologic predictors.

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