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Clinical, Dialytic, and Laboratory Factors Associated With Poor Health-Related Quality of Life in Mexican Patients on Hemodialysis

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ABSTRACT

Background: End-stage renal disease and its treatment have a negative impact on the quality of life of patients. **Objective:** To determine the clinical, dialytic, and laboratory factors associated with poor health-related quality of life in Mexican patients on hemodialysis. **Methods:** A multicenter, cross-sectional study. The KDQOL-SF36 v1.3 questionnaire was applied to patients with end-stage renal disease on hemodialysis in different regions of Mexico. Patients were classified according to their overall score on the questionnaire: poor health-related quality of life (overall score below the median) or good health-related quality of life (overall score above the median). Clinical, dialytic, and laboratory variables associated with poor health-related quality of life were analyzed using linear correlation and multivariate logistic regression. **Results:** We included 194 adult patients with a median age of 55 (45-64) years. The diagnosis of poor health-related quality of life was present in 47.4% of patients. A poor correlation was found between the clinical, dialytic, and biochemical parameters and the health-related quality of life score (range of correlations r = –0.4 to 0.2). Serum albumin level showed the highest number of weak, statistically significant correlations. Factors associated with poor health-related quality of life in the multivariate analysis were: time spent on hemodialysis (OR = 1.02; 95% CI; 1.00-1.04; p = 0.02), use of a venous catheter (OR = 3.2; 95% CI: 1.36-7.75; p = 0.01), and serum albumin < 4 g/dl (OR = 3.55; 95% CI: 1.44-8.74; p < 0.01). **Conclusions:** Poor health-related quality of life was common in Mexican patients undergoing hemodialysis. No strong correlation was found between the clinical, dialytic, or laboratory factors with health-related quality of life. Factors associated with poor health-related quality of life were: time on hemodialysis, use of a venous catheter, and serum albumin level < 4 g/dl. (REV INVES CLIN. 2016;68:192-200)

Key words: HRQoL. Quality of life. KDQOL-SF36. Hemodialysis.

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INTRODUCTION

In Mexico, similar to the rest of the world, end-stage renal disease (ESRD) is a public health problem due to its high prevalence, morbidity, mortality, and economic costs arising from medical care[1-9]. Additionally, it has been consistently demonstrated that ESRD and its treatment produces a negative impact on the quality of life of patients with this disease[10,11]. Moreover, the evaluation of the health-related quality of life (HRQoL) is a relatively new concept in the field of nephrology, but it is becoming increasingly important due to its role as an independent predictor of clinical outcomes[12] and as a key indicator in the evaluation of the quality of health care[13]. However, despite the current trend of including the evaluation of HRQoL as an important measure of medical care, studies evaluating the HRQoL of patients with ESRD undergoing hemodialysis are scarce. The aim of our study was to evaluate the HRQoL of patients and determine the clinical, dialytic, and laboratory factors associated with poor HRQoL (P-HRQoL) in Mexican patients with ESRD who are undergoing hemodialysis.

MATERIALS AND METHODS

We performed a cross-sectional study. The Institutional Research and Ethics Committee reviewed and approved the protocol. A version of the Kidney Disease Quality of Life Short Form (KDQOL-SF36 v1.3) questionnaire was administered by an interviewer to 194 adult patients with ESRD who were receiving chronic hemodialysis in different regions of Mexico. We included clinically stable patients with more than one month of dialysis treatment. We excluded patients with any physical disability. Patients were grouped according to their overall score as patients with a P-HRQoL (overall score of the questionnaire below the median score of the general group) and patients with a good HRQoL (G-HRQoL, overall score above the median score of the general group). Clinical (age, sex, comorbidities, and education), dialytic (type of vascular access, time on hemodialysis, and Kt/V), and laboratory (hemoglobin, serum calcium, serum phosphorus, and serum albumin levels) variables were collected and compared between groups. Descriptive statistics with means/standard deviations and medians/25-75th percentiles were used to describe continuous variables according to distribution data; frequencies and proportions were used to describe categorical variables. Comparisons between the two groups were performed using Student's *t* test or Mann-Whitney *U* test according to distributions of data in the case of continuous variables and by a X^2 test in the case of categorical variables. We used one-factor ANOVA for comparisons between more than two groups. Correlations between dialytic, laboratory variables and the HRQoL scores were done using the Spearman correlation coefficient. Risk factors associated with HRQoL scores were analyzed by multivariate logistic regression. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Patient characteristics

A total of 194 adult patients with ESRD who were undergoing chronic hemodialysis were included, of whom 37.6% (n = 73) lived in the northern region, 28.9% (n = 56) lived in the southern region, and 33.5% (n = 65) lived in the central region of Mexico. Median age was 55 (45-64) years, and 54.6% (n = 106) of the patients were male. The most frequently observed comorbidities included hypertension in 86.6% (n = 168), diabetes mellitus type 2 in 57.2% (n = 111), and dyslipidemia in 7.2% (n = 14) of patients. Regarding the educational level of our population, 12.4% (n = 24) were illiterate, 41.8% (n = 81) had a complete primary education, and 16.5% (n = 32) had a professional education. The main causes of ESRD were type 2 diabetes mellitus in 48.5% (n = 94) of patients and hypertension in 15.5% (n = 30); in 14.9% (n = 29), the cause was unknown. In addition, 75.3% (n = 146) of patients did not perform any type of paid work. In 55.2% (n = 107) of patients, vascular access was achieved with a catheter, and in 44.8% (n = 87) an arteriovenous fistula was used. The median time on hemodialysis was 19 (8-38) months. The medians (25-75 percentiles) of factors studied were: hemoglobin 10.5 (9.1-11.7) g/dl, calcium 8.7 (8.0-9.2) mg/dl, phosphorus 5.8 (4.8-7.3) mg/dl, serum albumin 4.0 (3.7-4.3) g/dl, Kt/V 1.2 (1.0-1.4), and 250 (20-600) ml/day for residual urine volume.

Comparison of clinical, dialytic, and laboratory characteristics between patients with good and poor health-related quality of life

The median overall score of HRQoL of our population was 55.6 points. A total of 47.4% (n = 92) of patients had a diagnosis of P-HRQoL according to the criterion used (the median score). When comparing general characteristics of patients with P-HRQoL and G-HRQoL, we observed that age was lower in patients with G-HRQoL (53 vs. 59 years; p = 0.03), the mean of time on hemodialysis was higher in patients with G-HRQoL, and the proportion of patients with type 2 diabetes mellitus was higher (65.2 vs. 50.0%; p = 0.03) in the group with P-HRQoL. In addition, the proportion of patients with an arteriovenous fistula was higher for patients in the G-HRQoL group (52.9 vs. 35.9%; p = 0.01). The proportion of patients with serum phosphorus levels greater than 5.5 mg/dl (45.6 vs. 66.3%; p = 0.01) was lower in patients with P-HRQoL. The proportion of patients with normal serum phosphorus levels was higher (50.6 vs. 28.3%; p = 0.01) in patients with P-HRQoL vs. G-HRQoL. Moreover, serum albumin levels (3.9 vs. 4.1 g/dl; p = 0.02) and the proportion of patients with serum albumin levels greater than 4.0 g/dl (40.5 vs. 64.3%; p = 0.001) were lower in patients with P-HRQoL compared with G-HRQoL. For the remaining clinical, dialytic, and laboratory characteristics shown in table 1, no statistically significant differences were found between groups.

Comparison of health-related quality of life between patients with end-stage renal disease undergoing hemodialysis and healthy patients

The mean overall score of the KDQOL-SF36 v1.3 questionnaire was 56.5 ± 11.0 points, with a minimum score of 25.6 and a maximum of 84.4 points. The most affected dimensions of the specific disease component (KDQOL component) of the questionnaire were the quality of social interaction (21.0 ± 20.9 points), cognitive dimension (21.8 ± 21.7 points), and work (33.7 ± 37.1 points). In the generic component (SF36 component) of the questionnaire, the most affected dimensions were physical role (25.9 ± 37.7), emotional role (37.8 ± 38.2), and general health perception (48.5 ± 23.0). We compared scores of the SF36 generic component of the KDQOL-SF36 with the scores of the QOL SF36 questionnaire obtained from healthy Mexican adults in a nationally representative sample reported by Duran, et al., which included 5,961 Mexican healthy individuals over 25 years old selected through multistage sampling covering rural and urban areas of Mexico[14]. We observed that Mexican patients with ESRD on hemodialysis had a lower score in all evaluated dimensions of quality of life, except for the dimension of emotional well being, in which the scores were similar (Table 2). On the other hand, patients with P-HRQoL had lower scores in all dimensions including the physical and mental component of QOL SF36 compared to patients with G-HRQoL and the healthy population. Finally, patients with G-HRQoL had lower scores on the physical and mental component of QOL SF-36 compared to healthy patients. However, these low scores were mainly attributed to physical functioning, role emotional, and role physical dimensions. In other dimensions of the SF36 component, the scores of G-HRQoL were very similar to the scores observed in the healthy population reported by Duran, et al. (Table 2).

Comparison of dimensions of health-related quality of life between patients with poor and good health-related quality of life

We compared the dimensions of HRQoL between patients with P-HRQoL and G-HRQoL in our population. We observed that in the specific disease component of the questionnaire (KDQOL component), patients with P-HRQoL had a lower score in most dimensions, particularly in the dimensions of burden of chronic kidney disease (CKD) (26.1 vs. 54.3; p < 0.01), work (22.8 vs. 43.6; p < 0.01), and the effect of CKD (53.2 vs. 71.6; p < 0.01). In contrast, patients with P-HRQoL had a higher score in the cognitive (28.2 vs. 16.1; p < 0.01) and quality of social interaction (25.7 vs. 16.7; p < 0.01) dimensions. No statistically significant differences were observed in the dimensions of support from the dialysis team (92.2 vs. 89.8; p = 0.34) and satisfaction with dialysis care (78.6 vs. 80.7; p = 0.49) among patients with G-HRQoL and P- HRQoL (Table 2).

In the generic component of the questionnaire (SF-36 component), patients with P-HRQoL had a lower score on most dimensions. This was especially seen in the physical role (4.0 vs. 45.8; p < 0.01), emotional role (18.1 vs. 55.5; p < 0.01), and pain (52.7 vs. 85.3;

Table 1. Comparison of clinical, dialytic, and laboratory characteristics between patients with poor and good health-related quality of life

Variables	P-HRQoL		G-HRQoL		p
	n = 92	%	n = 102	%	
Age (Md; 25-75p)	59 (48-68)		53 (43-60)		0.03
Male/female	52.2/47.8%		56.9/43.1%		0.51
Diabetes mellitus	60	65.2%	51	50%	0.03
Vascular access:					
Catheter	59	64.1%	48	47.1%	0.01
Arteriovenous fistula	33	35.9%	54	52.9%	
Time on hemodialysis (Md)	14 (5-34)		24 (12-36)		0.02
Kt/V (median)	1.2 (0.9-1.4)		1.2 (1.0-1.3)		0.94
Kt/V < 1.4	61	75.3%	74	79.6%	0.5
Kt/V > 1.4	20	24.7%	19	20.4%	
Hemoglobin (Md; 25-75p)	10.4 (8.9-11.6)		10.6 (9.3-11.9)		0.61
Hb < 9 g/dl	26	28.5%	18	17.6%	0.19
Hb 9-11 g/dl	33	36.3%	43	42.2%	
Hb >11 g/dl	32	35.2%	41	40.2%	
Serum calcium (Md; 25-75p)	8.8 (8.1-9.2)		8.6 (8.0-9.4)		0.58
Ca < 8.5 mg/dl	33	41.2%	38	40.8%	0.15
Ca 8.5-10 mg/dl	38	47.5%	33	35.5%	
Ca > 10 mg/dl	9	11.3%	22	23.7%	
Serum phosphorus (Md; 25-75p)	5.4 (4.5-6.6)		6.2 (5.3-7.9)		0.13
P < 3.5 mg/dl	3	3.8%	5	5.4%	0.01
P 3.5-5.5 mg/dl	40	50.6%	26	28.3%	
P > 5.5 mg/dl	36	45.6%	61	66.3%	
Serum albumin (Md; 25-75p)	3.9 (3.5-4.2)		4.1 (3.8-4.3)		0.02
Albumin < 4 g/dl	50	59.5%	35	35.7%	0.001
Albumin > 4 g/dl	34	40.5%	63	64.3%	

Md: median; 25-75p: 25-75th percentile; HRQoL: health-related quality of life; P: poor; G: good.

p < 0.03) dimensions, as well as the physical (32.2 vs. 43.5; p < 0.01) and mental components (41.3 vs. 51.7; p < 0.01) (Table 2).

Correlation between clinical, dialytic, and laboratory parameters and health-related quality of life in patients with end-stage renal disease undergoing hemodialysis

A poor correlation was observed between most clinical and biochemical parameters and the dimensional scores and overall score of HRQoL. Serum albumin level was the parameter with the highest number of statistically significant correlations. However, it showed a weak positive correlation with physical function (r = 0.2; p = 0.01), energy/fatigue (r = 0.3; p = 0.01), and the overall score of HRQoL (r = 0.2; p = 0.01). It also exhibited a weak negative correlation with cognitive function (r = –0.2; p = 0.01). Age showed a negative correlation with the physical dimensions (physical function: r = –0.4, p = 0.01; physical role: r = –0.2, p = 0.01) and the overall score of HRQoL (r = –0.2; p = 0.01). The Kt/V only exhibited a weak negative correlation with the sleep dimension (r = –0.2; p = 0.01) of the HRQoL, and time on hemodialysis showed a weak negative correlation with general health perception (r = –0.1; p = 0.01) and positive correlation with social function (r = 0.2; p < 0.01). The remaining correlations are shown in table 3.

Clinical, dialytic, and laboratory factors associated with poor health-related quality of life in patients with end-stage renal disease undergoing hemodialysis

In the multivariate logistic regression, the independent risk factors associated with P-HRQoL in Mexican

Table 2. Comparisons of health-related quality of life between healthy Mexican subjects and poor and good health-related quality of life patients with end-stage renal disease on hemodialysis

	Healthy*	General	P-HRQoL	G-HRQoL	p
KDQOL component					
Symptom/problem list	–	78.9	72.4	84.8	< 0.01
Effects of kidney disease	–	62.9	53.2	71.6	< 0.01
Burden of kidney disease	–	40.9	26.1	54.3	< 0.01
Work status	–	33.7	22.8	43.6	< 0.01
Cognitive function	–	21.8	28.2	16.1	< 0.01
Quality of social interaction	–	21.0	25.7	16.7	< 0.01
Sexual function	–	79.7	70.3	87.1	< 0.01
Sleep	–	62.3	58.1	66.1	< 0.01
Social support	–	69.0	64.3	74.0	0.03
Dialysis staff encouragement	–	90.9	92.2	89.8	0.34
Patient satisfaction	–	79.7	78.6	80.7	0.49
SF-36 Component					
Physical functioning	89.6	53.1	36.9	67.7	< 0.01†,‡,#
Role physical	88.7	25.9	4.0	45.8	< 0.01†,‡,#
Pain	85.5	69.8	52.7	85.3	< 0.01†,‡
General health	52.2	48.5	36.8	59.0	< 0.01†,‡,#
Emotional well-being	72.1	72.8	60.4	84.0	< 0.01†,‡,#
Role emotional	88.9	37.8	18.1	55.5	< 0.01†,‡,#
Social function	75.1	69.7	54.7	83.2	< 0.01†,‡,#
Energy/fatigue	70.7	61.9	48.4	74.0	< 0.01†,‡,#
Overall score	–	56.57	47.1	65.0	< 0.01
SF-12 physical	79.0	38.2	32.2	43.5	< 0.01†,‡,#
SF-12 mental	76.7	46.8	41.3	51.7	< 0.01†,‡,#

T-Student test between P-HRQoL vs G-HRQoL was used in the KDQOL component and overall score of KDQOL SF36.
ANOVA test between P-HRQoL, G-HRQoL and Healthy was used in the SF36 component.
*Score obtained from healthy Mexican patients in a nationally representative sample[14]; †P-HRQoL vs. G-HRQoL; ‡P-HRQoL vs. healthy; #G-HRQoL vs. healthy.
KDQOL: Kidney Disease Quality of Life; SF: short form; P-HRQoL: poor health-related quality of life; G-HRQoL: good health-related quality of life.

patients on hemodialysis were time spent on hemodialysis (OR = 1.02; 95% CI: 1.00-1.04; p = 0.02), the use of a venous catheter vs. arteriovenous fistula (OR = 3.2; 95% CI: 1.36-7.75; p = 0.01), and serum levels of albumin below 4 g/dl (OR = 3.55; 95% CI: 1.44-8.74; p < 0.01). The remaining clinical, dialytic, and laboratory factors included in the multivariate analysis shown in table 4 were not associated with P-HRQoL in our population.

DISCUSSION

Based on the results of our study, we can confirm that Mexican patients on hemodialysis have a marked decrease in their quality of life. When we compared scores of the SF36 generic component of the KDQOL-SF36 with the scores of the QOL SF36 questionnaire obtained from healthy Mexican adults in a nationally representative sample[14], hemodialysis patients showed a marked decrease in the scores of physical (38.1 ± 10.0 vs. 79.0 ± 0.2; p < 0.01) and mental (51.7 ± 7.8 vs. 76.7 ± 0.2; p < 0.01) components of QOL SF36. This decrease was more pronounced in the physical role (25.9 vs. 88.7; delta = −62.8 points), emotional role (37.8 vs. 88.9; delta = −51.1 points), and physical function (53.1 vs. 89.6; delta = −36.5 points) dimensions. In the medical literature, it has been consistently documented that ESRD and its treatment with hemodialysis or peritoneal dialysis produces a negative effect on the quality of life of these patients. Pagels, et al. conducted a study to evaluate the quality of life of patients with CKD in different stages and at the start of dialytic treatment. They included 535 patients with CKD stages 2-5 of the Kidney Disease Outcomes Quality Initiative (KDOQI) classification and

Table 3. Correlations between clinical, dialytic and laboratory factors with health-related quality of life

	Age	TH	Hb	Ca	P	Alb	Kt/V
KDQOL component							
Symptom/problem list	–0.099	0.119	0.059	–0.008	0.101	0.296*	–0.127
Effects of kidney disease	–0.136	0.036	0.160*	–0.005	0.167*	0.197*	0.041
Burden of kidney disease	–0.082	0.140	0.086	0.014	0.098	0.239*	–0.031
Work status	–0.114	0.140	–0.010	0.125	0.081	0.173*	–0.109
Cognitive function	0.064	–0.082	–0.071	–0.105	–0.152*	–0.284*	0.137
Quality of social interaction	–0.050	–0.071	–0.027	–0.098	–0.132	–0.218*	–0.047
Sexual function	–0.083	0.026	0.005	0.101	–0.076	0.032	0.034
Sleep	–0.198*	0.202*	0.110	0.024	0.072	0.278*	–0.208*
Social support	0.012	–0.101	0.101	–0.107	0.021	–0.040	0.055
Dialysis staff encouragement	0.045	–0.018	–0.116	0.078	–0.066	–0.095	0.092
Patient satisfaction	–0.071	–0.085	–0.005	–0.204*	0.006	–0.035	0.048
SF-36 component							
Physical functioning	–0.410*	0.088	0.217*	–0.015	0.196*	0.229*	0.106
Role physical	–0.236*	0.091	0.045	–0.005	0.174*	0.103	0.179*
Pain	–0.079	0.053	–0.023	0.012	0.147	0.234*	0.017
General health	0.045	–0.155*	0.168*	–0.002	0.070	0.024	0.070
Emotional well being	–0.122	0.155*	0.002	–0.007	0.184*	0.268*	–0.045
Role emotional	–0.096	0.079	0.115	–0.048	0.126	0.083	0.010
Social function	–0.097	0.217*	0.033	0.075	0.190*	0.221*	0.166*
Energy/fatigue	–0.134	0.198*	0.022	0.023	0.188*	0.310*	–0.024
Overall score	–0.263*	0.171*	0.131	0.017	0.190*	0.271*	0.021

*$p < 0.05$ for Spearman correlation coefficient.
KDQOL: Kidney Disease Quality of Life; SF: short form; P-HRQoL: poor health-related quality of life; G-HRQoL: good health-related quality of life; TH: time on hemodialysis (months); Hb: hemoglobin; Ca: serum calcium; P: serum phosphorus; Alb: serum albumin.

55 healthy control patients. Compared to the controls, a significant decline was observed in all dimensions of quality of life evaluated in patients with CKD, especially in the physical and general health dimensions, which were more pronounced in patients with more advanced stages of CKD (Stage KDOQI-5)[11]. These findings show that quality of life is affected even in patients with early stages of CKD, and is substantially impaired in patients with ESRD at the start of dialytic treatment. Furthermore, Brennan, et al. conducted a systematic review, including 47 studies, that evaluated the quality of life of patients with ESRD and compared the results to the quality of life of healthy control subjects. Patients with ESRD who received hemodialysis and peritoneal dialysis showed a significant decline in their quality of life compared to healthy subjects, especially in the physical, vitality, and, to a lesser degree, mental status dimensions, which demonstrates the negative effect of CKD and its treatment on the quality of life of these patients[10].

We performed a comparison of HRQoL scores between the different hemodialysis centers of our study. No statistically significant differences were found in the overall scores between hemodialysis patients of different regions of Mexico. However, in specific dimensions of KDQOL SF36 we observed differences between hemodialysis patients of different regions of our country (Table 5). Furthermore, when comparing the overall HRQoL score of our population (56.5) with that of patients with ESRD receiving hemodialysis reported in other countries, we observed that the score in Mexican patients was lower than that of patients in the USA (63.7), Europe (62.7), Japan (63.3), and Brazil (62.3) (Table 5)[15,16]. Similar to the results observed in other countries, the dimensions work and physical role in the quality of life component were the most affected in Mexican patients. However, the dimensions with lower scores in our population included quality of social interaction and cognition, which showed much lower scores than those observed for these dimensions in other countries. Such low scores observed in our population could be due in part to comprehension problems regarding the questions that evaluate these dimensions in the questionnaire. In contrast, the dimension of HRQoL with the highest score in our population

Table 4. Multivariate logistic regression analysis of clinical, dialytic and laboratory factors associated with poor health-related quality of life

Variables	OR	95% CI		p
		Lower	Upper	
Age (years)	1.02	0.99	1.05	0.18
Gender (male vs. female)	0.85	0.39	1.85	0.68
Diabetes mellitus (yes/no)	1.39	0.57	3.37	0.46
Vascular access (catheter vs. fistula)	3.25	1.36	7.75	0.01
Hemoglobin (9-11 g/dl reference)	1.00	-	-	-
Hemoglobin (< 9 g/dl)	1.62	0.55	4.73	0.37
Hemoglobin (> 11 g/dl)	1.79	0.72	4.40	0.20
Serum calcium (8.5-10.0 mg/dl reference)	1.00	-	-	-
Serum calcium (< 8.5 mg/dl)	0.61	0.25	1.50	0.28
Serum calcium (> 10 mg/dl)	0.32	0.10	1.03	0.06
Serum phosphorus (3.5-5.5 mg/dl reference)	1.00	-	-	-
Serum phosphorus (< 3.5 mg/dl)	0.48	0.06	3.83	0.49
Serum phosphorus (> 5.5 mg/dl)	0.49	0.22	1.08	0.07
Serum albumin (< 4 vs. > 4 g/dl)	3.55	1.44	8.74	< 0.01
Kt/V (< 1.4 vs. > 1.4)	0.99	0.38	2.55	0.98
Time on hemodialysis (months)	1.02	1.00	1.04	0.02

OR: odds ratio.

Table 5. National (between hemodialysis centers in our study) and international comparison of health-related quality of life of Mexican patients on hemodialysis

	National comparison					International comparison				
	Sinaloa	Veracruz	Puebla	SLP	p	Mexico	Europe	Japan	USA	Brazil
KDQOL component										
Symptom/problem list	73.0*	80.0*	80.9	87.1†	< 0.01	78.9	70.4	73.8	72.2	81.2
Effects of kidney disease	62.5	64.0	64.5	61.5	0.9	62.9	57.9	66.7	63.3	73.3
Burden of kidney disease	33.8*	49.3*	38.0	43.9	0.01	40.9	36.8	27.6	42.4	46.8
Work status	22.6†	38.4	37.5	45.1†	< 0.01	33.7	28.5	33.0	27.0	22.3
Cognitive function	22.1	21.3‡	35.0‡,#	14.5#	< 0.01	21.8	74.3	80.0	78.0	78.4
Quality of social interaction	18.4	24.9	29.4#	15.4#	0.02	21.0	77.2	60.6	76.0	80.9
Sexual function	73.9*	90.8*,‡	66.3‡	79.8	< 0.01	79.7	66.7	63.3	60.5	35.6
Sleep	59.5†	64.8	58.9	66.0†	0.02	62.3	58.1	61.2	59.9	75.5
Social support	63.5	73.8	77.1	69.5	0.17	69.0	73.0	72.0	74.1	86.7
Dialysis staff encouragement	95.7*	83.0*,§	93.2	92.1§	< 0.01	90.9	80.5	79.3	78.0	90.8
Patient satisfaction	86.3*,¶	73.5*	70.1¶	82.1	< 0.01	79.7	68.9	76.2	69.2	72.6
SF-36 component										
Physical functioning	54.1	63.5§	52.3	37.8§	< 0.01	53.1	45.0	60.3	42.7	61.0
Role physical	29.1†	35.3§	25.0	7.9†,§	< 0.01	25.9	37.2	46.5	37.6	59.0
Pain	72.9	72.8	59.4	66.8	0.18	69.8	56.4	61.4	57.1	67.4
General health	53.7†	51.0§	48.1	36.1†,§	< 0.01	48.5	36.1	40.7	41.0	59.0
Emotional well being	72.0	73.4	67.3	76.9	0.34	72.8	60.8	61.8	68.2	66.1
Role emotional	34.7*	56.0*,‡,§	31.9‡	22.0§	< 0.01	37.8	49.1	48.7	58.0	71.2
Social function	77.9†,¶	67.0	62.0¶	63.4†	< 0.01	69.7	62.2	69.2	63.5	76.6
Energy/fatigue	59.9	61.9	58.1	67.8	0.24	61.9	42.4	50.8	43.4	60.4
Overall score	55.8	59.8	55.2	54.2	0.06	56.5	62.7	63.3	63.7	62.3

KDQOL: Kidney Disease Quality of Life; SF: short form; P-HRQoL: poor health-related quality of life; SLP: Ciudad Valles, San Luis Potosi; Veracruz: Xalapa, Veracruz; Sinaloa: Culiacán, Sinaloa; Puebla: Puebla, Puebla.
ANOVA *post hoc* comparison: *Sinaloa vs. Veracruz; †Sinaloa vs. SLP; ‡Veracruz vs. Puebla; #Puebla vs. SLP; §SLP vs. Veracruz; ¶Sinaloa vs. Puebla.

was support from the dialysis team, similar to patients in Europe, the USA, and Brazil and in contrast to the results observed in Japan, where the cognitive dimension had the highest HRQoL score.

Furthermore, Brennan, et al., in their excellent systematic review of 47 studies, also investigated the association between biochemical parameters and HRQoL in patients with ESRD[10]. The authors identified 14 studies that evaluated the association between Kt/V, as a variable of dialysis adequacy, and the dimensions of the HRQoL of the SF36 questionnaire. The authors did not document a strong association between Kt/V and HRQoL (r = 0.01; 95% CI: –0.02-0.22; p = NS). With regard to anemia parameters, the authors identified 16 studies that evaluated the association between hematocrit value and the dimensions of HRQoL of the SF36 questionnaire. However, the authors did not find a strong association between hematocrit value and the dimensions of HRQoL (r = 0.1; 95% CI: 0.13-0.17). In two studies, the associations between hematocrit value and dimensions of HRQoL of the KDQOL component were evaluated, and only a weak statistically significant association (r < 0.2) was found between the hematocrit value and the satisfaction dimensions, effect of CKD, and quality of social interaction[17,18]. In contrast, the authors identified 16 studies that evaluated the associations between nutritional markers, such as serum albumin level, with dimensions of HRQoL of the SF36 questionnaire. A weak correlation (r < 0.2) was documented between albumin level and the different dimensions of the SF36 questionnaire, and a moderate correlation was found with physical function (r = 0.34), vitality (r = 0.22), and mental health (r = 0.29). Only one study documented a moderate association between serum albumin level and all dimensions of HRQoL of the KDQOL component (r = 0.3; p = 0.007)[19]. The authors found only one study that evaluated the association between parameters of bone metabolism (Ca x P product) and HRQoL, in which no association was documented between these variables[20]. However, a very important point to consider when analyzing the association between biochemical variables and the HRQoL score using a correlation coefficient is that the type of association between biochemical variables and clinical outcomes in patients with ESRD may have a "U"-shaped form instead of being linear, which could also occur with the HRQoL[21]. Based on this reasoning, using multivariate logistic regression, we performed an analysis of the association with ordinal or dichotomous statistical management of the main biochemical dialytic variables and the HRQoL. The independent risk factors associated with P-HRQoL in the analysis included the time spent on hemodialysis (OR = 1.02; 95% CI: 1.00-1.04; p = 0.02), use of a venous catheter vs. arteriovenous fistula for vascular access (OR = 3.2; 95% CI: 1.36-7.75; p = 0.01), and serum levels of albumin below 4 g/dl (OR = 3.55; 95% CI: 1.44-8.7; p < 0.01). In this type of multivariate analysis, Kt/V (Kt/V > or < 1.4) was analyzed dichotomously, and hemoglobin (Hb < 9 g/dl vs. Hb 9-11 g/dl vs. Hb > 11 g/dl), serum calcium (Ca < 8.5 mg/dl vs. Ca = 8.5-10 mg/dl vs. Ca > 10 mg/dl), and serum phosphorus levels (P < 3.5 mg/dl vs. P = 3.5-5.5 mg/dl vs. P > 5.5 mg/dl) were analyzed ordinally and were not associated with P-HRQoL in our population. In conclusion, these findings indicate that, while clinical and biochemical measurements provide important information to the physician regarding clinical outcomes, these parameters weakly correlate with HRQoL of patients with ESRD who receive hemodialysis. In this regard, the subjective evaluation that the individuals produce regarding their own quality of life plays an important role, and similar health states may correspond to different perceptions of the HRQoL.

Regarding the weaknesses of our study, one issue is the difficulty of precisely defining and measuring the quality of life as well as the lack of a universally accepted criterion for defining P-HRQoL based on the overall score of the KDQOL questionnaire. In contrast, our work is the first multicenter study to measure the HRQoL in Mexican patients with ESRD undergoing hemodialysis, in addition to studying the association between biochemical and dialytic factors and the HRQoL in a linear form and through multivariate logistic regression.

In conclusion, Mexican patients with ESRD undergoing hemodialysis have a marked decrease in their quality of life compared to the general population. Poor HRQoL was a common diagnosis, observed in up to 47.4% of our population. The most affected dimensions of the KDQOL component were work, cognition, and quality of social interaction, as well as the physical role, emotional role, and general health perception in the SF36 generic component. Factors associated with P-HRQoL included the use of a venous

catheter for vascular access, a serum albumin level < 4 g/dl, and time on hemodialysis. Based on these results, we can conclude that comprehensive treatment of patients with ESRD undergoing hemodialysis should include assessment of the HRQoL as a measure of dialysis adequacy and not be limited exclusively to measurement of clinical, dialytic, and biochemical parameters.

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