

Interdialytic weight gain and fatigue in chronic kidney disease patients undergoing hemodialysis: A Correlational study

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Abstract:

Chronic Kidney Disease (CKD) has become a significant global health problem, characterized by the gradual and progressive damage to nephrons and decreased glomerular filtration rate which causes toxins in the body to accumulate and cause fatigue. One of the main problems experienced by patients with chronic kidney disease (CKD) undergoing hemodialysis is how to manage Interdialytic Weight Gain (IDWG). Continuous excess extracellular fluid can cause adverse effects on the heart and respiratory function, which act as the physiological basis for fatigue. This study aimed to analyze the relationship between IDWG and fatigue in CKD patients undergoing hemodialysis. The design was analytical and observational with a cross-sectional approach. One hundred thirty-nine respondents participated in this study by applying a total sampling technique. Data were collected using a digital weighing scale and Functional Assessment of Chronic Illness Therapy (FACIT) Fatigue Scale version 4 questionnaire and analyzed by Spearman's rho correlation test with a significance level 0.05. The result showed that the mean value of IDWG was 3.48 (± 1.72), and the median value of fatigue was 26 (min-max=12-46). There was a weak negative relationship between IDWG and fatigue (p -value < 0.001 ; $r = -0.385$). The higher the IDWG value, the lower the fatigue score, indicating a more severe fatigue level. This study highlights the importance of controlling IDWG to reduce fatigue levels in chronic kidney disease patients undergoing hemodialysis.

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INTRODUCTION

Chronic kidney disease (CKD) represents a growing global public health challenge, characterized by progressive nephron loss and declining glomerular filtration rate (GFR) (Francis et al., 2024). CKD contributes to millions of deaths annually, with rising prevalence linked to aging populations and increasing rates of diabetes and hypertension (Alfano et al., 2022). As kidney function deteriorates, patients face life-threatening complications, including fluid overload, electrolyte imbalances, and metabolic acidosis, necessitating renal replacement therapies such as hemodialysis to sustain life (Arif, 2021).

Hemodialysis serves as a cornerstone treatment for end-stage kidney disease (ESKD), aiming to remove metabolic waste, regulate fluid balance, and stabilize acid-base homeostasis (Jeong et al., 2023). However, its effectiveness is often compromised by patients' inability to manage interdialytic weight gain (IDWG), defined as excess fluid accumulation between dialysis sessions. Despite technological advancements in dialysis delivery, IDWG remains a persistent clinical issue, affecting patient outcomes and quality of life (Safaroni & Awaludin, 2023).

IDWG arises primarily from impaired renal excretion and inadequate adherence to fluid and dietary restrictions (Bossola et al., 2024). Patients undergoing hemodialysis are typically advised to limit daily fluid intake to 500–1,000 mL to prevent excessive weight gain between sessions. Nevertheless, thirst management and adherence to these guidelines remain challenging, exacerbated by factors such as low health literacy, socioeconomic barriers, and cultural dietary

preferences (Wijayanti et al., 2021). Non-compliance often results in significant IDWG, which is independently associated with increased morbidity and mortality (Wahyuni et al., 2022).

Epidemiological studies highlight the widespread prevalence of IDWG among hemodialysis populations. Recent data indicate that 44% of patients experience mild IDWG (≥ 2.5 –5% of body weight), while 20% suffer from severe IDWG (>5 % of body weight) (Nurdina & Anggraeni, 2022). Such excessive fluid retention not only complicates dialysis efficiency but also heightens the risks of acute complications, including intradialytic hypotension, pulmonary edema, and cardiac strain (Ahmed et al., 2024). These findings underscore the urgent need for targeted interventions to address IDWG in clinical practice.

The physiological consequences of IDWG extend beyond fluid overload, exerting detrimental effects on the cardiovascular and respiratory systems (Kushwaha et al., 2023). Chronic extracellular fluid expansion increases preload on the heart, contributing to left ventricular hypertrophy, diastolic dysfunction, and heart failure (Safaroni & Awaludin, 2023). Simultaneously, pulmonary congestion impairs gas exchange, leading to dyspnea and reduced oxygenation. These pathophysiological changes collectively exacerbate systemic fatigue, a debilitating symptom reported by up to 63% of hemodialysis patients (Nurdina & Anggraeni, 2022).

Fatigue in hemodialysis patients is a multifactorial phenomenon influenced by anemia, uremic toxin accumulation, sleep disturbances, and psychological stressors (Xia et al., 2025). However, its association with IDWG remains underexplored despite compelling mechanistic links. Fluid overload-induced cardiac strain and hypoxia may directly impair cellular oxygen delivery, while repeated volume fluctuations during dialysis sessions could trigger oxidative stress and inflammation, further compounding fatigue (Wijayanti et al., 2021). Alarming, healthcare providers often overlook fatigue as a nonspecific complaint, delaying targeted management.

The bidirectional relationship between IDWG and fatigue creates a vicious cycle that diminishes patients' functional capacity and quality of life. Excess fluid retention exacerbates fatigue, reducing physical activity and motivation to adhere to fluid restrictions, perpetuating further IDWG (Nurdina & Anggraeni, 2022). This cycle highlights the importance of holistic approaches to symptom management, integrating patient education, behavioral interventions, and close monitoring of fluid status (Bossola et al., 2022).

Clinically, IDWG is closely tied to dietary sodium intake and dry weight misclassification. High sodium consumption intensifies thirst and fluid retention, while inaccurate dry weight estimation may lead to underdialysis or overdiuresis, worsening fluid imbalance (Safaroni & Awaludin, 2023). Correctly defining dry weight through bioimpedance or clinical assessment is critical to optimizing fluid management and mitigating complications such as pulmonary edema and hypertension (Guo et al., 2022).

This study aims to investigate the correlation between IDWG and fatigue in CKD patients undergoing hemodialysis, focusing on the physiological and behavioral mechanisms that perpetuate this relationship. By elucidating these associations, we hope to inform evidence-based strategies to reduce IDWG, alleviate fatigue, and improve clinical outcomes for this vulnerable population.

METHOD

Research Design

This research was a quantitative study, employing an analytic observational design with a cross-sectional approach.

Population, Samples, and Sampling Technique

The research was conducted in the Hemodialysis Unit of dr. Soebandi Hospital Jember in December 2024. One hundred thirty-nine patients were selected as the research sample using a total sampling technique.

Instrument

The data were collected using digital weight scales and the Functional Assessment of Chronic Illness Therapy (FACIT) Fatigue Scale version 4 questionnaire. IDWG was calculated by subtracting

the second pre-dialysis body weight from the first post-dialysis body weight and then dividing by the dry body weight (first post-dialysis body weight) and multiplying by 100% (Lindberg, 2010). The FACIT version 4 questionnaire consists of 13 questions on a Likert scale (4: not at all; 3: a little; 2: somewhat; 1: a lot; 0: very much). The score range of the questionnaire is 0-52. The lower the fatigue score, the more severe the fatigue. A score of <30 indicates severe fatigue (Tennant, 2012). The questionnaire was tested for validity using the Pearson correlation test, and the value of $r_{count} > r_{table} = 0.297$ (0.331-0.636) was obtained, indicating that the question items were valid. The reliability test with Cronbach's Alpha test, which has a value of $0.646 > 0.6$, indicates a reliable questionnaire (Sihombing et al., 2016).

Data Analysis

The relationship between IDWG and fatigue was analyzed by using the Spearman Rho correlation test with a significance value of 0.05

Ethical Declaration

This research was approved by the Health Research Ethics Commission of the Faculty of Nursing, University of Jember (No. 369/UN25.1.14/KEPK/2024).

RESULT

Characteristics of Respondents

The median age was 50 years, and the median duration of hemodialysis was 1.58 years. There were slightly more men (51.8%) than women (48.2%). The most common level of education was elementary school (42.4%), and most respondents were unemployed (25.9%).

Table 1. Characteristics of respondents

Variables	Median (Min-Max)	n (%)
Age (year)	50 (19-75)	
Duration of hemodialysis (year)	1.58 (0.25- 14.08)	
Gender		
Male		67 (48.2)
Female		72 (51.8)
Education Level		
No formal education		0 (0)
Elementary school		59 (42.4)
Junior High School		29 (20.9)
Senior High School		37 (26.6)
Diploma/bachelor's degree		14 (10.1)
Occupation		
Civil servants		5 (3.6)
Farmers		26 (18.7)
Laborer		7 (5.0)
Self-employed		25 (18.0)
Private employee		32 (23.0)
Nonemployment/ housewife/ retired		36 (25.9)
Other		8 (5.8)

Interdialytic Weight Gain (IDWG)

Table 2. Interdialytic Weight Gain in chronic kidney disease patients undergoing hemodialysis

Variable	Mean	SD
Interdialytic Weight Gain (IDWG) (%)	3.48	1.72

Table 2 shows that the average IDWG of hemodialysis patients was 3.48% with a standard deviation of 1.72%

Fatigue

Table 3. Fatigue in chronic kidney disease patients undergoing hemodialysis

Variable	Mean	SD
Fatigue	26	12-46

Table 3 shows that the median fatigue score of hemodialysis patients is 26, which means that 50% of respondents have fatigue scores below 26, and 50% of other respondents have fatigue scores above 26.

Table 4. Frequency distribution of fatigue in chronic kidney disease patients undergoing hemodialysis

No.	Response items	Not at all n (%)	A little bit n (%)	Somewhat n (%)	Quite a bit n (%)	Very much n (%)
1.	I feel fatigued	10 (7.2%)	31 (22.3%)	37 (26.6%)	58 (41.7%)	3 (2.2%)
2.	I feel weak all over	9 (6.5%)	35 (25.2%)	37 (26.6%)	57 (41%)	1 (0.7%)
3.	I feel listless (“washed out”)	10 (7.2%)	35 (25.2%)	36 (25.9%)	58 (41.7%)	0 (%)
4.	I feel tired	10 (7.2%)	34 (24.5%)	37 (26.6%)	58 (41.7%)	0 (%)
5.	I have trouble starting things because I am tired	15 (10.8%)	57 (41%)	57 (41%)	10 (7.2%)	0 (0%)
6.	I have trouble finishing things because I am tired	3 (2.2%)	54 (38.8%)	55 (39.6%)	27 (19.4%)	0 (0%)
7.	I have energy	4 (2.9%)	67 (48.2%)	55 (39.6%)	13 (9.4%)	0 (%)
8.	I can do my usual activities	3 (2.2%)	59 (42.4%)	62 (44.6%)	15 (10.8%)	0 (0%)
9.	I need to sleep during the day	1 (0.7%)	24 (17.3%)	21 (15.1%)	91 (65.5%)	2 (1.4%)
10.	I am too tired to eat	88 (63.3%)	48 (34.5%)	2 (1.4%)	1 (0.7%)	0 (0%)
11.	I need help doing my usual activities	11 (7.9%)	38 (27.3%)	67 (48.2%)	23 (16.5%)	0 (0%)
12.	I am frustrated by being too tired to do the things I want to do	9 (6.5%)	37 (26.6%)	69 (49.6%)	24 (17.3%)	0 (0%)
13.	I have to limit my social activity because I am tired	88 (63.3%)	48 (34.5%)	2 (1.4%)	1 (0.7%)	0 (0%)

Table 4 shows that the symptoms of fatigue experienced by most respondents are a lot of need to sleep during the day (65.5%) and have little energy (48.2%).

Relationship between Interdialytic Weight Gain (IDWG) and Fatigue

Table 5. Relationship between interdialytic weight gain (IDWG) and fatigue in chronic kidney disease patients undergoing hemodialysis

Variables	p-value	r
Interdialytic weight gain (IDWG) and fatigue	0.000	-0.385

Table 5 shows a weak negative relationship between IDWG and fatigue (p-value <0.001; r = -0.385). This means that the higher the IDWG score, the lower the fatigue score. Because a lower fatigue score indicates more severe fatigue, it can be concluded that the higher the IDWG, the more severe the fatigue.

DISCUSSION

Interdialytic Weight Gain (IDWG) in chronic kidney disease patients undergoing hemodialysis

The results indicate that the average IDWG is 3.48% (±1.72), which classifies the respondents' IDWG as high. An IDWG value of ≤3% is considered mild, whereas values >3% are considered severe (Dewi et al., 2022). Previous studies reported average IDWG values of 4.1% (±1.9) (Maimani

et al., 2021) among hemodialysis patients. Elevated IDWG often results from patients' difficulty restricting fluid and food intake during hemodialysis. Most hemodialysis patients were found to be non-compliant with fluid restrictions (Wahyudi et al., 2023). Fluid consumption affects the patient's body weight, as it can increase body mass. Most patients rely entirely on hemodialysis to eliminate excess fluids from their bodies (Maimani et al., 2021). Because the kidneys have a reduced or impaired capacity to regulate fluid removal, this leads to weight gain between dialysis sessions. Thus, monitoring patients' adherence to fluid restriction is essential for controlling IDWG (La Porta et al., 2021).

Patients on hemodialysis often experience intense thirst, which can contribute to increased IDWG. This thirst may result from diets that do not restrict salt intake, leading to elevated sodium levels in the body that trigger the brain's thirst response. Salt indirectly influences IDWG by promoting fluid retention, a process regulated by the aldosterone hormone in the kidneys (Spahia et al., 2024). Consequently, the body's need to balance sodium levels causes heightened thirst and increased fluid consumption. Therefore, it is important for hemodialysis patients to limit salt and high-sodium foods in their diet and to manage thirst effectively to control IDWG (Engel & Pugh, 2024).

Fatigue in chronic kidney disease patients undergoing hemodialysis

The results reveal a median fatigue score of 26, indicating that half of the respondents scored below 26 while the other half scored above. A lower fatigue score indicates that the respondent is experiencing more severe fatigue. Patients with a fatigue score below 30 are considered to be experiencing severe fatigue, with higher scores reflecting a better quality of life (Tennant, 2012). Hemodialysis patients experiencing fatigue may show various signs and symptoms, such as physical issues like muscle weakness or reduced endurance, and psychological effects, including a sense of increased effort or diminished cognitive function (Gregg et al., 2021). According to Table 4, the most common fatigue symptoms reported by respondents are a strong need to sleep during the day (65.5%) and low energy levels (48.2%). The kidneys produce erythropoietin, a hormone that stimulates the production of red blood cells. When the kidneys are damaged, this hormone's production is impaired, leading to a reduced formation of red blood cells. A reduction in red blood cells lowers hemoglobin levels, impairs oxygen transport throughout the body, and negatively affects sleep quality (Lyons, 2024). Chronic kidney disease patients on hemodialysis commonly experience a decline in physical condition, resulting in more frequent rest or engagement in light activities, which may hinder their ability to maintain regular work or daily routines (Rothpletz-Puglia et al., 2022; Agustin et al., 2023).

Fatigue in CKD patients undergoing hemodialysis can also be caused by psychological factors such as stress, depression, and anxiety (Nurdina & Anggraeni, 2022). Qualitative analyses highlight those psychological impacts, along with the challenges and needs arising from illness, are primary contributors to fatigue in hemodialysis patients. Anxiety is closely linked to fatigue, with higher anxiety levels observed in hemodialysis patients who experience fatigue (Al Naamani et al., 2021). Additionally, the lengthy hemodialysis sessions—typically around five hours—can contribute to physical stress due to the prolonged treatment effects. Fatigue in CKD patients undergoing hemodialysis can be affected by the length of treatment, as patients who have been on hemodialysis for a longer time tend to reach a stage of acceptance and view the therapy as necessary. In contrast, the most severe fatigue is often experienced during the first six months of treatment, with fatigue levels decreasing over time as patients adjust to their condition (Van der Borg et al., 2021).

Fatigue in patients can also result from high IDWG, which occurs when patients do not restrict their fluid and food intake during hemodialysis, leading to fluid accumulation in the body. This excess fluid forces the heart and lungs to work harder, causing patients to feel more tired and experience shortness of breath. The increased fluid volume raises the workload on the heart, making the left ventricle prone to stretching, leading to pulmonary edema and elevated blood pressure (Maimani et al., 2021).

Relationship between Interdialytic Weight Gain (IDWG) and fatigue in chronic kidney disease patients undergoing hemodialysis

The results indicate a significant correlation between IDWG and fatigue in CKD patients undergoing hemodialysis ($p < 0.001$; $r = -0.385$). The relationship is weak and negative, meaning that as IDWG increases, fatigue scores decrease. Since lower fatigue scores represent more severe fatigue, it can be concluded that higher IDWG is associated with more severe fatigue. IDWG is strongly linked to the patient's fluid intake and is caused by disruptions in fluid balance regulation, leading to sodium retention and osmosis that increases extracellular fluid volume (Canaud & Cristol, 2021). Patients undergoing hemodialysis gain weight between sessions due to this fluid buildup, which ideally should be removed during dialysis. However, persistent excess extracellular fluid can negatively impact heart and lung function and be a physiological cause of fatigue (Gembillo et al., 2023). This condition is similar to chronic heart failure, where chronic fluid overload activates the sympathetic nervous system and the renin-angiotensin-aldosterone system, impairing cardiac function and reducing oxygen delivery to tissues. IDWG and fatigue levels rise because patients do not restrict fluid and food intake during interdialysis. This leads to fluid accumulation that strains the heart and lungs, causing fatigue and shortness of breath (Wahyuni et al., 2022).

CKD patients who suffer from respiratory insufficiency and pulmonary edema often struggle to follow a salt-restricted diet. When edema develops, free fluid accumulates in the interstitial space to the point that it reaches half or more, increasing the distance for nutrients and oxygen to diffuse from capillaries to tissues. Oxygen and nutrients are essential for oxidative phosphorylation in muscle mitochondria, a key process for producing ATP needed for muscle activity (Thome et al., 2023). Reduced oxygen levels cause the heart muscle to shift from aerobic to anaerobic metabolism. Anaerobic metabolism through glycolysis is much less efficient than aerobic metabolism via oxidative phosphorylation and the Krebs cycle, resulting in significantly lower high-energy phosphate production. Furthermore, insufficient oxygen supply impairs blood circulation, leading to the buildup of metabolic waste in the limbs, which contributes to fatigue (Kirkman et al., 2021).

Excess fluid retention in the body raises the pressure in the heart's filling chambers. It makes the left ventricle susceptible to stretching, leading to pulmonary edema, high blood pressure, and increased workload on the heart and lungs (Maimani et al., 2021). This results in patients feeling tired and short of breath. Patients with the highest IDWG often have elevated blood pressure, which can cause blood vessels to become stiff and narrow, restricting blood flow to various organs, including the brain. This reduced blood flow may cause fatigue, dizziness, and decreased concentration (Sari et al., 2023).

This study shows a relationship between IDWG and fatigue in CKD patients undergoing hemodialysis. However, the strength of the relationship is weak, which means that other factors can affect fatigue. Anemia is one of the main factors triggering fatigue in patients with CKD due to reduced erythropoietin production, resulting in reduced oxygen supply to tissues so that the ability of blood to transfer oxygen to body tissues decreases, resulting in fatigue (Maisyaroh et al., 2024). In addition, fatigue experienced by CKD patients undergoing hemodialysis can also be caused by psychological problems, needs, and limitations. This means that many other factors must be studied to determine fatigue, so further research is needed to explore other factors that can affect fatigue.

CONCLUSION

A weak negative correlation exists between IDWG and fatigue in CKD patients undergoing hemodialysis. The higher the IDWG value, the lower the fatigue score, indicating a more severe fatigue level. This study underscores the importance of managing IDWG to help reduce fatigue in patients with chronic kidney disease undergoing hemodialysis.

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