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Analysis of Risk Factors Related to Quality of Life in Kidney Failure Patients Undergoing Hemodialysis: A Single-Center Observational Study at Besemah Regional Hospital, Pagaralam, Indonesia

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A B S T R A C T

Hemodialysis significantly impacts the quality of life (QoL) of patients with kidney failure. Identifying modifiable risk factors is crucial for targeted interventions to improve QoL. This study aimed to analyze the risk factors associated with QoL in hemodialysis patients at Besemah Pagaralam Regional Hospital, Indonesia. This single-center observational study included 150 hemodialysis patients. Sociodemographic data, clinical characteristics, laboratory parameters, and QoL (measured using the Kidney Disease Quality of Life-36 Short Form questionnaire - KDQOL-36 SF) were collected. Univariate and multivariate analyses were performed to identify independent predictors of QoL. The mean age of participants was 55.2 ± 12.3 years, with 62% being male. The mean duration of hemodialysis was 3.8 ± 2.5 years. Factors independently associated with lower QoL included older age (OR 1.04, 95% CI 1.01-1.07, p=0.01); Lower hemoglobin level (OR 0.92, 95% CI 0.87-0.97, p=0.003); Presence of comorbidities (diabetes, cardiovascular disease); Depression symptoms (OR 0.85, 95% CI 0.79-0.92, p<0.001). This study identifies several modifiable risk factors associated with impaired QoL in hemodialysis patients. Interventions targeting anemia management, comorbidity control, and mental health support may be beneficial in improving the overall well-being of these patients.

1. Introduction

Chronic kidney disease (CKD) represents a substantial global health burden, with a growing prevalence attributed to the aging population and the rising incidence of diabetes and hypertension. As CKD progresses to end-stage kidney disease (ESKD), renal replacement therapy (RRT) becomes imperative to sustain life. Hemodialysis, a prevalent modality of RRT, while life-saving, profoundly affects patients' physical and mental well-being, with a significant impact on their overall quality of life (QoL). QoL is a complex and multidimensional construct encompassing physical health, psychological well-being, social relationships, and environmental factors. For patients with ESKD on hemodialysis, QoL becomes particularly pertinent due to the numerous challenges they face, including the loss of kidney function, the need for regular dialysis sessions, dietary restrictions, and potential complications like anemia, bone disease, and cardiovascular problems. The impact of hemodialysis on QoL is multifaceted. Physically, patients may experience fatigue, pain, sleep disturbances, and limitations in physical functioning. Psychologically, they may grapple with depression, anxiety, stress, and a sense of loss of control. Socially, they may encounter challenges in maintaining

relationships and engaging in activities they once enjoyed.[1,2]

Numerous factors can influence QoL in hemodialysis patients. Sociodemographic factors like age, gender, marital status, and socioeconomic status can play a role. Clinical factors, including the duration of dialysis, the primary cause of kidney failure, and the presence of comorbidities like diabetes, hypertension, and cardiovascular disease, can also significantly impact QoL. Laboratory parameters, such as hemoglobin levels, serum albumin, and dialysis adequacy (Kt/V), have been associated with QoL. Anemia, a common complication of CKD, can lead to fatigue, weakness, and reduced exercise tolerance, all of which can negatively affect QoL. Hypoalbuminemia, a marker of malnutrition and inflammation, has been linked to impaired physical functioning and poorer survival in hemodialysis patients. Adequate dialysis (measured by Kt/V) is essential for removing waste products and toxins, and suboptimal dialysis can contribute to a range of symptoms and complications that can impair QoL. Psychosocial factors, including depression, anxiety, stress, social support, and coping mechanisms, also play a crucial role in QoL. Depression is particularly prevalent in hemodialysis patients and has been associated with poorer treatment adherence, increased hospitalizations, and higher mortality rates.[3,4]

While large-scale studies provide valuable insights into the factors affecting QoL in hemodialysis patients, single-center studies are equally important. These studies offer a more in-depth understanding of the specific challenges and needs of patients within a particular healthcare setting. They can help identify local factors that may be unique to a specific population or region, and they can inform the development of tailored interventions to improve QoL.[5,6] This study aims to analyze the risk factors associated with QoL in hemodialysis patients at Besemah Pagaralam Regional Hospital, Indonesia. By identifying the specific factors that influence QoL in this population, we can develop targeted interventions to enhance the overall well-being of these patients. This study will contribute to the growing body of literature on QoL in hemodialysis patients and provide valuable insights for healthcare professionals and policymakers in Indonesia. The primary objective of this study is to identify the sociodemographic, clinical, and laboratory factors that are independently associated with QoL in hemodialysis patients at Besemah Pagaralam Regional Hospital.

2. Methods

This study employed a single-center, cross-sectional observational design to examine the risk factors associated with quality of life (QoL) in patients undergoing hemodialysis. It was conducted at Besemah Pagaralam Regional Hospital, a secondary care center located in Pagaralam, South Sumatra, Indonesia. The hospital serves a diverse population with varying socioeconomic backgrounds and healthcare access levels. The study period spanned 12 months, from January 2023 to December 2023, to capture a representative sample of the patient population. The target population comprised adult patients (≥18 years) receiving maintenance hemodialysis at the hospital's dialysis unit. To be eligible for inclusion, patients had to have been on hemodialysis for at least three months, ensuring that they had adapted to the treatment regimen and its potential impact on QoL. Patients with acute kidney injury (AKI), defined as a sudden decline in kidney function requiring urgent dialysis, were excluded to avoid confounding the assessment of QoL due to the acute nature of their condition. Additionally, patients with documented cognitive impairment, as determined by a mini-mental state examination (MMSE) score of <24, were excluded due to their potential inability to provide reliable responses to the QoL questionnaire. Similarly, patients who were unable to provide informed consent due to language barriers or other communication difficulties were excluded from upholding ethical principles of voluntary participation.

The sample size was determined based on a power analysis considering the primary outcome of the KDQOL-36 SF score. Assuming a medium effect size (0.5) and a power of 80%, a minimum sample size of 138 patients was calculated. To account for potential dropouts or incomplete data, a total of 150 patients were recruited for the study. Recruitment was conducted through a consecutive sampling approach, where eligible patients were identified from the dialysis unit's patient registry and approached for participation in the order of their scheduled dialysis sessions. Informed consent was obtained from each participant after a detailed explanation of the study's purpose, procedures, risks, and benefits. A comprehensive data collection process was employed, utilizing multiple sources to ensure the accuracy and completeness of information. Trained research personnel collected data through the following methods: 1. Patient interviews: Face-to-face interviews were conducted with each participant using a structured questionnaire. The questionnaire elicited sociodemographic information, including age, gender, marital status, educational level, and employment status. Additionally, it gathered details on clinical characteristics, such as the duration of hemodialysis, the primary cause of kidney failure (e.g., diabetes, hypertension, glomerulonephritis), and the presence of comorbidities (e.g., diabetes, hypertension, cardiovascular disease). 2. Medical record review: A thorough review of electronic medical records was performed to extract additional clinical data not captured during the patient interview. This included information on dialysis adequacy (Kt/V), laboratory parameters (hemoglobin, serum albumin), and medication history. 3. Quality of life assessment: The kidney disease quality of life-36 short form (KDQOL-36 SF) questionnaire was administered to each participant to assess their QoL. The KDQOL-36 SF is a validated instrument specifically designed for patients with kidney disease, encompassing eight dimensions: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health. The questionnaire was administered in the Indonesian language to ensure comprehension and accurate responses.

Descriptive statistics were used to summarize the sociodemographic, clinical, and QoL data. Continuous variables were presented as means and standard deviations (SD) or medians and interquartile ranges (IQR) as appropriate, while categorical variables were presented as frequencies and percentages. Univariate analyses were conducted to examine the association between individual risk factors and the overall KDQOL-36 SF score, as well as scores for each of the eight domains. Independent t-tests or Mann-Whitney U tests were used for continuous variables, while chi-square tests or Fisher's exact tests were used for categorical variables. Multivariate logistic regression analysis was performed to identify independent predictors of QoL after adjusting for potential confounding factors. Variables with a p-value of <0.10 in the univariate analysis were included in the multivariate model. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to quantify the strength of the association. Subgroup analyses were conducted to explore the impact of specific factors on QoL within different patient groups (e.g., by age, and presence of comorbidities). Correlation analyses were performed to examine the relationships between QoL domains and clinical parameters. All statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY). A p-value of <0.05 was considered statistically significant. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of Besemah Pagaralam Regional Hospital. All participants provided written informed consent after receiving a thorough explanation of the study's procedures and potential risks and benefits. The confidentiality of participant data was maintained throughout the study.

3. Results and Discussion

Table 1 provides a snapshot of the demographic and clinical profile of the 150 hemodialysis patients participating in the study. The average age of participants was 55.2 years, with a wide range (28-82 years) indicating diversity in age among hemodialysis patients. The presence of both younger and older individuals underscores the need to consider age-related factors in assessing quality of life (QoL). The majority of participants were male (62%), suggesting a potential gender disparity in the prevalence or access to hemodialysis. Further research may be needed to understand the reasons for this imbalance. Most participants were married (70%), highlighting the importance of spousal support in coping with the challenges of hemodialysis and its impact on QoL. The distribution of educational levels suggests a relatively lower educational attainment in this sample, with 45% having primary school education or lower. This may have implications for health literacy and understanding of treatment regimens, potentially affecting QoL. The majority of participants were unemployed (72%), reflecting the potential socioeconomic burden of hemodialysis and its impact on employment opportunities. The average duration of hemodialysis was 3.8 years, with a wide range (0.5-15 years). This suggests a diverse group of patients, some relatively new to hemodialysis and others with long-standing experience, which could influence their perception of QoL. The high prevalence of comorbidities, particularly hypertension (63%) and diabetes (37%), highlights the multi-faceted health challenges faced by hemodialysis patients. These comorbidities can significantly impact QoL and complicate the management of kidney disease. Table 1 provides a comprehensive picture of the study population, revealing a diverse group of hemodialysis patients with varying demographic characteristics and clinical profiles. This diversity underscores the importance of identifying individual risk factors that may influence QoL in different subgroups. The findings from this table will be crucial in the subsequent analyses to understand the complex interplay between these factors and QoL in this population.

Table 1. Sociodemographic and clinical characteristics of study participants.

Characteristic	n (%)
Age (years)	
Mean ± SD	55.2 ± 12.3
Range	28-82
Gender	
Male	93 (62%)
Female	57 (38%)
Marital status	
Married	105 (70%)
Unmarried	45 (30%)
Education level	
Primary school or lower	68 (45%)
Secondary school	52 (35%)
Tertiary education	30 (20%)
Employment status	
Employed	42 (28%)
Unemployed	108 (72%)
Duration of hemodialysis (years)	
Mean ± SD	3.8 ± 2.5
Range	0.5-15
Comorbidities	
Diabetes	55 (37%)
Hypertension	95 (63%)
Cardiovascular disease	2 (25%)

Table 2 presents a nuanced picture of the quality of life (QoL) experiences among hemodialysis patients, as reflected in their mean scores across the eight domains of the kidney disease quality of life-36 short form (KDQOL-36 SF) questionnaire. The most striking observation is the significantly lower mean scores in the physical functioning and role-physical domains. This indicates that patients on hemodialysis experience substantial limitations in their physical health and their ability to carry out daily activities due to their physical condition. This finding aligns with the known physical burdens of hemodialysis, such as fatigue, muscle weakness, and limitations in mobility. In contrast, the highest mean scores are observed in the role-emotional and social functioning domains. This suggests that despite facing physical challenges, patients are relatively resilient in their emotional well-being and ability to maintain social connections. This may be attributed to coping mechanisms, social support systems, or adaptation strategies that patients develop over time. The remaining domains (bodily pain, general health, vitality, and mental health) show moderate mean scores. While not as severely impacted as the physical domains, these scores still indicate room for improvement. For instance, the moderate score in mental health suggests that a significant proportion of patients experience psychological distress, which needs to be addressed alongside physical health concerns. The overall mean KDQOL-36 SF score of 58.3 reflects a moderate level of QoL. However, the substantial standard deviation (15.2) highlights a wide range of experiences among patients. This emphasizes the importance of individualizing care and addressing the specific needs and challenges of each patient.

Table 2. Mean scores for each KDQOL-36 SF domain.

KDQOL-36 SF domain	Mean score (SD)
Physical functioning	45.2 (18.6)
Role-physical	48.7 (20.3)
Bodily pain	55.9 (16.2)
General health	62.1 (14.5)
Vitality	58.8 (13.9)
Social functioning	65.4 (15.8)
Role-emotional	68.3 (17.1)
Mental health	60.5 (14.2)

Table 3 reveals the independent predictors of lower QoL in hemodialysis patients, shedding light on the key factors that healthcare providers should prioritize to optimize patient well-being. Each additional year of age is associated with a 4% increase in the odds of having lower QoL. This highlights the vulnerability of older patients to decreased QoL in the context of hemodialysis. Each 1 g/dL decrease in hemoglobin level is associated with an 8% increase in the odds of having lower QoL. This emphasizes the importance of anemia management in this population. The presence of diabetes more than doubles the odds of having lower QoL, highlighting the significant impact of this comorbidity on patients' well-being. While the association with cardiovascular disease did not reach statistical significance (p=0.08), it suggests a trend toward lower QoL in these patients. The presence of depression symptoms is associated with a 15% decrease in the odds of having higher QoL, underscoring the detrimental impact of mental health on overall well-being in hemodialysis patients.

Table 3. Independent predictors of lower quality of life (QoL) in hemodialysis patients (multivariate logistic regression).

Risk factor	Odds ratio (OR)	95% confidence interval (CI)	p-value
Age (per year increase)	1.04	1.01 - 1.07	0.01
Hemoglobin level (per g/dL decrease)	0.92	0.87 - 0.97	0.03
Comorbidities			
Diabetes	2.15	1.05 - 4.41	0.03
Cardiovascular disease	1.87	0.92 - 3.80	0.08
Depression symptoms (present)	0.85	0.79 - 0.92	<0.001

Table 4 provides valuable insights into how specific factors differentially impact various aspects of quality of life (QoL) among hemodialysis patients. The subgroup analyses reveal distinct patterns of vulnerability within different patient groups. The data clearly demonstrate the detrimental effect of aging on QoL in hemodialysis patients. Older individuals (≥60 years) experience significantly lower scores across multiple domains, particularly those related to physical functioning, role limitations due to physical health, general health perception, and energy levels (vitality). This highlights the need for tailored interventions for older patients, focusing on managing physical symptoms, optimizing functional capacity, and addressing age-related health challenges. The presence of comorbidities, especially diabetes and cardiovascular disease (CVD), significantly diminishes QoL across various domains. Diabetes, in particular, exerts a broader impact, affecting physical functioning, role limitations, bodily pain, and general health perception. This emphasizes the importance of aggressive comorbidity management in this population, as improving glycemic control and cardiovascular health may improve overall QoL. Depression emerges as a potent and pervasive factor affecting all aspects of QoL in hemodialysis patients. The stark differences in scores between patients with and without depression underscore the critical need for routine screening and early intervention for depression in this population. Addressing depression is not only essential for improving mental health but also for enhancing physical functioning and overall well-being.

Table 4. Subgroup analyses of KDQOL-36 SF domain scores by age, comorbidities, and depression symptoms.

KDQOL-36 SF domain	Age <60 (Mean ± SD)	Age ≥60 (Mean ± SD)	p-value	Diabetes (Mean ± SD)	No diabetes (Mean ± SD)	p-value	CVD (Mean ± SD)	No CVD (Mean ± SD)	p-value	Depression (Mean ± SD)	No depression (Mean ± SD)	p-value
Physical functioning	52.3 (17.5)	38.5 (19.2)	<0.001	40.8 (18.1)	58.7 (18.8)	<0.001	42.3 (19.3)	56.2 (17.8)	<0.001	35.1 (15.2)	64.7 (12.3)	<0.001
Role-physical	56.2 (19.8)	42.1 (21.0)	<0.001	43.5 (19.6)	65.1 (19.8)	<0.001	45.9 (20.7)	62.3 (19.5)	<0.001	38.6 (16.1)	70.2 (13.5)	<0.001
Bodily pain	60.2 (15.1)	51.7 (17.0)	<0.001	50.5 (15.3)	69.2 (14.7)	<0.001	57.3 (16.4)	58.4 (16.1)	0.61	45.2 (13.8)	68.3 (11.9)	<0.001
General health	65.3 (13.8)	59.0 (15.2)	0.02	56.9 (13.4)	71.2 (14.1)	<0.001	58.2 (14.6)	67.4 (13.5)	<0.001	48.7 (12.5)	75.1 (10.8)	<0.001
Vitality	61.4 (12.9)	56.2 (14.7)	0.01	55.1 (12.5)	67.3 (13.6)	<0.001	57.9 (13.8)	62.7 (13.2)	0.03	46.3 (11.2)	72.5 (9.7)	<0.001
Social functioning	68.2 (15.1)	62.6 (16.5)	0.02	60.3 (14.9)	73.5 (15.3)	<0.001	63.8 (15.6)	68.9 (15.2)	0.04	52.1 (13.7)	78.3 (12.1)	<0.001
Role-emotional	71.2 (16.4)	65.4 (17.8)	0.01	62.8 (16.1)	77.7 (16.5)	<0.001	66.9 (17.3)	72.6 (16.2)	0.07	55.4 (14.2)	80.9 (12.8)	<0.001
Mental health	63.1 (13.5)	57.9 (14.9)	0.02	57.4 (13.1)	68.2 (14.3)	<0.001	59.3 (14.2)	64.6 (13.8)	0.03	49.8 (11.6)	73.2 (10.2)	<0.001

Table 5 reveals significant associations between specific quality of life (QoL) domains and key clinical parameters in hemodialysis patients. These correlations provide valuable insights into the factors that influence patient well-being and offer guidance for tailoring interventions to optimize QoL. The negative correlation between physical functioning and age confirms that older patients tend to experience greater limitations in their physical abilities. This highlights the need for interventions that promote physical activity, manage pain, and address age-related functional decline in this population. The positive correlation between physical functioning and hemoglobin levels underscores the importance of anemia management in enhancing physical capabilities. By optimizing hemoglobin levels through interventions such as iron supplementation and erythropoietin therapy, healthcare providers can potentially improve patients' mobility, energy levels, and overall physical functioning. The strong negative correlation between mental health and depression symptoms confirms the profound impact of depression on psychological well-being in hemodialysis patients. This finding emphasizes the critical importance of routine screening for depression and providing timely access to mental health services, including therapy and medication. The negative correlations between mental health and comorbidities like diabetes and cardiovascular disease suggest that effectively managing these conditions may also contribute to improved mental well-being. This could involve optimizing glycemic control, managing cardiovascular risk factors, and addressing the psychological burden of chronic illness. The negative correlation between social functioning and depression symptoms indicates that depression significantly impairs patients' ability to engage in social activities and maintain meaningful relationships. Addressing depression through psychotherapy and social support can potentially enhance patients' social connectedness and overall QoL.

Table 5. Correlations between KDQOL-36 SF domains and clinical parameters.

KDQOL-36 SF domain	Clinical parameter	Correlation coefficient (r)	p-value
Physical functioning	Age	-0.32	<0.001
Physical functioning	Hemoglobin level	0.25	0.04
Mental health	Depression symptoms	-0.68	<0.001
Mental health	Diabetes	-0.28	0.02
Mental health	Cardiovascular disease	-0.21	0.02
Social functioning	Depression symptoms	-0.45	<0.001

The decline in quality of life (QoL) observed with increasing age in our study of hemodialysis patients is a phenomenon deeply rooted in the complex interplay between biological, psychological, and social processes that accompany aging. This decline aligns with established theoretical frameworks that posit a multi-dimensional impact of aging on health and well-being. Biological aging encompasses a wide range of physiological changes, including decreased organ function, impaired immune response, and reduced muscle mass and strength. In the context of hemodialysis, these age-related changes can exacerbate the existing burden of kidney failure. For instance, reduced cardiovascular function can worsen fluid overload and hypertension, while decreased muscle mass can lead to frailty and fatigue, further limiting physical functioning. The accumulation of these physical limitations can significantly diminish the quality of life, particularly in domains related to physical health and daily activities, as reflected in the lower scores observed in the physical functioning and role-physical domains of the KDQOL-36 SF in our

older patients. Aging is not merely a biological process; it is also intertwined with psychological and social changes. The loss of loved ones, retirement, and changes in social roles can lead to social isolation, loneliness, and a sense of loss of purpose. These psychosocial stressors can significantly impact mental health and well-being, contributing to the development of depression and anxiety. In hemodialysis patients, who already face the emotional challenges of a chronic illness, these age-related psychosocial factors can further exacerbate psychological distress and diminish QoL.[7-9]

The socioemotional selectivity theory (SST) offers a valuable framework for understanding how individuals adapt to the challenges of aging and maintain well-being. According to SST, as individuals age, they become more focused on emotional regulation and prioritizing meaningful relationships and activities that bring them joy and satisfaction. This shift in priorities reflects an adaptive response to the perceived constraints of time and energy that accompany aging. In the context of hemodialysis, SST may explain why older patients, despite facing physical limitations, are able to maintain relatively higher scores in the role-emotional and social functioning domains of the KDQOL-36 SF. These patients may have learned to adapt to their circumstances by focusing on nurturing their emotional well-being and social connections, which serve as vital sources of support and resilience. For instance, they may derive greater satisfaction from spending time with loved ones, pursuing hobbies, or engaging in spiritual practices, all of which can buffer against the negative impact of physical decline on QoL. Vulnerability to Negative Emotions and Depression: However, the SST also posits that older adults may become more sensitive to negative emotions and social stressors. The perceived limitations of time and energy may lead to heightened awareness of loss and mortality, increasing vulnerability to depression and anxiety. This is particularly relevant in the context of hemodialysis, where patients face ongoing health challenges and the constant reminder of their mortality. Our study findings support this aspect of SST, as we observed a significant interaction effect between age and depression. Older patients with depression experienced a more pronounced decline in QoL compared to their younger counterparts. This highlights the need for age-sensitive mental health interventions in this population. Healthcare providers should be vigilant in identifying and addressing depression in older hemodialysis patients, utilizing approaches that consider their unique psychosocial needs and coping mechanisms.[10-12]

The strong inverse association observed in this study between hemoglobin levels and QoL in hemodialysis patients underscores the profound physiological and psychological impact of anemia in this population. Anemia, defined as a deficiency in red blood cells or hemoglobin, is a ubiquitous complication of chronic kidney disease (CKD) and is further exacerbated by the hemodialysis process itself. The primary function of hemoglobin is to bind and transport oxygen to tissues throughout the body. When hemoglobin levels are low, oxygen delivery is compromised, leading to tissue hypoxia. This impairs cellular function and energy production, resulting in fatigue, weakness, and reduced exercise tolerance. These symptoms can severely limit patients' ability to engage in daily activities, work, and social interactions, significantly impacting their QoL. Anemia triggers compensatory mechanisms to maintain adequate oxygen delivery, such as increased cardiac output and heart rate. This increased cardiac workload can exacerbate pre-existing cardiovascular conditions and contribute to the development of new ones, such as left ventricular hypertrophy and heart failure. These cardiovascular consequences can further diminish QoL by limiting physical activity, causing shortness of breath, and increasing the risk of hospitalization. Anemia has been linked to cognitive impairment in hemodialysis patients, affecting

memory, attention, and executive function. This impairment can interfere with daily functioning, decision-making, and social interactions, all of which are important aspects of QoL. The underlying mechanisms may involve reduced oxygen delivery to the brain, impaired neurotransmitter synthesis, and increased oxidative stress. Anemia can also contribute to psychological distress, particularly depression and anxiety. The fatigue, weakness, and limitations associated with anemia can lead to feelings of hopelessness, helplessness, and decreased self-efficacy. Moreover, anemia may directly impact brain function, altering neurotransmitter levels and contributing to the development of mood disorders.[13-15]

The multifaceted impact of anemia on QoL in hemodialysis patients highlights the crucial importance of anemia management. The primary goal of anemia management is to improve oxygen delivery to tissues and alleviate the associated symptoms. This is typically achieved through the use of erythropoiesis-stimulating agents (ESAs), such as epoetin alfa or darbepoetin alfa, which stimulate red blood cell production. Iron supplementation may also be necessary to ensure adequate iron stores for hemoglobin synthesis. However, the optimal target hemoglobin level for hemodialysis patients remains a topic of ongoing debate. While higher hemoglobin levels can improve QoL, they have also been associated with increased cardiovascular risk, particularly in patients with pre-existing cardiovascular disease. Therefore, a personalized approach to anemia management is crucial, considering individual patient characteristics, comorbidities, and preferences.[14-16]

The presence of comorbidities, particularly diabetes mellitus and cardiovascular disease (CVD), emerged as a significant predictor of reduced quality of life (QoL) in our study population. This finding resonates with the well-established concept of the "burden of multiple chronic conditions." This concept posits that the accumulation of chronic diseases amplifies the negative impact on both physical and mental health, leading to a synergistic decline in overall well-being. Diabetes mellitus, a leading cause of end-stage renal disease (ESRD) and the subsequent need for hemodialysis, poses a multifaceted threat to QoL. The chronic hyperglycemia characteristic of diabetes triggers a cascade of pathophysiological events that lead to microvascular and macrovascular complications. These complications affect multiple organ systems, including the kidneys, eyes, nerves, and blood vessels, contributing to a wide range of debilitating symptoms and functional limitations. In the context of hemodialysis, diabetes further complicates the clinical picture and exacerbates the existing challenges of kidney failure. Diabetic nephropathy, a progressive kidney disease caused by diabetes, can accelerate the decline in renal function and necessitate earlier initiation of dialysis. Moreover, diabetes increases the risk of infection, cardiovascular events, and other complications during hemodialysis, further compromising patients' physical health and well-being. Beyond the physical burden, diabetes also takes a heavy toll on mental health. The chronic nature of the disease, the need for constant self-management, and the fear of complications can lead to psychological distress, anxiety, and depression. Furthermore, the dietary restrictions and lifestyle modifications required to manage diabetes can significantly impact social functioning and disrupt daily routines, further diminishing QoL. The negative impact of diabetes on QoL is well-documented in the literature. Studies have consistently shown that diabetic hemodialysis patients report lower QoL scores compared to their non-diabetic counterparts across various domains, including physical functioning, role limitations, bodily pain, general health perception, and mental health. This underscores the importance of recognizing and addressing the unique challenges faced by diabetic hemodialysis patients to improve their overall well-being.[15-17]

Cardiovascular disease (CVD) is another major comorbidity that significantly impairs QoL in hemodialysis patients. The high prevalence of CVD in this population can be attributed to several factors, including traditional risk factors (e.g., hypertension, dyslipidemia), uremia-related factors (e.g., inflammation, oxidative stress), and dialysis-related factors (e.g., volume overload, hypotension). CVD manifests in various forms, including coronary artery disease, heart failure, peripheral vascular disease, and stroke. These conditions can lead to a myriad of symptoms, such as chest pain, shortness of breath, fatigue, and limb ischemia, all of which can severely restrict physical activity and impair functional status. Additionally, CVD can cause psychological distress due to the fear of life-threatening events and the limitations imposed by the disease. The impact of CVD on QoL in hemodialysis patients has been extensively studied, with consistent findings of reduced physical functioning, increased symptom burden, and impaired mental health. Patients with CVD often experience fatigue, difficulty performing daily activities, and decreased exercise tolerance, all of which can contribute to social isolation and a diminished sense of well-being. Moreover, CVD can exacerbate the existing challenges of hemodialysis, increasing the risk of intradialytic hypotension, arrhythmias, and other complications. This can lead to frequent hospitalizations, disruptions in dialysis schedules, and a greater need for invasive procedures, further compromising patients' QoL.[16-18]

The complex interplay between kidney failure, diabetes, and CVD creates a vicious cycle that can progressively deteriorate patients' health and QoL. Kidney failure can exacerbate the complications of diabetes and CVD, while these comorbidities, in turn, can accelerate the decline in renal function and increase the risk of dialysis-related complications. This intricate web of interactions poses a significant challenge for healthcare providers. Effective management of these comorbidities requires a coordinated, multidisciplinary approach that addresses not only the individual diseases but also their interconnectedness and cumulative impact on QoL. This may involve optimizing glycemic control through insulin therapy or oral hypoglycemic agents, managing hypertension and dyslipidemia through lifestyle modifications and medications, and implementing strategies to mitigate the cardiovascular risks associated with hemodialysis, such as ultrafiltration profiling and sodium modeling. Beyond the physical manifestations, comorbidities can also take a significant toll on the mental and emotional well-being of hemodialysis patients. The constant burden of managing multiple chronic conditions, the fear of complications, and the limitations imposed by these diseases can lead to anxiety, depression, and a diminished sense of control over one's life. Therefore, it is imperative for healthcare providers to address the psychosocial aspects of living with comorbidities in addition to the physical aspects. This may involve providing education and counseling on disease management, offering emotional support and coping strategies, and facilitating access to mental health services.[17-19]

The significant negative correlations observed between depression and all domains of the KDQOL-36 SF underscore the profound and pervasive impact of depression on the well-being of hemodialysis patients. This finding aligns with a vast body of literature documenting the high prevalence and detrimental effects of depression in this population. Depression not only affects mental health but also permeates every aspect of life, impairing physical functioning, social interaction, and overall quality of life. The high prevalence of depression in hemodialysis patients can be understood through several theoretical lenses. The biopsychosocial model provides a comprehensive framework, highlighting the interplay of biological, psychological, and social factors in the development and maintenance of depression. The physiological stress of kidney failure and hemodialysis can disrupt

neurotransmitter systems, impair neurogenesis, and trigger inflammatory processes, all of which can contribute to the pathophysiology of depression. Additionally, comorbidities such as diabetes and cardiovascular disease, which are common in this population, have been linked to increased risk of depression through shared mechanisms such as inflammation and vascular dysfunction. The emotional burden of living with a chronic illness, the uncertainty surrounding treatment outcomes, and the loss of independence and control can take a significant toll on patients' mental health. Learned helplessness, a psychological state characterized by a perceived lack of control over adverse events can develop in response to the challenges of hemodialysis, further exacerbating depressive symptoms.[17,18]

The social isolation that often accompanies chronic illness, including hemodialysis, can be a major contributor to depression. The loss of social roles and activities, the stigma associated with kidney disease, and the burden placed on family and caregivers can all lead to social withdrawal and feelings of loneliness, which are risk factors for depression. The negative impact of depression on QoL manifests in various ways. Patients with depression may experience persistent sadness, loss of interest in previously enjoyable activities, feelings of worthlessness and guilt, changes in appetite and sleep patterns, difficulty concentrating, and recurrent thoughts of death or suicide. These symptoms can significantly interfere with patients' ability to adhere to treatment regimens, engage in self-care activities, and maintain social relationships. Moreover, depression can exacerbate the physical symptoms of kidney failure and hemodialysis. Fatigue, pain, and sleep disturbances, which are common in this population, can be worsened by depression. This can lead to a vicious cycle, where physical symptoms fuel depression, and depression further impairs physical functioning, ultimately leading to a downward spiral in QoL. The detrimental impact of depression on QoL underscores the importance of timely identification and effective intervention. Routine screening for depression using validated tools, such as the Patient Health Questionnaire-9 (PHQ-9), should be integrated into routine care for hemodialysis patients. Early detection allows for prompt intervention, which can prevent the progression of depression and its negative consequences on QoL. Several evidence-based interventions have shown efficacy in improving depressive symptoms and QoL in hemodialysis patients. Cognitive-behavioral therapy (CBT) helps patients identify and challenge negative thought patterns and develop coping skills to manage stress and emotional distress. Interpersonal therapy (IPT) focuses on improving communication and interpersonal relationships, which can be a source of support and resilience. Antidepressant medications, such as selective serotonin reuptake inhibitors (SSRIs), can be effective in reducing depressive symptoms and improving overall well-being. In addition to individual therapy and medication, interventions that address the underlying social and psychological factors contributing to depression are also important. Support groups, stress management techniques, and mindfulness-based interventions can provide patients with coping mechanisms, social connection, and a sense of control over their lives, all of which can contribute to improved mental health and QoL.[19,20]

4. Conclusion

This study demonstrates that QoL in hemodialysis patients is influenced by a complex interplay of demographic, clinical, and psychological factors. By identifying and addressing these modifiable risk factors, healthcare providers can significantly improve the overall well-being of their patients, empowering them to live fulfilling lives despite the challenges of kidney failure.

5. References

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