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Research Article

The Impact of Health-Related Quality of Life and Comorbidities in Chronic Kidney Disease: A Hospital-Based Cross-Sectional Study

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Abstract

Background: Chronic kidney disease (CKD) is a primary global health concern, often progressing silently and leading to severe complications in later stages.

Methods: A hospital-based cross-sectional study was conducted over six months among 196 CKD patients (stages 3–5D) at a tertiary care hospital. Health-related quality of life (HRQoL) was assessed using the validated Malayalam version of the KDQOL-SF™ 1.3 questionnaire. Sociodemographic, clinical, and biochemical data were collected, and CKD staging was based on the CKD-EPI equation. The impact of 12 common comorbidities was analyzed using patient history, clinical evaluation, and laboratory data. Statistical analysis included ANOVA, chi-square tests, Pearson's correlation, and logistic regression, with $p < 0.05$ considered statistically significant.

Results: Quality of life (QOL) declined notably as CKD progressed from stage 3 to stage 5, with stage 5 patients exhibiting higher creatinine, lower hemoglobin, and increased serum uric acid and urea levels. HRQoL scores, measured by KDQOL-SF 1.3, worsened across all dimensions, with stage 3 patients having higher SF-36 scores than those in stages 4 and 5. Comorbidities such as hypertension, diabetes, hyperlipidemia, and heart issues were prevalent and significantly impacted CKD progression. Regression analysis highlighted that age above 55, proteinuria, hyperuricemia, unhealthy BMI, and lower GFR were linked to having multiple comorbidities in CKD patients, accelerating progression to stage 5 and increasing treatment burdens.

Conclusion: Chronic kidney disease (CKD) significantly impairs health-related quality of life, with the impact intensifying in advanced stages and in the presence of multiple comorbidities.

Keywords: chronic kidney disease, diabetes, hypertension, quality of life

INTRODUCTION

Chronic kidney disease (CKD) is a major contributor to global morbidity and mortality[1], ranked as the 8th leading cause of death in India by the Global Burden of Disease Study 2015[2].CKD is defined by either kidney damage or an estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m^2, lasting for three months or longer, regardless of the underlying cause[3]. In India, CKD affects 17.2% of the population, with 6% having stage 3 or worse. Rising cases are linked to diabetes, hypertension, and heart disease[4]. Quality of life (QoL) is a key concern in chronic kidney disease (CKD), particularly in end-stage renal disease (ESRD), as it closely relates to mortality risk. Factors such as symptoms, medication side effects, and family dynamics contribute to reduced QoL, which worsens with declining kidney function[5]. ESRD patients, especially those on hemodialysis, report lower health-related QoL than the general population, while those receiving transplants or peritoneal dialysis often fare better[6]. CKD also raises the risk of cardiovascular disease, early death, and higher healthcare use, further diminishing QoL[7]. Notably, cardiovascular mortality in CKD patients is 8–10 times higher than in those without CKD[8].

The current study aims to assess the health-related quality of life (HRQoL) among CKD patients from stages 3 to 5, including hemodialysis patients, while also exploring the impact of multimorbidity on CKD.

MATERIALS AND METHODS

Study design and setting

A hospital-based cross-sectional study was conducted from November 2023 to April 2024, spanning a period of 6 months, among patients with chronic kidney disease in a tertiary care hospital.

Inclusion and exclusion criteria

The study enrolled 196 patients diagnosed with chronic kidney disease at a tertiary care hospital, meeting specific inclusion criteria. The inclusion criteria consisted of patients with chronic kidney disease attending nephrology, general medicine, and cardiology departments, adults aged 18 years or older, and those who signed a written informed consent. Exclusion criteria included patients who were under the age of 18, those unwilling to participate in the study, Patients with severe dementia, pregnant women, critically ill patients, and patients with incomplete medical records.

Ethical clearance

The study was approved by the Institutional Ethics Committee (IEC) with Approval No. SJPCEC/P25/PP/2023/006 of the St James' College of Pharmaceutical Sciences, Chalakudy, Kerala, India.

Study procedure

A total of 196 patients diagnosed with chronic kidney disease (CKD) stages 3 to 5D were assessed for health-related quality of life (HRQoL) utilizing the Kidney Disease Quality of Life Short Form Version 1.3 (KDQOL-SF 1.3) questionnaire, which has been validated in Malayalam[9]. Informed consent was obtained from each participant, and the study protocol received approval from the institution's ethics committee. At the outset, sociodemographic information and biochemical parameters were collected. The glomerular filtration rate (GFR) was calculated using the CKD-EPI equation[10], and patients were classified into three categories based on their CKD stages: stage 3, stage 4, and stage 5. The KDQOL-SF 1.3 questionnaire was employed to evaluate the HRQoL of these individuals[11]. Those in the inpatient department (IPD) were requested to complete the questionnaire. For patients unable to fill out the KDQOL-SF 1.3 independently, their responses were recorded by the research investigator through direct interaction to ensure precise data collection.

To evaluate the influence of comorbidities on patients with chronic kidney disease (CKD), a thorough assessment was performed, which included reviews of medical history, clinical evaluations, and blood and urine analyses. This study concentrated on 12 specific comorbidities frequently observed in CKD patients: Hypertension, Diabetes Mellitus, Hyperlipidemia, Congestive Heart Failure, Coronary Artery Disease, Cerebrovascular Disease, Pyelonephritis, Glomerulonephritis, Polycystic Kidney Disease, Pulmonary Edema, Musculoskeletal Disorders, Urosepsis, Peripheral Vascular Disease, and Depression. These comorbidities were chosen due to their high occurrence among CKD patients and their clear identification through patient self-reports, documented medication histories, or specific laboratory results. The presence of each comorbidity was established based on the patient's self-reported history of doctor-diagnosed conditions, current use of disease-specific medications, or abnormal laboratory findings.

Statistical analysis

Continuous variables were presented as mean ± standard deviation (SD), and categorical variables were expressed as frequencies and percentages. Analysis of variance (ANOVA) was used to compare means across CKD stages for continuous variables, while chi-square tests assessed associations between categorical variables. Pearson's correlation coefficients were calculated to examine the relationships between various biochemical parameters and HRQOL scores. Univariate and multivariable logistic regression analysis was conducted to identify independent variables associated with the number of comorbidities and p-value < 0.05 was considered statistically significant.

RESULTS

Demographic and clinical characteristics of the patients

In the study sample, the majority of participants were aged 61–80 years (58%), male (63%), and married (84%), with 43% having proteinuria and 31% having hyperuricemia. Notably, 77% were smokers and 45% reported a family history of kidney disease (table 1).

Table 1: Demographic and clinical characteristics of the patients

Characteristics	Number (%)
Age (year)	
20-40	8(4)
41-60	49(25)
61-80	114(58)
81-100	25(13)
Sex	
Female	72(37)
Male	124(63)
Marital status	
Married	165(84)
Unmarried	31(16)
Educational status	
No education	19(10)
Elementary	42(21)
Secondary	72(37)
College and above	63(32)
Proteinuria	
Yes	84(43)
No	112(57)
Hyperuricemia	
Yes	60(31)
No	136(69)
Smoking	
Yes	151(77)
No	45(23)
Family history of kidney disease	
Yes	88(45)
No	108(55)

Distribution of baseline biochemical parameters based on CKD stages

Significant biochemical differences were observed across CKD stages III to V. Hemoglobin levels, albumin, and GFR decreased progressively with advancing stages, while serum creatinine, potassium, serum urea, and uric acid levels increased significantly ($p < 0.05$). Serum creatinine and GFR showed the most marked changes ($p < 0.001$), reflecting worsening kidney function. However, age, sodium, and total protein levels did not differ significantly between the stages ($p > 0.05$) (table 2).

Table 2; Distribution of baseline biochemical parameters based on CKD stages

Sl. No	Biochemical parameters	CKD stage III (N=67)		CKD stage IV (N=62)		CKD stage V (N=67)		Total (n=196)		F value (ANOVA)	P value
		Mean	SD	Mean	SD	Mean	SD	Mean	SD		
1	Age	64.25	12.17	68.48	15.57	64.99	12.64	65.84	12.85	1.991	0.139
2	Hemoglobin	11.66	2.51	11.17	2.53	10.41	2.35	11.08	2.51	4.379	0.014*
3	Sr. Creatinine	1.83	0.31	2.70	0.59	7.74	4.21	4.13	3.62	109.368	<0.001***
4	Sodium	137.88	4.82	136.18	4.97	136.93	5.07	137.02	4.98	1.919	0.150
5	Total protein	6.43	1.18	6.37	1.54	6.11	1.04	6.30	1.27	1.188	0.307
6	Potassium	4.24	0.60	4.41	0.85	4.92	0.87	4.53	0.83	13.386	<0.001***
7	Albumin	3.74	1.04	3.41	1.02	3.31	0.88	3.49	0.99	3.500	0.032*
8	S.Uric Acid	5.72	2.04	6.15	2.44	6.79	1.90	6.22	2.17	4.281	0.015*
9	Sr.Urea	39.99	19.45	53.23	29.30	77.09	42.57	56.86	35.39	23.176	<0.001***
10	GFR	38.64	6.59	22.77	4.35	7.78	2.89	23.07	13.68	673.515	<0.001***

*significant at 0.05 level, ***significant at 0.001 level

Evaluation of HRQOL in patients with CKD

Significant declines were observed in multiple KDQOL domains as CKD progressed from stage III to V. Physical functioning, role-physical, and pain scores showed marked reductions ($p < 0.05$), indicating impaired physical health in advanced stages. Mental domains such as emotional well-being, role-emotional, and social function also declined significantly ($p < 0.001$). Kidney disease-specific domains—including burden, symptoms, effects, sleep, and work status—worsened progressively across stages ($p < 0.05$). Patient satisfaction and dialysis staff encouragement were notably high in stage V, reflecting increased support and satisfaction at more advanced stages (table 3).

Table 3: Evaluation of HRQOL in patients with CKD

S. N.	KDQOL domains	CKD stage III (N=67)		CKD stage IV (N=62)		CKD stage V (N=67)		Total (n=196)		F-value (ANOVA)	p value
		Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Physical composite summary											
1	Physical functioning	54.5	20.42	54.18	18.98	47.02	18.89	51.94	19.65	3.903	0.042*
2	Role physical	35.45	21.82	34.68	23.24	30.22	28.38	33.42	24.66	4.868	0.002**
3	Pain	29.18	17.94	24.85	15.38	24.60	16.05	26.25	16.57	8.604	<0.001***
4	General health	44.63	8.45	43.81	9.18	42.81	9.66	43.72	9.10	10.75	<0.001***
Mental composite summary											
5	Emotional well-being	46.51	11.16	47.04	10.52	44.65	10.99	46.10	10.88	6.852	<0.001***
6	Role emotional	26.88	28.85	25.37	30.20	21.89	27.56	24.66	28.82	5.511	<0.001***

7	Energy/fatigue	43.51	11.58	44.85	8.62	41.94	10.73	43.47	10.39	5.272	<0.001***
8	Social function	43.84	18.25	45.77	20.24	39.74	16.98	43.05	18.57	9.804	<0.001***
Kidney disease composite summary											
9	Burden of kidney disease	46.67	15.55	44.80	15.25	44.69	14.44	45.40	15.05	7.358	<0.001***
10	Quality of social interaction	51.72	10.65	50.91	10.97	50.35	9.44	50.75	10.33	6.400	<0.001***
11	Cognitive function	39.25	13.17	39.90	13.79	37.82	12.49	39.01	13.30	4.386	0.006**
12	Symptom/ problem list	38.17	12.11	36.97	10.34	34.21	10.22	36.44	11.57	3.678	<0.001***
13	Effects of kidney disease	39.80	10.63	39.23	12.38	38.40	10.29	39.14	10.88	12.280	<0.001***
14	Sexual function	16.83	12.10	16.41	12.08	15.12	12.31	10.59	16.30	10.971	<0.001***
15	Sleep	49.81	8.11	49.60	8.45	47.91	8.99	49.82	8.49	3.135	0.012*
16	Social support	42.54	20.98	41.40	19.96	40.79	23.62	41.58	21.52	4.113	0.011*
17	Work status	50.81	21.22	48.51	21.27	45.52	20.84	48.21	21.11	8.019	<0.001***
18	Patient satisfaction	-	-	-	-	52.74	11.11	18.03	25.90	37.379	<0.001***
19	Dialysis staff encouragement	-	-	-	-	64.74	20.29	22.13	32.97	25.119	<0.001***

*significant at 0.05 level , **significant at 0.01 level, ***significant at 0.001 level

Range, mean, and standard deviation of PCS, MCS, and KDCS scores

The physical composite summary score declined from CKD stage III (mean = 40.89) to stage IV (mean = 37.26), with a slight improvement in stage V (mean = 38.28), though overall scores remained low across all stages. Mental composite scores remained relatively stable in stages III and IV (mean = 39.81), but declined in stage V (mean = 38.38), indicating worsening mental health with disease progression. The kidney disease composite summary in stage V patients (mean = 43.00) reflected a moderate burden, suggesting considerable impact on disease-specific quality of life in advanced CKD (table 4).

Table 4; Range, mean, and standard deviation of PCS, MCS, and KDCS scores

CKD stages	Range	Mean	SD
Physical composite summary n=196			
Stage III	8.80-63.80	40.89	12.62
Stage IV	8.80-63.80	37.26	11.63
Stage V	8.80-65.0	38.28	11.21
Total	8.80-65.0	38.85	11.88
Mental composite summary n=196			
Stage III	12.38-65.0	39.81	11.71
Stage IV	12.38-58.92	39.81	11.30
Stage V	12.38-59.63	38.38	9.96
Total	12.38-65.0	39.32	10.97
Kidney disease composite summary N=67			
Stage V	20.87-62.39	43.00	7.03

Correlation between PCS, MCS, and KDCS with various covariates

Hemoglobin levels showed a significant positive correlation with physical (r = 0.203), mental (r = 0.303), and kidney disease composite scores (r = 0.410), indicating better quality of life with higher hemoglobin. Serum creatinine was negatively correlated with all three domains ($p < 0.05$), reflecting worsening quality of life with declining renal function. GFR was positively associated with all composite scores ($p < 0.05$), especially with physical and kidney-specific domains. Serum uric acid was positively correlated with physical and mental scores, while serum potassium correlated significantly with the kidney disease summary. (table 5)

Table 5: Correlation between PCS, MCS, and KDCS with various covariates

Parameter	Correlation coefficient	p values	Correlation coefficient	p values	Correlation coefficient	p values
	Physical composite summary n=196		Mental composite summary n=196		Kidney disease composite summary N=67	
Age (in years)	-0.078	0.276	-0.062	0.385	-0.042	0.733
Hb level (g/dL)	0.203	0.039*	0.303	0.031*	0.410	0.043*
S. Creatinine (mg/dL)	-0.401	0.011*	-0.402	0.022*	-0.221	0.012*
S. Sodium (mg/dL)	0.071	0.324	0.018	0.804	0.219	0.075
Total Protein (g/dL)	-0.048	0.502	-0.143	0.045	0.204	0.098
S. Potassium (mg/dL)	0.044	0.537	-0.036	0.614	0.302	0.013*
S. Albumin (g/dL)	-0.021	0.765	-0.109	0.129	0.235	0.055
S. Uric acid(mg/dL)	0.169	0.018*	0.221	0.002**	-0.080	0.522
S. Urea (mg/dL)	-0.058	0.420	0.045	0.532	-0.353	0.003**
GFR (mL/min/1.73m^2)	0.307	0.028*	0.244	0.029*	0.303	0.041*

* Correlation is significant at the 0.05 level, ** Correlation is significant at the 0.01 level (2-tailed)

Distribution based on complications of CKD

Among chronic kidney disease patients, hypertension emerged as the most prevalent complication, affecting 92.3% of the population. Cardiovascular disease and anemia follow, with prevalence rates of 50.5% and 46.4%, respectively. Hyperkalemia affects 41.3%, and metabolic acidosis 38.8% (table 6).

Table 6; Distribution based on complications of CKD

COMPLICATIONS	NUMBER	PERCENTAGE (%)
Hypertension	181	92.3
Cardiovascular disease	99	50.5
Anemia	91	46.4
Hyperkalemia	81	41.3
Metabolic acidosis	76	38.8
Volume overload	59	30.1
Mineral bone disorder	56	28.6
Others (infection, pruritus, insomnia)	38	19.4

Prevalence of comorbidities among different stages of CKD

Hypertension (92.3%) and diabetes mellitus (75.5%) were the most prevalent comorbidities among CKD patients, with their frequency increasing from stage III to V. Hyperlipidemia (30.6%) and coronary artery disease (41.8%) were also common, particularly in advanced stages. Conditions such as pulmonary edema, peripheral vascular disease, and depression showed a rising trend in later stages of CKD, reflecting a greater burden of systemic complications as kidney function declines. Other comorbidities like congestive heart failure, pyelonephritis, and glomerulonephritis were present in varying proportions but did not show a consistent pattern across stages (Table 7).

Table 7: Prevalence of comorbidities among different stages of CKD

Sl. No	Comorbidities	CKD stage III (N=67)		CKD stage IV (N=62)		CKD stage V (N=67)		Total (n=196)	
		F	%	F	%	F	%	F	%
1	Hypertension	57	85.1	59	95.2	65	97	181	92.3
2	Diabetes Mellitus	46	68.6	44	71	58	86.6	148	75.5
3	Hyperlipidemia	16	23.9	13	21	31	46.3	60	30.6
4	Congestive Heart Failure	12	17.9	6	9.7	10	14.9	28	14.3
5	Coronary Artery Disease	24	35.8	22	35.5	36	53.7	82	41.8
6	Cerebrovascular Disease	9	13.4	8	12.9	7	10.4	24	12.2
7	Pyelonephritis	12	17.9	10	16.1	13	19.4	35	17.9
8	Gromerulonephritis	8	11.9	10	16.1	7	10.4	25	12.8
9	Polycystic Kidney Disease	10	14.9	9	14.5	11	16.4	30	15.3
10	Pulmonary Edema	6	9	10	16.1	18	26.9	34	17.3
11	Musculoskeletal Disorders	6	9	6	9.7	7	10.4	19	9.7
12	Urosepsis	3	4.5	6	9.7	9	13.4	18	9.2
13	Peripheral Vascular Disease	4	6	8	12.9	15	22.4	27	13.8
14	Depression	12	17.9	13	21	17	25.4	42	21.4

Number of comorbidities among different stages of CKD

The number of comorbidities increased with the progression of CKD. While most stage III and IV patients had 2–4 comorbidities, a significant proportion of stage V patients (55%) had five or more. Overall, 70 out of 196 patients (35.7%) had ≥5 comorbidities, highlighting the increasing multimorbidity burden in advanced CKD stages (table 8).

Table 8; Number of comorbidities among different stages of CKD

No of Comorbidities	CKD stage III (N=67)	CKD stage IV (N=62)	CKD stage V (N=67)	Total (n=196)
1	8	1	0	9
2	12	10	9	32
3	9	20	10	39
4	20	16	11	47
≥5	18	15	37	70

Independent variables associated with the number of comorbidities

Multivariate analysis revealed that age >55 years (AOR = 2.12; $p < 0.001$), lower eGFR (≤25 mL/min/1.73 m^2; AOR = 1.46; $p = 0.022$), and presence of proteinuria (AOR = 1.39; $p = 0.013$) were independent predictors of having three or more comorbidities. Although smoking and hyperuricemia were significant in univariate analysis, they did not remain significant after adjustment. Sex and education level were not significantly associated with multimorbidity (Table 9).

Table 9: Independent variables associated with the number of comorbidities

Variable	Two or fewer comorbidities (vs. three or above)			
	Univariate		Multivariate[a]	
	COR (95% CI)	p-Value	AOR (95% CI)	p-Value
Age (≤ 55 vs >55)	3.13 (1.40-7.03)	0.004**	2.12 (1.22-4.28)	<0.001**
Sex (female vs male)	1.13 (0.56-2.30)	0.732	0.98 (0.44-2.20)	0.960
Education (up to secondary level vs above secondary)	0.68 (0.33-1.39)	0.289	0.92 (0.41-2.08)	0.927
Smoking (no vs yes)	0.63 (0.32-0.95)	0.039*	0.52 (0.14-1.12)	0.146
eGFR (≤25 vs >25 mL/min per 1.73 m^2)	0.61 (0.30-0.96)	0.032*	1.46 (1.01-1.97)	0.022*
Proteinuria (no vs yes)	2.35 (1.68-3.70)	0.036*	1.39 (1.02-2.09)	0.013*
Hyperuricemia (no vs yes)	2.48 (1.67-3.25)	0.021*	2.31 (0.87-4.47)	0.241

[a] Adjusted for old age, sex, education, smoking, estimated glomerular filtration rate (eGFR), proteinuria, and hyperuricemia; OR, odds ratio; CI, confidence interval.

*significant at 0.05 level , **significant at 0.01 level

DISCUSSION

Chronic kidney disease (CKD) is associated with increased hospitalisation, mortality, and reduced health-related quality of life (HRQOL), especially in patients on dialysis. While transplantation offers symptom relief and improved HRQOL, it remains lower than in those without CKD[12]. In the present study, most patients were aged 61–80 years (58%) and predominantly male (63%). Although global data show CKD prevalence is slightly higher in women (14.6%) than men (12.8%), and more common in those over 65 (up to 44%), age-related kidney changes may explain the high prevalence in the elderly[13].

The present study revealed that QoL decreased across all CKD stages, similar to previous studies[5,14]. The study findings align with previous studies showing poorer physical QoL compared to mental QoL in renal patients,[15,16], likely due to the chronic nature of CKD and patients' psychological adaptation over time. An intervention study in hemodialysis patients reported that Physical QOL was more affected initially but improved significantly after the intervention compared to mental QOL. Education and exercise proved effective in enhancing physical function, reducing pain, and improving daily tasks, making them ideal for addressing physical challenges[17]. Low income and hemoglobin levels are linked to poorer QoL[15]. CKD patients, particularly older dialysis patients, face a higher risk of cognitive decline, affecting memory, adherence, and quality of life, often linked to frailty, depression, and hospitalizations. Managing cardiovascular risks, reducing albuminuria, and promoting mental stimulation, exercise, and social support may help limit cognitive deterioration[18]. Hemodialysis patients report significantly lower QOL compared to the general population[15]. Studies in Kerala and Chennai revealed that self-management and social support moderately improve QOL in CKD patients, while HRQoL is impaired by financial hardships in hemodialysis. Decentralized, community-based care can address treatment challenges and productivity loss[19,20]. Technology-based tools, such as apps, websites, virtual reality, and phone support, further improve psychological well-being, motivation, and treatment adherence[21].

Chronic kidney disease (CKD) is associated with serious complications, including cardiovascular disease, hypertension, diabetes, anemia, hyperlipidemia, and metabolic bone disorders, significantly impacting morbidity, mortality, and quality of life[22,23]. In our study, hypertension and diabetes are the most common comorbidities associated with CKD. Diabetes and hypertension are major causes of CKD and CVD, and managing modifiable risk factors can improve survival, reduce CVD, and slow CKD progression to ESRD[24]. In our study, the burden of comorbidities increases with CKD progression, rising from fewer cases in stage III to a higher prevalence in stage IV, and peaking in stage V, where most patients have ≥5 comorbid conditions, in this the most prevalent one are hypertension (92.3) and diabetes (75.5). similar to the studies conducted by MacRae C et. al[24], Lau DCW et. al[25], and Li, Y. et, al[26], found that hypertension and diabetes is the most common comorbidity associated with CKD. A study conducted by Tonelli M et. al found that, Concordant comorbidities like diabetes, heart failure, and hypertension add to CKD's burden, with 25% of patients having three or more comorbidities and 7% having five or more[27]. Hypertension is a hallmark of CKD, in CKD arises from sodium retention, renin-angiotensin-aldosterone activation, vascular stiffness, and endothelial dysfunction, leading to inflammation and oxidative stress. Obesity and Type 2 diabetes further exacerbate CKD progression through metabolic inflammation, pro-inflammatory cytokines, and gut microbiota changes. CKD-related dyslipidemia is marked by

hypertriglyceridemia, altered LDL/HDL metabolism, and impaired reverse cholesterol transport, increasing cardiovascular risk[28]. Managing diabetes and hypertension in CKD patients reduces healthcare resource utilization and costs, emphasizing the need for coordinated care focusing on glucose and blood pressure control[26].

CONCLUSION

Chronic kidney disease (CKD) significantly impairs health-related quality of life, with the impact intensifying in advanced stages and in the presence of multiple comorbidities. The presence of multimorbidities, such as diabetes and hypertension, further exacerbated QoL decline, contributing to poorer clinical outcomes.

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